International Conference
on
Composite Materials for Environment Protection & Remediation (ICCMEPR-2024)

2 - 3 July, 2024

Online Conference
https://www.rpconfseries.com/

e-Abstract Book

Organized by:

Gram Bharti College, Ramgarh
A Constituent Unit of VKS University, Ara
Bihar, India

In Association with

Research Plateau Publishers
(An academic publisher of scientific and technical journals)

International Conference
on
COMPOSITE MATERIALS FOR ENVIRONMENT PROTECTION & REMEDIATION
(ICCMEPR-2024)

(2 – 3 July, 2024)

Online Conference
https://www.rpconfseries.com/

e - Abstract Book

Organized by:

G.B. College, Ramgarh,
VKS University, Ara, Bihar, India

In Association with

Research Plateau Publishers
(An academic publisher of scientific and technical journals)

About Conference

Aims:-

- To provide a platform for presenting research to an international and interdisciplinary audience.
- To help in establishing business or research relations and find global partners for future collaboration.
- The scientific programme will highlight the latest advances in materials research.
- To acquire deep theoretical and experimental knowledge from young researchers and experts.

Outcomes:-

- Exposure to International Research & Development.
- Opportunity to collaborate with leading researchers around the globe.
- Opportunity to learn from the leading researchers in your research area.
- Full-length quality research papers will be published in an peer reviewed open-access, Google Scholar or Scopus Indexed Journals.
- Proceedings of all abstracts will be published online.

Themes of Conference (but not limited to)

*International Conference on Composite Materials for Environment Protection & Remediation arranged with the theme "**Exploring new prospect & Sustainable technologies to heal the earth**" to cover the wide extend of critically vital sessions of **Environment Science and Climate Change** equally Environmental Science section will cover all the major and minor topics like ecology, Green Synthesis, soil science, plant science, geology and physical geography, atmospheric science and more for a brief discussion to collect various investigations focused on the environmental applications of composites materials, such as soil and water remediation, or the recycling and recovery of waste. We will also cover the technology section which plays an important role. The Future Technology, Renewable Energy like Solar Energy, Wind Energy, and Geothermal power. Computing, Designing, Renewable energy, technology, biofuel, CO_2 capture, storage, and utilization. Nano- Info- Bio- Eco- Technologies for air, water, soil, and food purification, management of zero waste, wealth from waste, reuse, recycling, repair, and involving legal aspects and sustainable development.*

1. **Nanomaterials and Nanotechnology:**
   Nanoparticles, Nanocomposites, Nanotubes, Nanophotonics, Nanoelectronics.
2. **Environmental Sustainability:**
   Green Synthesis, Green materials, Recycling and Reuse, Waste reduction, Sustainable production methods.
3. **Material Characterization and Properties:**
   Chemical properties, Surface properties, Mechanical properties, Thermal properties, Electrical properties, Microscopy techniques, Optical and Magnetic properties, pectroscopic techniques, Computational Studies on nanomaterials or nanocomposites.
4. **Energy Applications of Materials:**
   Solar cell materials, Fuel cell materials, Battery materials, Materials for energy storage and conversion.
5. **Structural Materials:**
   Composite materials, Metals and alloys, Polymers, Ceramics, Corrosion-resistant materials, Lightweight materials, High-strength materials, Hydrogels, pH-responsive materials.
6. **Materials Synthesis and Processing:**
   Chemical synthesis, Bulk material processing, Nanofabrication techniques, Thin film deposition, Sol-gel processing, Surface modification techniques, Powder metallurgy, Biomaterials, Light-responsive materials, Nuclear materials.
7. **Emerging Smart and Responsive Materials:**
   2D materials (graphene), Topological materials, Quantum materials, Perovskite materials, Metamaterials, Piezoelectric materials.
8. **Advanced Characterization Techniques:**
   X-ray diffraction (XRD), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Nuclear magnetic resonance (NMR), Mass spectrometry (MS), Atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS), Computational design, Materials databases and informatics.

About Us

G.B. College, Ramgarh, VKS University, Ara, Bihar, India

G. B. College Ramgarh is a constituent unit of Veer Kunwar Singh University, Ara, and is located in Kaimur district of Bihar. It was founded in 1971. G. B. College offers a wide spectrum of academic programs in different disciplines like Science, Arts, Commerce, and vocational courses like BCA and BBA. Department of Chemistry makes a significant contribution to education and research. The Chemistry department offers programs such as B.Sc. (Hons.), & Ph.D. The department has well-equipped labs to cater to the requirements of undergraduate, and research programs.
Website: https://gbcramgarh,in/index.php

Research Plateau Publishers

Research Plateau Publishers is an academic publisher of scientific and technical journals. Our aim is to provide up-to-date scientific and technical achievement with high creativity and great significance on interdisciplinary and multidisciplinary platform for all the professionals to publish the research articles and to share knowledge for research studies. Our vision is to provide a one step solution for scientific and quality information. The main intention is to provide easy access of articles for all the Researchers, Scholars, Scientific Authors, Academic Societies, Professors, Lectures, Graduates, and Students.
We publish Original Research Articles, Short Research Articles, Short Communications, Review Articles, Mini Review Articles, Comments / Opinion Articles, Method Articles, Data Articles, Case Reports / Case Studies (Mainly for bio-medical journals), Clinical Practice Articles, Letter to the Editor, and Scholarly Book Review depending upon the scope and variety of a Journal.
Our Journals:
RP Current Trends in Applied Sciences
RP Current Trends in Agriculture and Environmental Sciences
RP Current Trends in Engineering and Technology
RP Materials: Proceedings
RP World History and Cultural Studies
RP Current Trends in Humanities, Business and Social Sciences
Website: https://researchplateau.com/

Organizing Committee

Prof. Shailendra Kumar Chaturvedi

[Chief Patron]

Vice-Chancellor

Veer Kunwar Singh University, Ara, Bihar, India

Prof. Radhey Shyam Singh

[Patron]

Principal

G. B. College, Ramgarh

VKS University, Ara, Bihar, India

Dr. Madhulata Shukla

[Convenor]

Head

Department of Chemistry, G. B. College, Ramgarh

VKS University, Ara, Bihar, India

Dr. Amrita Hooda

[Organizing Secretary]

Founder

Research Plateau Publishers, Haryana, India

Technical Committee

Mr. Raj Kumar Singh

Dr. Ajay K. Choudhary

Dr. Priyadarshini Singh

Mr. Sunil Shukla

Mr. Ashutosh Raj Singh

International/ National Advisory Committee

Dr. Mhamad Bakro, Cordoba Private University, Syria

Dr. Omid Akbarzadeh Pivehzhani, Texas A&M University, USA

Prof. Sourav Pal, Ashoka University

Prof. Anunay Samanta, University of Hyderabad

Prof. A. K. Tyagi, BARC, Mumbai

Prof. P. K. Mishra, VC, AKTU, Lucknow

Prof. N. Jayaraman, IISc Bangalore

Prof. Neelima Gupta, University of Rajasthan

Prof. Ramjatan Sinha, Patna University

Prof. V. K. Tiwari, BHU

Dr. Indrajit Sinha, IIT BHU

Dr. Ved Prakash Singh, Mizoram University

Dr. Rakesh Kumar Gupta, Shandong University, China

Dr. Manjeet Singh Goyat, UPES, Dehradun

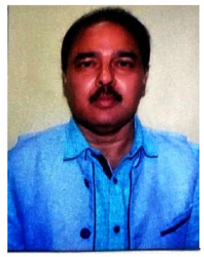
प्रो० शैलेन्द्र कुमार चतुर्वेदी
कुलपति
Prof. Shailendra Kumar Chaturvedi
VICE-CHANCELLOR

वीर कुँवर सिंह विश्वविद्यालय
आरा - 802301 (बिहार)
VEER KUNWAR SINGH UNIVERSITY
ARA - 802301 (BIHAR)
Fax & Tel. P.: 06182 - 239369 (O)
E-mail : vcvksuarrah@gmail.com

पत्रांक / Ref. No. : ....

दिनांक / Date : 24.06.24

Chief Patron Message



I am extremely delighted to know about the International Conference on Composite Materials for Environment Protection and Remediation (ICCMEPR- 2024), being organized by the Department of Chemistry, Gram Bharti College Ramgarh (a constituent unit of Veer Kunwar Singh University, Bihar).

The progressive growth of human society has brought remarkable developments in the last few decades. But, the extensive development of these activities has resulted in irreversible environmental damage. There is a passionate need to direct research towards practicing "Green" science that involves not just the scientific methods and practices that cause minimum harm to the environment but also produce materials that have footprints for the future. It is indeed heartening to see the effort made by the Department of Chemistry, G. B. College Ramgarh to bring together eminent scientists and researchers for discussion on such a relevant theme. I congratulate Dr. Madhulata Shukla, convener of this conference, and the whole organizing team for planning this wonderful event and wish an overwhelming success for this conference.

Sincerely

(Prof. S.K. Chaturvedi)

Vice Chancellor

GRAM BHARTI COLLEGE, RAMGARH

Kaimur. Bihar - 821110.

(A Constituent Unit of V. K. S. University, Ara)

OFFICE OF THE PRINCIPAL

Visit on Us : www.gbcramgarh.in

Web OPAC : www.gbclibramgarh.org

E-mail ID : gbcramgarh@gmail.com

: +91 - 9546499969

: +91 - 7479515656

Patron Message

It's a matter of immense pleasure that the Department of Chemistry, Gram Bharti College, Ramgarh is going to organize an **International Conference on Composite Materials for Environment Protection and Remediation (ICCMEPR- 2024)**. Such academic effort generates productive enthusiasm and inspiration among the teachers and students.

In recent years, people made astonishing developments to make our livelihood easier. People in Western countries are exploiting natural resources extensively. But this led to an imbalance in our natural resources and environmental damage. Since the beginning of civilization on Earth, several efforts such as plantation, cleanliness drives, etc have been made to maintain the environment's security. It is very important to make balance between scientific growth and environmental remediation to sustain healthy life on Earth. There are several physical, chemical, and biological methods for the remediation of pollution. One should practice Green Chemistry research which includes environment-friendly chemicals that cause least damage to the environment.

I appreciate the effort made by the Department of Chemistry, G. B. College, Ramgarh to organize such a great event.

I congratulate the convener of this conference and all the technical and organizing team for organizing ICCMEPR-2024 and my best wishes for success for this conference.

Prof. Radhey Shyam Singh
(Principal)

DEPARTMENT OF CHEMISTRY

Gram Bharti College Ramgarh

Kaimur, Bihar - 821110

Lt. (Dr.) Madhulata Shukla
HEAD
Department of Chemistry
Convener: CRSI Bihar & Jharkhand

(A Constituent Unit of VKS University, Ara)

E-mail: madhu1.shukla@gmail.com

Members:- *CRSI (Chemical Research Society of India)*
ISCA- Indian Science Congress Association
SMC- Society for Materials Chemistry

Convenor's Message

The conference is centered on the theme of Environment Protection and Remediation. This colloquium will help in "Exploring new prospect & Sustainable technologies to heal the earth" to cover the wide extent of critically vital sessions of Environment Science and Climate Change equally. The design of different types of composite materials has been a recent hot topic of research targeting its diverse applications to control different types of environmental pollution. In today's world, there are many pollution issues not least of which is air pollution and its effect on our health and quality of life. Water and air pollution is a hot topic of conversation across the world, especially in major cities where crowd monitoring takes place from multiple locations. A highly challenging interdisciplinary field with direct applications in diverse aspects of modern-day life, new materials ought to be the focus of effective research of our society, so as much being in the limelight of this seminar. Being one of the basic sciences, chemistry has the means and tools required to effectively implement any innovative idea from the point of its design, synthesis, and refinement/ modification subject to its application. Surely this holds credit for hosting such an event, ICCMEPR 2024 in association with the Research Plateau Publishers, Jhajjar Haryana, Chemical Research Society of India (Bihar & Jharkhand chapter). I must acknowledge the full support and suggestion from the Vice Chancellor, VKSU Prof. Shailendra Kumar Chaturvedi, Principal, G. B. College Ramgarh Prof. (Dr.) Radhey Shyam Singh. I must thank all the advisory, technical, and organizing committee members of this conference. I also thank all the interdisciplinary colleagues of our college.

I thank all the participants for their direct and indirect contributions to ICCMEPR 2024.

Madhulata

Dr. Madhulata Shukla
(Convener, ICCMEPR – 2024)

RESEARCH PLATEAU PUBLISHERS
(An Academic Publishers of Scientific and Technical Journals)

Dr. Amrita Hooda
Research Plateau Publishers
Address: Jhajjar, NCR – Delhi, (Haryana) INDIA
Email: contact@researchplateau.com

Organizing Secretary's Message

It is a great honour that Department of Chemistry of G.B. College, Ramgarh in association with Research Plateau Publishers (an academic publisher of scientific and technical journals) is organizing an online International Conference on Composite Materials for Environment Protection & Remediation 2024 (ICCMEPR-2024) on July 2 & 3, 2024 in online mode.

The conference aims at providing a common forum for eminent scientists, technologists, entrepreneurs and scholars from various disciplines such as Physics, Chemistry, Material Science and Environmental Science to present their work and discuss the latest advances and innovations in this exciting area of research.

When addressing societal challenges, the scientific world must strike the right balance between supporting research in all scientific areas and creating opportunities for both large-scale and small-scale projects that break through disciplinary boundaries. In the modern era, interdisciplinary research is the key to future innovations. From such funders to journal editors, policymakers to think tanks all seem to agree that the future of research lies outside firm disciplinary boundaries.

The "International Conference on Composite Materials for Environment Protection & Remediation 2024 (ICCMEPR-2024)" is being organized to bring together academicians, scientists and industrialists from various fields for the establishment of enduring connections to solve the common global challenges across a number of disciplines. The conference would be a platform to tackle complex problems from a range of perspectives, thereby modeling integrated, solution-focused thinking and partnerships.

I am sure that this conference would be thought provoking and lead to germination of new ideas.

I wish the conference a great success.

Dr. Amrita Hooda
(Founder)
(Research Plateau Publishers)

Contents

Kamatchi Hariharan M, Ravikumar K, Haja Syeddu Masooth P, Anderson A	ICCMEPR-2024/FIT/SIT/014	An assessment of the mechanical properties of a composite material composed of natural fibres and reinforced with polymer	19
Amit Kumar	ICCMEPR-2024/FIT/SIT/017	Thermodynamic modelling and experimental validation for long term carbon capture and storage (CCS) in Deccan basalt	20
Sheerin Masroor	ICCMEPR-2024/FIT/SIT/018	Anti-Corrosion Properties of Metallic Substrates via Nanocomposite Coatings	21
Kumar Gaurav	ICCMEPR-2024/FIT/SIT/019	Utilizing Microbial Fuel Cells to Produce Bioelectricity represents a Sustainable Energy Solution	22
Zeenat Arif	ICCMEPR-2024/FIT/SIT/021	Low cost nanao bio-adsorbent for Cr(VI) contaminated effluent discharge from leather Industry	23
Tan Suet May Amelia	ICCMEPR-2024/FIT/SIT/023	Recent Advancements in Polyhydroxyalkanoates and their Composites: Towards Sustainable Bioplastics and Beyond	24
T. Mahalakshmi	ICCMEPR-2024/FIT/SIT/024	Convection of unitary nanofluids and hybrid nanofluids in enclosures of heat transfer – An overview	25
Obaid Saleh Ba Yuosef, Mohmmad Salah Eldin Haij, Abdulmajeed Sami Alnemry, Ammar Ahmed Holbah, Mohammed Fahmi Lathkani, Ibrahim Sahban Abuhayyah, Abdulaziz mahdi alameer, Turki Nasser Jraba, Rajasekaran Saminathan	ICCMEPR-2024/FIT/SIT/025	Artificial Intelligence Analysis of Corrosion Behaviour of H59 Brass Alloy in Red Sea Conditions with and without Ceramic Coating	26
Subhendu Bhandari, Rushikesh S. Kothale, Prathamesh B. Sutar, Sandeep G. Kamble, Uday Shankar, Anasuya Bandyopadhyay	ICCMEPR-2024/FIT/SIT/026	Simultaneous dual doping with succinic and citric acid leading toward synergistic improvement of electrical and thermal characteristics	27
Manorama Singh	ICCMEPR-2024/FIT/SIT/027	Detection of A Skin Lightening Agent ‘Quinol’ In Whitening Cream Using Electrochemically Reduced Graphene Nanosheets Co Doped g-C_3N_4 Modified Electrode	28
Angesh Chandra, Archana Chandra	ICCMEPR-2024/FIT/SIT/028	Preparation and conductivity measurements of a new sodium ion conducting blended solid polymer electrolytes	29
Chetan Chauhan	ICCMEPR-2024/FIT/SIT/029	Voltammetric estimation of thiophanate-methyl via electrochemical investigation of copper-thiophanate methyl reaction in its fungicide formulation (topsin M) and agricultural products	30
Bappaditya Naskar	ICCMEPR-2024/FIT/SIT/030	A Study of Langmuir Blodgett Technique in the Synthesis of Catalytically Active Gold Nanoparticles Nanocomposite Film by Star Block Co-polymer Mediated Synthesis	31
C. K. Arvinda Pandian	ICCMEPR-2024/FIT/SIT/031	Characterization of natural fabrics incorporated hybrid composite laminates using industrial waste fumed silica	32
Rashmi Ramesh Shanbhag, Shiny K.S., Vani, C. N., Sundararaj Ramachandran	ICCMEPR-2024/FIT/SIT/033	Coconut Shell Pyrolytic Oil Distillate (CSPOD) as wood preservative for industrial application	33
Yalew Tamene Tadegea, Tamiru Hailu Koria, Dawit Muluneh Yonaa, A. Johnson Santhosh	ICCMEPR-2024/FIT/SIT/034	Enhancing Mechanical Properties of Aluminum Alloy 7050 with Glass Particle Reinforced Composites: A Stir Casting Approach	34
Pankaj Arora	ICCMEPR-2024/FIT/SIT/035	2D nanomaterials in plasmonic sensors for medical diagnosis	35

	2024/FIT/SIT/065	Powering Electronics	
Jaivir Singh	ICCMEPR-2024/FIT/SIT/073	Resonance enhanced polaron interaction in magnetoactive $A^{III}B^{V}$ and $A^{II}B^{VI}$ type semiconductor plasmas	59
Vikas Lahariya	ICCMEPR-2024/FIT/SIT/076	Sustainable Synthesis and Optoelectronic Applications of Carbon Dots for Environmental and Water Remediation	60
Dr. Rishi Pal	ICCMEPR-2024/FIT/SIT/077	Embedment of Various types of Materials in Polyaniline Matrix for Reduction in Electromagnetic Pollutions	61
Aman Kumar, Lekshmi Manasa S, Gayatri Mishra, Jnanendra Rath, Gyana Ranjan Rout, Kishore CS Panigrahi, Madhusmita Panigrahy	ICCMEPR-2024/FIT/SIT/079	Carbon Nanoparticle: a boon to rice plant growth and yield in a non-transgenic manner	62
Vaishali Raut, Supriya Shukla, Sharda Gadale	ICCMEPR-2024/FIT/SIT/084	Synthesis and Characterization of MoO_3 supported Nanocomposites for catalytic applications	63
Rakhi Khandelwal	ICCMEPR-2024/FIT/SIT/091	"Green Synthesis of Silver Nanoparticles: Eco-Friendly Methods and Versatile Applications"	64
Sanchayita Rajkhowa	ICCMEPR-2024/FIT/SIT/095	Beneficiation of iron ore by selective flocculation using surface-active agent, settling study and characterization of the beneficiation waste for value addition	65
R. Barik, Manas. R. Panigrahi	ICCMEPR-2024/FIT/SIT/097	Fabrication, structure and optical properties of 1wt% Dy doped BZBS double perovskite material for application in solar cells	66
A. P. Manake, S. R. Patil, P. M. Raotole	ICCMEPR-2024/FIT/SIT/102	Synthesis and Characterization of Cadmium Sulfide Nanoparticles	67
S. Girish Kumar	ICCMEPR-2024/FIT/SIT/103	Gold-Zinc oxide composite structures: Insights into preparation method and photocatalytic activity	68
Kattinti Mahesh Babu, Dr MVSS Nagendranath	ICCMEPR-2024/FIT/SIT/106	An Extensive Examination of Multi-Level Feature Extraction Approaches for High-Dimensional Data	69
Subhashish Dey	ICCMEPR-2024/FIT/SIT/117	The parthenium biosorbents for removal of chlorides and hardness from water	70
Shalini K S, Nirmala B	ICCMEPR-2024/FIT/SIT/119	Microwave Assisted Green Synthesis of NiO - AlPO Composites for Enhanced Photocatalytic Degradation of Methylene Blue	71
Soma Banerjee	ICCMEPR-2024/FIT/SIT/126	Recent Developments in Multiscale Polymer Composites: Fabrication and Associated Challenges	72
Yohanes Abebe, Sivaprakasam Palani, Belete Sirahbizu	ICCMEPR-2024/FIT/SIT/128	Glass-Natural Wool Fiber and Nano Alumina Reinforced Polymer Biocomposites for Improving their Mechanical and Water-Absorsion Properties	73
Soumya Mukherjee	ICCMEPR-2024/FIT/SIT/129	Evolution of Magnesium Aluminate by chemical route, modified solid state process and its characterization	74
Getachew Gebreamlak, Sivaprakasam Palani, Belete Sirahbizu	ICCMEPR-2024/FIT/SIT/131	The influence of process parameters and Al_2O_3 Nano-particles on the Mechanical and Microstructural properties of Dissimilar aluminum alloys - A Comparative study	75
Sreekala. G, Beena. B	ICCMEPR-2024/FIT/SIT/134	Removal of Lead (II) ions from Water by using green nano Trimanganese Tetroxide	76
Parimaladevi R	ICCMEPR-2024/FIT/SIT/136	Bismuth Ferrite Oxide decorted Titanium Dioxide and Silver Sulfide nanocomposites as a Turn-Off Fluorescent Sensing Probe to Organochlorine Pesticides	77
A. N. Yerpude, C. M.	ICCMEPR-	Optical properties of $Ba_2Ca(PO_4)_2$: RE (RE =	78

Nandanwar, S. J. Dhoble	2024/FIT/SIT/138	Dy^{3+}, Eu^{3+}) phosphor for ecofriendly lighting technology	
Soumya Sharma, Rachana Sahney, Praveen Dahiya	ICCMEPR-2024/FIT/SIT/142	Green synthesis of iron alginate nanogels by microemulsion method and Taguchi-assisted encapsulation of Candida rugosa lipase for butyl butyrate ester synthesis	79
Manjeet Singh Barwa, Balaram Pani	ICCMEPR-2024/FIT/SIT/144	GIS based Multi-variate Analysis of Groundwater Uranium in the Central Ganga-Yamuna basin of India	80
Anita. B. Padasalagi, M. K. Rabinal	ICCMEPR-2024/FIT/SIT/145	Highly Efficient Sericin Derived Carbon Quantum Dots as Metal Free Green Photocatalyst for Degradation of Dyes	81
Shubhra Barwa, Balaram Pani	ICCMEPR-2024/FIT/SIT/146	Sustainable Environmental Remediation using Green Routes	82
Nagendra Prasad, H. S., Sundaravadivelu Sumathi, Sangamesha, M.A, Ananda, A.P	ICCMEPR-2024/FIT/SIT/148	Exploiting Citral-Tryptamine Conjugated Silver NanoparticlesforAntibacterial, Anticancer and Sensor application	83
A.A. Joshi, P.M. Raotole	ICCMEPR-2024/FIT/SIT/161	High Frequency Dielectric properties of ZSM zeolite at room temperature	84
S. Manikandan	ICCMEPR-2024/FIT/SIT/162	Enhancing Supercapacitor Performance with innovative doping: Electrochemical investigation of Phosphorus Supported MnO_2-Metal organic frameworks	85
Jayashree Avvadukkam, Sruthi V, Arun Krishna Kodoth, Suphiya Khan	ICCMEPR-2024/FIT/SIT/177	Harnessing the Power of Agricultural Waste Peels: A Renewable Biomass for Sustainable Water Purification	86
Monika Joshi, Sbhasha Nigam	ICCMEPR-2024/FIT/SIT/180	Nature inspired versatile superhydrophobic nanocomposites for oily wastewater remediation	87
Konica Sharma, M. K. Malik, M. S. Goyat	ICCMEPR-2024/FIT/SIT/181	Development of superhydrophopic surfaces on Copper and Brass for corrosion resistance applications: A comparative study	88
Murarilal Barik, Debashis Das, Sandhya Rani Mishra, Pramoda Kumar Satapathy	ICCMEPR-2024/FIT/SIT/187	Synthesis, Characterizations, and Application of rGO-CeO_2-TiO_2 Composite for the removal of heavy metal ions from Contaminated water	89
Anita Verma, Ravi Sharma, D.P.Bisen, Nameeta Brahme	ICCMEPR-2024/FIT/SIT/191	Material Synthesis by Sol-gel Method and Investigation of Luminescence Properties of the Trivalent Rare Earth Doped Garnet Phosphors	90
Piyali Das, Mangal Roy, Piyali Basak, Partha Roy, Samit Kumar Nandi	ICCMEPR-2024/FIT/SIT/200	Utilization of Discarded Animal Cartilage for Cartilage Tissue Engineering Applications	91
Prakash Gadipelli, Dr.Muralasetti Nookaraju, Mummidi Siva Sankar	ICCMEPR-2024/FIT/SIT/222	Sustainable Synthesis of Imine Derivative from Furan 2- carbaldehyde: A Single-Step, Environmentally Benign Method with Antioxidant Assessment	92
Supriya Kumari, Sunil Kumar	ICCMEPR-2024/FIT/SIT/224	A highly efficient Photocatalytic system for rapid Degradation of organic Pollutants	93
Bomkesh Bhoi, Bidya Bedant Joshi, Pranati Purohit	ICCMEPR-2024/FIT/SIT/225	Energy Harvesting Circuits with Piezoceramic Material: Design, Integration and Optimization	94
T. Somanathan, A.R. Sasieekhumar	ICCMEPR-2024/FIT/SIT/226	How to Control the Diameter and Wall Thickness of Carbon Nanotubes	95
Nookaraju M, Prakash G, Siva Sankar M	ICCMEPR-2024/FIT/SIT/228	Green synthesis and anti microbial investigation of pyridine-2- carbaldehyde based chalcones under aqueous condition using functionalized MCM-41 materials	96
S. B. Vishwakarma, S. K. Dubey, R. L. Dubey, A.Yadav, I. Sulania, D. Kanjilal	ICCMEPR-2024/FIT/SIT/237	Annealing Effects on 100 keV Silicon Negative Ions Implanted SiO_2 Thin Films	97
Sourav Mohanto	ICCMEPR-2024/FIT/SIT/242	"EcoNano": Harnessing Bio-Waste for Sustainable Nanoparticle Solutions in Pharmaceutical and Biomedical Industries	98

Faculty/ Scientist Talks

Tamgadge, R P Ganorkar, S V Khangar	2024/FT/ST/100	Polymer Thin Film	
Reena Kumari	ICCMEPR-2024/FT/ST/107	Nano material Synthesis & Controlling Aspects: A State-of-the-art Review	120
Aisha Siddekha, H. S. Lalithamba, G. K. Prashanth	ICCMEPR-2024/FT/ST/125	Nanomaterials in optoelectronics - An overview	121
Shivaprasad Chalawadi, Rajashekhar Bhajantri, Malatesh S Pujar	ICCMEPR-2024/FT/ST/149	CuO/Polyaniline/Multiwalled Carbon Nanotube Composites for Hydrogen Gas Sensing Using Macaranga Indica Leaf Extract	122
Madhumati S. Dhaduti, Sandeep C. Dhaduti, Sandhya Jalgar	ICCMEPR-2024/FT/ST/150	Treatment of college canteen sullage using microcosm phytorid system	123
Neha Nidhi Tirkey	ICCMEPR-2024/FT/ST/156	Antifungal Potential of Phyllanthus niruri - Derived Nanoparticles: A Novel Therapeutic Approach	124
Mahesh Bhat, Ramya, Rangaswamy J, Suparna	ICCMEPR-2024/FT/ST/165	Photocatalytic degradation of aqueous dyes by TiO_2/Fe_2O_3/Starch nanocomposites	125
Sushil Kumar, Harish Garg, Ankita Taneja, Rajwinder Singh, Hardev Singh, Sanjeev Kumar	ICCMEPR-2024/FT/ST/188	Magnetic and dielectric behaviour of PVP capped $Cu_{1-x}Fe_xO$ (x = 0.2- 0.10) nano-composites	126
Tejas D. Doshi, Malatesh S Pujar	ICCMEPR-2024/FT/ST/197	Enhancement of mechanical strength and durability properties of LC3 concrete incorporating TiO_2 and Lathe Fibers	126
Digambar Yevale, Chetan B. Sangani	ICCMEPR-2024/FT/ST/198	PI3Kδ and mTOR dual inhibitors: design, synthesis and anticancer evaluation of 3-substituted aminomethylquinoline analogues	128
Madhumati S. Dhaduti, Anand M. Hunashyal, Rajappa S K	ICCMEPR-2024/FT/ST/202	Fluoride removal from aqueous solution using granular natural soil and activated charcoal	129
Vinisha Valsaraj P, Ashna P, Anagha Rajan, Sreshma Rajan	ICCMEPR-2024/FT/ST/206	Green Solvent Mediated Solution Combustion Synthesis of Photocatalytic Active Copper Doped Zinc Oxide Nanoparticles and its Antimicrobial Activity Study	130
K.M. Mishra, P.K. Pandey, Apara Tripathi, F.Z. Haque	ICCMEPR-2024/FT/ST/211	High Ionic Conductivity in Sodium Titanate: Na_4TiO_4	131
M. K. Malik, Konica Sharma, R. R. Deshmukh	ICCMEPR-2024/FT/ST/227	Host polymer matrix dependent significant improvements in electro optical switching of polymer dispersed liquid crystal films	132
Vandana Saxena, Atul Srivastava Anushree Srivastava	ICCMEPR-2024/FT/ST/243	Mechanistic Insight into Zr-O Imprinted Pyrolytic Agricultural Biomass Char for Adsorptive Defluoridation from Aqueous Environment	133
Devanand Chelot, Vijaya Lakshmi Mishra, Priyank Upadhyaya	ICCMEPR-2024/FT/ST/248	Experimental Study On Chemical Resilience Of Glass Reinforced Polymer Pipes For Sewage Applications	134
Manoj K. Singh, Preeti Yadav, Arushi Pandey	ICCMEPR-2024/FT/ST/258	Optical band gap study of $Bi_{(1-x)}Ca_xFeO_3$ nanoparticles for photovoltaic applications	135
Mohammad Mujahid Ali Khan	ICCMEPR-2024/FT/ST/294	New approach for electrochemical studies of polymer based composite membrane	136
Ranjit Kumar	ICCMEPR-2024/FT/ST/295	Electric Polarisation Studies of Oxide-Polymer Composite	137
Anand Kishore, Anupama Singh	ICCMEPR-2024/FT/ST/298	Development and Characterization of Citric acid and Heat moisture Modified jicama (Pachyrhizus, spp.) Starch-Based Biodegradable Films	138
Dr. Raminder Kaur, Amanpreet Kaur	ICCMEPR-2024/FT/ST/305	Synthesis of Tin Ferrite Nanoparticles and their Electrochemical Performance	139
Student Talks			

Sharma, Sandeep Kumar Sharma, and Rajeev Mehta	2024/ST/122	Coatings Using Different Nano-Fillers	
Suhriday Barman, Partha Pratim Sahu	ICCMEPR-2024/ST/123	Evolution of H_2 and O_2 through overall Efficient Electrochemical Water splitting using $ZnTiO_3$ Perovskite deposited Electrode	182
Gobinda Prasad Chutia, Kandarpa Phukan	ICCMEPR-2024/ST/124	Mesua assamica (king & prain) seed shell derived recyclable Bronsted acid nanocatalyst for biodiesel production from different oil feedstocks	183
M Ramya, Jitha P Marydasan, Swathy Satheesh, V P N Nampoori, M Kailasnath	ICCMEPR-2024/ST/127	ZnO Nanostructure Shape Effects in Photocatalysis of Methylene Blue	184
Apurba Sarkar, Soumya Mukherjee, Jamil Akhtar, Shibayan Roy, Nandan Pakhira	ICCMEPR-2024/ST/130	Synthesis and Characterization of Cu-Al-O based Delafossite by Ball Milling process	185
Bhavya N.S., H.V. Jayaprakesh, H.S. Lalithamba, Prashanth G.K.	ICCMEPR-2024/ST/132	Assessment of Ground Water of different taluks of Tumkur District, Karnataka	186
Keval bambharoliya, Sanskruti H. Patel, Chetan B. Sangani, H. N. Patel	ICCMEPR-2024/ST/133	Novel dischiff's base esters with 2-Aminobenzothiazole containing liquid crystalline derivatives: Studying for new antimicrobial agents	187
Praween Kumar Srivastava, Atul Kumar, Ajay Kumar	ICCMEPR-2024/ST/137	Optimizing Gallium Nitride (GaN) Based SOI-TF-FinFETs for Enhanced Linearity and Low Distortion in High-Frequency Applications	188
Kusum Sharma, Pardeep Singh, Pankaj Raizada	ICCMEPR-2024/ST/140	The enhanced charge isolation over dual Z-scheme $CeO_2/BiOCl/Ag_2WO_4$ photocatalyst for cationic dyes degradation: mechanistic insights and pathway	189
Priyanka Agrwal, Ajay Kumar	ICCMEPR-2024/ST/141	Reliability Investigation of Interfacial Defects in $In_{0.53}Ga_{0.47}As$ SOI-FinFET for High-Performance Applications	190
Sajan Masih, Anupinder Singh	ICCMEPR-2024/ST/143	High temperature dielectric and hopping mechanism of thin flexible mats of PU/PMMA-$(PrFeO_3)_{0.24}$-$(PbTiO_3)_{0.76}$	191
V. K. Linima, R. Ragunathan, Jesteena Johney	ICCMEPR-2024/ST/147	Metal nanoparticles via green approaches and their applications	192
S. N. Rahane, S. R. Rondiya, S. R. Jadkar	ICCMEPR-2024/ST/151	Experimental and Theoretical Insights into the Bi-based Halide Double Perovskites for Optoelectronic Applications	193
Shisak Sharma, Dipak Sinha	ICCMEPR-2024/ST/152	Efficient photocatalytic degradation of 4-nitrophenol in wastewater using novel activated carbon-based nanocomposites	194
Lata Shete, Rakesh Shedam, Shivanand Masti	ICCMEPR-2024/ST/153	Photoelectrocatalyatic Degradation of Methylene Blue using Nanocrystalline Al-doped CdSe/TiO2 Thin Film under Visible light	195
Anchal Rana, Pardeep Singh	ICCMEPR-2024/ST/154	Integrating BiOI/g-C_3N_4/Bi_2WO_6 Derived Dual S-Scheme Photocatalyst with Biochar for Emerging Adsorption for Photocatalysis: Multicharge Migration and Mechanistic Insights	196
NikhilGupta, Subodh Barthwal, Praveen pachauri	ICCMEPR-2024/ST/155	An overview of magnesium matrix composites reinforced with waste materials	197
D. M. Tejashwini, H. P. Nagaswarupa, Ramachandra Naik, A S Manjunatha	ICCMEPR-2024/ST/157	Green BZF Nanocomposite for Electrochemical Sensor Applications	198
Anila Thomas, Sheenu Thomas	ICCMEPR-2024/ST/158	Effect of Sb addition on physical and optical properties of ternary Ge-Se-Te glasses	199
Pooja Kumari	ICCMEPR-2024/ST/160	Nanoparticles as Potential Antimicrobials: A Novel Approach to Combatting Drug-Resistant	200

		Pathogens	
Mukesh Kumar Bind, Sajai Vir singh, Kaushal Kumar Nigam	ICCMEPR-2024/ST/163	Sensitivity Analysis of a GaAs/GaSb Heterojunction Polarity Control TFET-Based Biosensor	201
Bhavya N.S., H.V. Jayaprakash, H.S. Lalithamba, Prashanth G.K.	ICCMEPR-2024/ST/164	Nanoparticles for defluoridation of ground water - A review	202
Indranil Maity, Aman Kumar Jha, Yash Shaw	ICCMEPR-2024/ST/166	Modeling of ZnO based Nano Sensor Device for Evaluating Electronic Interaction with NO2 Pollutant: Combining Multiphysics Approach and DFT Study	203
Indranil Maity, Arighna Bhattacharjee, Arijit Mondol	ICCMEPR-2024/ST/167	Development of $In_{0.51}Ga_{0.49}P$/GaAs Dual Junction based Solar Cell Devices to Calculate and Analyse Key Solar Cell Parameters utilising Silvaco TCAD Simulation	204
Indranil Maity, Saurabhi Biswas	ICCMEPR-2024/ST/168	A Comparative Analysis of Structural and Electronic Properties in 2D Transition Metal Dichalcogenides (MoS_2 and $MoSe_2$) based on DFT Calculations	205
Philominrajan Maria Viyanni, Mathur Gopalakrishnan Sethuraman	ICCMEPR-2024/ST/169	Deep eutectic solvent assisted electrodeposition of NiCu alloy on the surface of stainless-steel mesh: Unveiling Its potential for water splitting reactions	206
Harishchandra Patel, Dwesh K. Singh, O. P. Verma	ICCMEPR-2024/ST/171	Machine Learning Application in Vapor Compressor Refrigeration Cycle in Real-Time Applications and Renewable Energy - A Review	207
K. Shreevani, B. Narayana, B. K. Sarojini	ICCMEPR-2024/ST/172	Fabrication and characterization of eugenol-loaded eudragit (RS100) nanofibrous mats	208
Himanshi, Rohit Jasrotia	ICCMEPR-2024/ST/173	Cobalt and Dysprosium doped Barium hexaferrite for waste water treatment	209
Ganesha H, Vijaykumar S P, Sapna S, Abdullaha Ba shbil, Suresh D S, Devendrappa H, Sutasinee Kityakarn, Sirikanjana Thongmee	ICCMEPR-2024/ST/174	Polymer doped NiO blend composite for electrochemical performance	210
Surekha Kademani, Kariyappa S Katagi	ICCMEPR-2024/ST/175	Analysis of green metrics for liquid fuel production from Feronia elephantum seed oil using waste egg shell derived heterogeneous catalyst	211
Shivanshi Tyagi, Rachana Singh, Riti Thapar Kapoor	ICCMEPR-2024/ST/178	Microbial Immobilization Techniques for Enhanced Dye Degradation and Textile Wastewater Remediation	212
Gajendra Kumar, Rajan Kumar, Rabinder Singh Bharj	ICCMEPR-2024/ST/179	Efficient cooling system for lithium-ion battery Pack by using non-Newtonian nano-fluid in cooling channel under laminar flow A numerical analysis	213
Sreedevi Paramparambath, Mithra Geetha, Anglet Chiramal Jacob, Maryam Al Ejji, John-John Cabibihan, Kishor Kumar Sadasivuni	ICCMEPR-2024/ST/182	Advances in colorimetric detection; A short review of techniques for interdisciplinary applications	214
Nishin C, Gopika M S, Savitha Pillai S	ICCMEPR-2024/ST/183	Synthesis, Structural, Optical and Magnetic properties of Fe_3O_4@ ZnO nanocomposites for biomedical applications	215
Deepika Dhaterwal, Mahesh Matoria, Annu Dalal, Surender Kumar, Sonika Singh	ICCMEPR-2024/ST/184	Synthesis and Photoluminescence Dynamics of Europium (III) and Terbium (III) Co- Doped of $GdSrAl_3O_7$ Color- Tunable Nanophosphors	216
Sandhya Rani Mishra, Pramoda Kumar Satapathy, Rajesh Kumar Sing, Kallola Kumar Swain	ICCMEPR-2024/ST/186	Analysis of Groundwater Quality Parameters and its Remediation using Graphene-based Nanocomposites in Bisoi Block, Mayurbhanj District, Odisha	217

Teeyasha Das, Ispita Biswas, Animesh Debnath	ICCMEPR-2024/ST/189	A short review on adsorptive removal of fluroquinolone antibiotics by plant-based biochar and their composites	218
Komal Poonia, Pankaj Raizada	ICCMEPR-2024/ST/190	Advanced adsorption-assisted photocatalytic degradation of tetracycline hydrochloride using $Bi_4O_5Br_2$ and $Co_3(PO_4)_2$ immobilized on activated carbon-based photocatalyst	219
Deepti Amol Khedekar, Bhushan B.Dhale	ICCMEPR-2024/ST/192	Characteristic Study of NiCoP Thin Films Successively Deposited by Spray pyrolysis Technique Predicted for Water Splitting Activity	220
Rajwinder Singh, Sushil Kumar, Ankita Taneja, Hardev Singh, J.S. Shahi, Sanjeev Kumar	ICCMEPR-2024/ST/193	Hydrothermal synthesis of 2D $Mo_{1-x}Co_xS_2$ (x = 0.2 – 0.10) nanostructures for decomposition of organic pollutants in water	221
Jaspreet Kaur, Rajesh Kumar	ICCMEPR-2024/ST/194	Intra-Particle Diffusion Method to Describe Adsorption Activity of Ammonium Vanadate Nanostructures	222
Imotila T Longchar, Dipak Sinha	ICCMEPR-2024/ST/195	Evaluation of a new activated carbon/graphene oxide as an efficient composite adsorbent for the removal of herbicide 2,4-Dichlorophenoxyacetic acid: Composite synthesis, characterization, and adsorption	223
Raplang Steven Umdor, Dipak Sinha	ICCMEPR-2024/ST/196	Adsorption of Ciprofloxacin antibiotic by highly efficient MgAl activated carbon composite: Kinetics, Isotherm and Thermodynamic study	224
Meenal Garg, Homdutt Sharma	ICCMEPR-2024/ST/201	Identification of polycyclic aromatic hydrocarbons (PAHs) in air particulate samples using synchronus fluorescence spectroscopic technique	225
Dhruv kumar, Subodh Barthwal, Praveen Pachauri	ICCMEPR-2024/ST/203	Recent Advances in fabrication, characterization, and wear behavior of aluminum matrix composites	226
Madhulata Shukla	ICCMEPR-2024/ST/204	DFT Study of Molecular Interaction of Curcumin with Silver Nanocluster	227
Rashi Bhardwaj, Tinku Basu	ICCMEPR-2024/ST/205	Unlocking Janus Particles: The Power of Post-Synthesis MOF Modification	228
Sakarapani Sarala, Velusamy Sasikala, Palani Karthik, Natarajan Prakash, Azhagurajan Mukkannan	ICCMEPR-2024/ST/207	High-Efficiency Photocatalytic Degradation of Organic Contaminants Using $MnO_2/NiO@g-C_3N_4$ Under UV Light	229
P.K. Pandey, F.Z.Haque, Apra Tripathi, K.M. Mishra	ICCMEPR-2024/ST/209	Superionic Phase in Na_2MoO_4	230
Mohammedhamidraza A Mawazzan, M. K. Rabinal	ICCMEPR-2024/ST/210	CuI/VO_2(M) Composites for Enhanced Thermoelectric Performance	231
Neha, Mohd Zubari Ansari	ICCMEPR-2024/ST/212	Growth of Single Phase CZTS by Hydrothermal Method	232
Shiffali Middha, Anupinder Singh	ICCMEPR-2024/ST/213	Comparative analysis of the structural, magnetic, dielectric and electrical properties of Ba^{2+} doped PrFeO3 through solid-state and sol-gel auto- combustion routes	233
Pramendra Kumar Pandey, Bharat Kumar	ICCMEPR-2024/ST/214	Synthesis of low cost CuO nanoparticles by Hydrothermal method using rice husk and ethanol	234
Vaishali.N Birge, Manjunatha B, Shruti Gogi, Sangshetty Kalyane	ICCMEPR-2024/ST/215	Investigatuion of Arrhenius Plot and Activation Energy In LPG Sensing Properties of Nickel Oxide Doped Polyaniline Composite (PnNiO)	235
Swati D Wakade, Dr. V. T. Vader	ICCMEPR-2024/ST/217	Synthesis and Characterization of Magnesium Doped Mixed Metal Oxide	236
Nida Khan, Mohd Umar Khan, Zeba N. Siddiqui	ICCMEPR-2024/ST/218	Selective esterification of glycerol over ionic liquid functionalized cellulose (IMD-Si/HSO4@Cellulose) under energy-efficient microwave irradiation	237

Surender Kumar		removal of cationic dyes from single and binary systems	
Abhinav Mishra, Dipendra Sharma, S. N. Tiwari	ICCMEPR-2024/ST/262	DFT and Molecular Docking Studies of a Naturally Occurring Anticancer Drug: Ellipticine	257
Roomul Mushtaq, Mohd Zubair Ansari	ICCMEPR-2024/ST/263	Structural, optical and morphological properties of Solvothermally synthesized CZTS nanomaterials	258
Anisha Grewal, Nishita Sharma, Partiksha Panghal, Annu Dalal, Sonika Singh, Surender Kumar	ICCMEPR-2024/ST/264	Investation of the adsorptive efficiency of Base modified Saccharum munja biomass for Safranine O and crystal violet dyes in single and binary systems	259
Nishita Sharma, Sonika Singh, Surender Kumar	ICCMEPR-2024/ST/265	Insights into Adsorptive and efficient removal of Rose Bengal dye from wastewater by biomass-based adsorbent	260
M. G. Veena, Usha Rani C M, Shalini M S, Anusha Narayan, Madhukar B S	ICCMEPR-2024/ST/266	Zinc Silicate Doped PDMS-PVA Nanofibers using Electrospinning Process	261
Sweta Kumari	ICCMEPR-2024/ST/268	Impact of Climate Change on Sone River Water Quality: A Study in Selected Blocks of Bihar and Uttar Pradesh	262
Anjali Nisha, Amitabha Acharya	ICCMEPR-2024/ST/269	Bio-inspired Carbon Dots as Potential Nanozymes for Combating Glioblastomal Hypoxia	263
Partiksha, Surender Kumar	ICCMEPR-2024/ST/270	Adsorptive removal of Eosin yellow dye from aqueous solutions using Pennisetum glaucum as a low-cost and green biosorbent	264
Sarita Yadav, Surender Kumar	ICCMEPR-2024/ST/271	Adsorption behavior of dyes onto Pennisetum glaucum in wastewater effluent	265
Nandini, Amitabha Acharya	ICCMEPR-2024/ST/272	Green Synthesis of Fluorescent Carbon Nanomaterial to Minimize the Cross-Interaction of Aß42 and Tau Hyperphosphorylation	266
Rubina Dhiman, Amitabha Acharya	ICCMEPR-2024/ST/273	Investigating Essential Oil-Based Nanoemulsions as a Potential Approach to Address the Growing Threat of Antibiotic Resistance	267
Harpreet Kaur , Amitabha Acharya, Sudesh Kumar Yadav	ICCMEPR-2024/ST/274	Increasing Bioavailability of an Antioxidant Through Nanotechnological Approach	268
Rahul Bhardwaj, Amitabha Acharya	ICCMEPR-2024/ST/275	Bio-conjugated functional fluorescent metal nanoparticles targeting glioblastoma	269
Isha Sihmar, Neeru Chaudhary	ICCMEPR-2024/ST/276	Chalcogenide based Thermoelectrics: A window from history to future	270
Sahil Jangra, Bhushan Kumar, Jaishree Sharma, Subhankar Das, M.S. Goyat	ICCMEPR-2024/ST/277	MXenes: Synthesis, Properties, and Applications in Advanced Energy Storage Technologies	271
Bhushan Kumar, Sahil Jangra, M.S. Goyat, Subhankar Das	ICCMEPR-2024/ST/279	State-of-the-Art Developments in MXenes: A Comprehensive Review	272
Mini Yadav, Ajay Shankar, Sandeep Yadav, Mamta Rani	ICCMEPR-2024/ST/281	Optical Analysis of Single- and Double-Layer Thin Film Using Nickel and Chromium Transition Metal as a Neutral Density Filter	273
Avinash Kumar Patel, Shilpi Banerjee	ICCMEPR-2024/ST/284	Preparation of Mesoporous CuO Nanoparticles: Structural and Optical Properties	274
Saurabh Prasad, B. N. Parida, R. K. Parida	ICCMEPR-2024/ST/285	Enhanced dielectric and optical properties of PVDF/$(LaBiFeO_3)_{0.5}$ $(BaTiO_3)_{0.5}$ composite films	275
Alshifa Memon, Priyanka Singh	ICCMEPR-2024/ST/287	Recent Techniques to Identify Round Spermatid Injection in Azoospermic Male Sheep Model	276
Mamta Rani, Ajay Shankar, Sujata Sanghi, Mini Yadav	ICCMEPR-2024/ST/288	Polarization Phase Shifting Interferometery as an application of 2-D Refractive Index Distribution of liquids	277

Keynote Talks

Success in Developing CVD Graphene Coating on Mild Steel: A Disruptive Approach to Remarkable/Durable Corrosion Resistance

Prof. (Dr.) Raman Singh
Department of Mechanical & Aerospace Engineering, and
Department of Chemical & Biological Engineering, Monash University, Australia

Abstract

The talk will discuss the challenges in developing corrosion resistant graphene coating on most common engineering alloys, such as mild steel, and present recent results demonstrating circumvention of these challenges. In spite of traditional approaches of corrosion mitigation (e.g., use of corrosion resistance alloys such as stainless steels and coatings), loss of infrastructure due to corrosion continues to be a vexing problem. So, it is technologically as well as commercially attractive to explore disruptive approaches for durable corrosion resistance. Graphene has triggered unprecedented research excitement for its exceptional characteristics. The most relevant properties of graphene as corrosion resistance barrier are its remarkable chemical inertness, impermeability and toughness, i.e., the requirements of an ideal surface barrier coating for corrosion resistance. However, the extent of corrosion resistance has been found to vary considerably in different studies. The author's group has demonstrated an ultra-thin graphene coating to improve corrosion resistance of copper by two orders of magnitude in an aggressive chloride solution (i.e., similar to sea-water). In contrast, other reports suggest the graphene coating to actually enhance corrosion rate of copper, particularly during extended exposures. Authors group has investigated the reasons for such contrast in corrosion resistance due to graphene coating as reported by different researchers. On the basis of the findings, author's group has succeeded in demonstration of remarkable and durable corrosion resistance of mild steel as result of development of suitable graphene coating.

ICCMEPR-2024/KT/II

Engineering at the Nanoscale: A Strategy for Developing High Performance Functional Materials from Biomass

Prof. (Dr) Sabu Thomas
Chairman, Trivandrum Engineering Science & Technology Research Park (TrEST Research Park)
Former Vice Chancellor, Mahatma Gandhi University, Kottayam, Kerala, India
Director, School of Energy Materials
Director, School of Nanoscience and Nanotechnology,
Director, International and Inter-University Centre for Nanoscience and Nanotechnology,
Former Director, School of Chemical Sciences,
Founder, School of Polymer Science and Technology,
Mahatma Gandhi University, Kottayam, Kerala, India

Abstract

Microwave welding of thermoplastics

Dr. Voon Chun Hong
Associate Professor
Institute of Nano Electronic Engineering (INEE)
Universiti Malaysia Perlis (UniMAP) Perlis, Malaysia

Abstract

Traditional joining methods for thermoplastics, such as hot tools, friction, ultrasonic, and laser welding, often face limitations including geometric restrictions, small joining areas, and the necessity for skilled operators. These methods can also be energy-intensive and less environmentally friendly. Microwave welding of thermoplastics represents an innovative technique that leverages the unique properties of microwave volumetric heating. Currently available susceptors for microwave welding include carbon-based materials and conductive polymers. While carbon-based materials are effective in absorbing microwave energy, they pose significant health hazards and have low magnetic loss, making impedance matching challenging. Conductive polymers, on the other hand, require additional acidic doping, which adds to the processing time and complexity. To address these limitations, we propose using silicon carbide nanowhiskers (SiCNWs) due to their superior dielectric properties, thermal stability, and mechanical strength. Our research systematically investigated the effects of various parameters, such as heating duration, solid loading of SiCNWs, microwave power, and clamping pressure, on the mechanical properties of the welded joints. Optimal conditions were identified, resulting in maximum tensile and flexural strengths of 2.21 MPa and 8.62 MPa, respectively, for SiCNWs suspension. Furthermore, the introduction of SiCNWs/PMMA nanocomposite thin films as susceptors demonstrated improved joint properties, achieving tensile and flexural strengths of 2.66 MPa and 12.28 MPa. To enhance the compatibility between SiCNWs and polypropylene (PP), surface modification of SiCNWs using silane coupling agents was performed. This modification significantly improved the interfacial bonding and mechanical properties of the welded joints. Our findings indicate that microwave welding using SiCNWs, particularly in nanocomposite thin film form, is a highly effective method for joining thermoplastics, offering a safer, more efficient, and environmentally friendly alternative to conventional methods. This research not only contributes to the field of composite materials but also opens new avenues for industrial applications.

Sustainability in Polymers Composites

Dr. Lim Bee Ying
Associate Professor
Faculty of Chemical Engineering & Technology
Universiti Malaysia Perlis (UniMAP) Perlis, Malaysia

Abstract

Polymer composites offerattractive solutions to many applications due to its lightweight properties and high strength to weight ratio.However, the petroleum-based polymer composites had caused disposal issue after their end of use.With the aim to reduce the usage of non-degradable polymer composites, the natural fillers served as alternative fillers to inorganic fillers.Most of them are obtained fromplant based, especially the waste. They are known to below cost, biodegradable, and environmentally friendly. The addition of natural fillers in polymer composites werefound to enhance the properties of biocomposites. The palm kernel shell, kapok husk, and coconut husk were turned into powder form and improved the mechanical properties and thermal properties of several thermoplastic composites.On the other hand, the use of nano sized fillers in thermoplastic composites also had drawn the attention of many researchers. However, the filler agglomeration is the biggest obstacle faced by conventional melting mixing of thermoplastic.Hence, the solution casting which can disperse the nanofiller is used to prepare the nanocomposite films.Besides, selection of a suitable solvent in solution casting is also important to maintain the properties of the films. Acetone is used as nontoxic solvent in PMMA while silicon carbide (SiC) nanofillers are used as fillers. The presence of SiC managed to improve the properties of PMMA/SiC composite films.Moving towards a sustainable environment, biocompositeshave huge potential in multifunctional applications.Even though there are some drawbacks, the advancement in research would be able to overcome them in future. The growing awareness of preserving mother earth shouldencourage more research that focus on green processing of polymer composites.

3D Au-decorated perovskite $BiFeO_3$ nanostructures enhanced by piezo-plasmon phototronics

Khalid Mujasam Batoo
King Abdullah Institute For Nanotechnology,
King Saud University, P.O. Box-2455, Riyadh-11451, Saudi Arabia

Abstract

Bismuth ferrite-based oxide nanostructures were chemically processed to offer an effective solution for the growing energy crisis and environment pollution by employing them as photoelectrodes for water splitting reactions and remediation of organic pollutants through photocatalysis. The influence of plasmonic effects via gold (Au) incorporating the physicochemical properties and their resulting impact on the application performance has been studied systematically. The processed materials were examined using X-ray diffraction (XRD), absorbance, and transmission electron microscopic instruments. Au interaction in the host BFO nanoparticle surface was affirmed through an in-depth examination of their photoelectron spectroscopic data. The plasmonic effect was also visualized in the absorbance spectra, along with a significant change in the optical spectrum of Au decoration. Photoluminescence spectra approved the quality of defect states to be significantly influenced by the BFO nanoparticles, and the Au nanoparticles influenced charge transmigration and separation. Enhanced photocatalytic and photoelectrochemical performance from the Au-decorated BFO nanostructures was evaluated through comparative analysis of pristine BFO. Time-dependent photocurrent density studies also proved the stability of processed photoelectrode materials in efficient water splitting via Au nanoparticles, which enhanced the charge transfer efficiency by offering improved conductivity as studied via Nyquist plots. The piezophotocatalysis activity of the nanocomposite exhibited a high degree of degradation of organic pollutants and better hydrogen production from water splitting reaction upon direct sunlight illumination.

Keywords: Energy; BFO; Nanostructures; Photocatalysis; Plasmonic.

Overview of Tunable Material Applications in Antenna Systems

Dr. Nasimuddin
Principal Scientist, Institute for Infocomm Research (I2R), A*STAR, Singapore

Abstract

The incorporation of tunable materials into reconfigurable antenna systems has been pivotal since the advent of microwave/mmWave technology. These materials encompass phase shifters, resonators, and antennas, serving critical roles in applications requiring radiofrequency (RF) signal filtering, beamforming, and beam-steering. Advances in electronic and material sciences offer promising opportunities to develop reconfigurable antenna systems that are not only versatile in frequency, pattern, and polarization but also energy-efficient.

This talk provides an overview of tunable material applications in reconfigurable antenna systems, focusing particularly on the use of liquid crystal materials whose dielectric properties vary with biasing voltage. The presentation emphasizes the controlled manipulation of frequency response and beam steering through voltage biasing in antennas based on tunable materials. Specific examples, including leaky-wave antennas, array antennas, and beam steering antennas employing liquid crystals, will be discussed in detail to illustrate their applications and highlight potential advancements in the field.

Unlocking the Potential of Nanocellulose in Eco-Friendly Food Packaging

R.A. Ilyas [1,2,3,4]

[1] Department of Chemical Engineering, Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor, Malaysia

[2] Centre for Advanced Composite Materials (CACM), Universiti Teknologi Malaysia (UTM), Johor Bahru 81310, Johor, Malaysia

[3] Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia, Serdang 43400, Selangor, Malaysia

[4] Centre of Excellence for Biomass Utilization, Universiti Malaysia Perlis, 02600, Arau, Perlis, Malaysia

[5] Advanced Membrane Technology Research Centre (AMTEC), Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia, 81310, Johor Bahru, Johor, Malaysia

Abstract

Given the ecological ramifications associated with the utilization of petroleum-derived packaging materials, there exists an imperative need to spearhead the development of innovative alternatives in food packaging. Nanocellulose emerges as a viable candidate, presenting a sustainable solution owing to its unique attributes. This presentation endeavors to examine the realm of nanocellulose and its prospective applications in transforming food packaging practices. Commencing with an elucidation of the fundamental characteristics of nanocellulose, including its structural intricacies, inherent properties, and methodologies of extraction, the discourse will progress to an examination of its efficacy in fabricating composite films customized for food packaging purposes. Particular emphasis will be accorded to the exceptional mechanical robustness, barrier functionalities, and thermal resilience exhibited by nanocellulose-based packaging materials, crucial requisites for upholding food quality and safety standards. Moreover, the presentation will underscore the versatility of nanocellulose in augmenting the shelf life and preservation efficacy of diverse food commodities. Practical demonstrations elucidating the applications and advantages of integrating nanocellulose in food packaging will be proffered. Ultimately, this discourse aims to engender a comprehensive appreciation of nanocellulose as an ecologically sound alternative for food packaging, while also providing insights into its potentiality to ameliorate environmental exigencies and align with contemporary packaging exigencies.

Keywords: Nanocellulose; sustainable packaging; food packaging; alternative materials; environmental impact.

The nanoscale: exploring the synthesis of nanomaterials

Dr. Sanjeev Kumar
India-IOP, Top-cited author in materials (2019-20-21)
Associate Professor, Chandigarh University-Gharuan, Mohali, Punjab, India

Abstract

At the nanoscale, material characteristics diverge significantly from those at the bulk scale, ushering in a new era of materials research. The intriguing world of nanomaterials is explored in this talk, which goes into detail on their properties and the ways they are synthesised.To start, we'll define the nanoscale, explain its dimensions, and emphasise the basic principles that control the behaviour of materials at this microscopic level. Learn how optical response, electrical conductivity, and reactivity are affected by phenomena such as quantum confinement and increasing surface area.Our next stop will be a tour of the several methods used to synthesise nanomaterials. We will display techniques for dismantling large materials into nanoparticles and constructing them from atoms or molecules, as well as "top-down" and "bottom-up" approaches. We will go over the pros and cons of several techniques, including as lithography, CVD, and sol-gel procedures.You will leave this lecture with a better grasp of the intriguing realm of nanomaterials. Learn how these materials are painstakingly made at the nanoscale and come to appreciate their one-of-a-kind characteristics. Thanks to this newfound knowledge, nanomaterials are poised to play a pivotal role in determining the trajectory of technology in areas such as healthcare, energy, and electronics, among many others.

Melanin added composites film in food packaging applications

Swarup Roy
Department of Food Technology and Nutrition, School of Agriculture,
Lovely Professional University, Phagwara, Punjab 144411, India

Abstract

Recent research has shifted its focus to functional films-based food packaging, which can provide a material with an additional distinct feature, such as protection from unwanted food-borne microbes and prevention of food oxidation. The reinforcement with functional filler materials with biopolymer can not only improve the physical properties of the film but also provide additional functional properties such as antibacterial and antioxidant activity. In this context, melanin has shown good potential recently. Melanin is a dark brown to black biomacromolecule with biologically active multifunctional properties that do not have a precise chemical structure. The structure of melanin principally depends on the polymerization conditions during the synthesis process. Natural melanin can be easily extracted from various animal, plant, and microbial sources, whereas the synthetic melanin-like compounds can be synthesized by simple polymerization of dopamine. Melanin is widely used in various areas owing to its excellent functional properties like photosensitivity, light barrier property, free radical scavenging ability, antioxidant activity, etc. Moreover, it also has an excellent ability to act as a reducing agent and capping agent to synthesize various metal nanoparticles such as silver, gold, etc. Melanin nanoparticles (MNP) or melanin-like nanoparticles (MLNP) have the unique potential to act as functional materials to improve bionanocomposite films' physical and functional properties. Recently different food applications have been made by mixing melanin or MNP/MLNP. The general aspects of melanin that highlight biological activity, along with a description of MNP and the use as nanofillers in packaging films were reviewed. The functional properties and applications of several melanin or its nanofillers added nanocomposite film in food packaging is already well-known. It is anticipated that in future the bionanocomposite films might be applied commercially to improve shelf life and preserve the quality of foods.

Keywords: Functional materials, Melanin, Biopolymers, Bio-nanocomposite, Food packaging.

Hybridnanocomposites embedded with grapheme self-assembly liquid crystalline optical materials as novel switchable device implementation

Kaushik Pal
Department of Physics, University Centre for Research and Development, Chandigarh University, Gharuan, Mohali, Punjab, 140 413, India

Abstract
Dielectric relaxations are studied at three different frequencies of a hydrogen bond liquid crystal chloro benzoic acid with nonyloxy benzoic acid. The process of synthesis is described and the synthesized mesogen is a monophase variant with nematic phase. Carbon-based nanomaterials (CNMs), like CNTs, graphene, carbon dots (C-dots), and some other CNMs, have recently drawn a lot of interest in their future application as an elevated-performance sensor implementation.For the first time in the history of liquid crystal dielectric work, we observed that in the present sample at higher frequency the process mentioned above is reversed. All the dielectric data points obtained at various temperatures when plotted they are found to converge at the ε_∞ values and diverge at ε_0 values. This process is referred as frequency cross over.Nematic growth order derived from dielectric studies is also presented.We explored that qualitatively different behaviors could emerge via the specific nature of the inter-component interaction. Mastering this mechanism could lead to various applications based on phase tunable properties and novel switching.

Keywords: Nanomaterials; Graphene; Hybrid Nanocomposites; Spectroscopy; Switching.

Faculty / Scientist (Invited) Talks

Advancements in Hydrogenated Diamond-Like Carbon Thin Film Deposition & Surface Modification

Hari Shankar Biswas
Department of Chemistry, Surendranath College, 24/2, Mahatma Gandhi Road, Kolkata, India

Abstract

Materials synthesis and processing play a crucial role in advancing various technological advancements across various domains, ranging from electronics to biomedical applications. This comprehensive review delves into recent progressions in thin film deposition techniques, with a particular emphasis on hydrogenated diamond-like carbon (HDLC) films, alongside an exploration of diverse surface modification methodologies. Commencing with an insightful overview, the paper elucidates the properties and manifold applications of HDLC films, underscoring their significance in contemporary materials science. Subsequent sections meticulously dissect different methodologies employed for HDLC film deposition, notably encompassing chemical vapor deposition (CVD) and physical vapor deposition (PVD). Furthermore, a detailed exploration of surface modification techniques, such as plasma treatment, ion implantation, and laser processing, is presented, shedding light on their mechanisms and potential applications. Through an amalgamation of theoretical underpinnings and practical implications, this paper endeavors to furnish researchers and engineers with an in-depth understanding of advanced materials synthesis and processing. By encapsulating recent advancements and methodologies in thin film deposition and surface modification, this review aspires to serve as a valuable resource, fostering innovation and paving the way for transformative applications across diverse fields of science and technology.

Keywords: Thin film deposition, Hydrogenated diamond-like carbon, Surface modification, Chemical vapor deposition, and Physical vapor deposition.

ICCMEPR-2024/FIT/SIT/002

Extraction of cellulose from agro-waste and its utilization in developing active food packaging films

Pratibha Kumari
Department of Chemistry, Deshbandhu College, University of Delhi, Kalkaji, New Delhi 110019, India

Abstract

Agro-waste, such as rice husks, sugarcane bagasse, corn stalks, and wheat straw, contains cellulose as a major component. Extracting cellulose from agro-waste and utilizing nanocellulose for food packaging applications is an innovative approach that addresses both environmental concerns and the need for sustainable packaging solutions. Nanocellulose is produced from cellulose through mechanical or chemical processes. Nanocellulose holds great promise for food packaging applications due to its unique properties, including its biodegradability, renewability, and excellent mechanical strength. Nanocellulose-based films exhibit excellent barrier properties against gases such as oxygen and carbon dioxide, as well as against water vapor. Nanocellulose can be combined with other bioactive compounds, such as antioxidants or antimicrobial agents, to create active packaging systems that actively interact with the packaged food to extend its shelf life. Herein, we report the extraction of cellulose from wheat straw and the utilization of nanocellulose in combination with chitosan and metal organic framework for developing active food packaging films. The developed films exhibited good barrier and antioxidant properties with extended shelf life.

Keywords: Cellulose, food safety, packaging, antioxidant film, nanocellulose.

Metal-Oxide based Modification of carbon fiber fabric for mechanical strengthening of CFRP composites

Ravi Shankar Rai
Department of Automation and Robotics, Sandip Institute of Technology and Research Centre, Nashik, Maharashtra, India

Abstract

In this work, the effects of ZnO nanostructure-surface functionalized carbon fibers has been examined along with their impacts on mechanical attributes of resulting hybrid carbon fiber reinforced polymer (CFRP) composites. The procedure involves hydrothermally generating ZnO nanostructures on carbon fibers. To generate hybrid composites, the modified carbon fiber fabric is then utilized as reinforcement in a matrix made of bisphenol-A epoxy resin and polymer. The electron microscopy technique was employed to study development phenomenon of nanostructures on the fiber. According to the findings, lengthening the growth treatment and increasing seeding cycles improves the rate of ZnO formation. However, the results are not significantly impacted by the growth solution's concentration. The weight change analysis, X-ray diffraction, Fourier transform infrared spectroscopy, UV-spectroscopy, and energy dispersive spectroscopy all provide additional support for these conclusions. In comparison to plain CFRP composites, the developed hybrid CFRP composites tensile properties and impact resistance are significantly better. The ZnO-modified CFRP composites exhibit improvements in elastic modulus, tensile strength, and in-plane shear strength of up to 46.44%, 48.63%, and 20.79%, respectively. The hybrid composites' capacity to absorb impact energy also rises by 76%. Based on these results, the developed hybrid composites exhibit promising properties for applications in industries such as aircraft and automobile manufacturing. They offer high impact strength, high modulus, lightweight characteristics, and low void content, making them desirable materials for these industries.

Keywords: ZnO; Nanostructures; Carbon fibers; CFRP composites; Mechanical properties.

Green and simplistic synthesis of zinc oxide nanoparticles for improved photocatalytic organic pollutant degradation

V. Lakshmi Ranganatha[1], G Nagaraju[2], C. Mallikarjunaswamy[3]

[1]Department of Chemistry, The National Institute of Engineering, Manandavadi Road, Mysuru, Karnataka 570008, India

[2]Energy Materials Research Laboratory, Department of Chemistry, Siddaganga Institute of Technology, Tumakuru, Karnataka, 572103, India

[3]Postgraduate Department of Chemistry, JSS College of Arts, Commerce and Science and JSS Research Centre

Abstract

ZnO nanoparticles show great potential for photodegradation applications due to their excellent physical and chemical properties. Finding a greener approach to producing nanoparticles is of the utmost importance for multidimensional application purposes. In the present study, the ZnO nanoparticles were synthesized by a simple combustion method at 400 ^{o}C, using jackfruit extract. X-ray diffraction (XRD) pattern revealed a crystalline structure of the nanoparticles. Scanning electron microscope (SEM), Raman spectroscopy, BET surface area were used to further characterize the synthesized nanoparticles. Further, it has been used as a photocatalyst for the degradation of one of the organic pollutant methylene blue dye. In general, the method employed here is a greener approach to synthesize ZnO nanoparticles with good photocatalytic activity.

Keywords: Nanopatricles, Green sybthesis, Zinc oxide, Photocatalyst, Jack fruit extract.

Magnetically separable Nanocatalysts: Sustainable Catalysts for Nitroaromatics Reduction

Rinku Ghanta[1], Rimpa Mondal[1], Madhulata Shukla[2], Tanmay Chattopadhyay[1]

[1]Department of Chemistry, Diamond Harbour Women's University, Diamond Harbour Road, Sarisha, South 24 Pgs, 743368, India

[2]Department of Chemistry, G.B. College, Veer Kunwar Singh University, Arrah, Bihar, India

Abstract

Catalyst retrieval and reusability stand as paramount considerations in catalytic processes. The array of catalyst types, magnetically separable nanoparticles (MSNps) emerge as a preeminent class of nanocatalysts due to their capacity to fulfil pivotal criteria of high accessibility to active sites and recyclability. Extensive research into the synthesis conditions of nanoparticles, including the exploration of diverse capping agents, precursors, surfactants, and solvents, have yielded substantial advancements in the realm of superparamagnetic nanoparticles.

Keywords: Nanocatalyst, Magnetic nanoparticles, Magnetic separation, Nitroaromatics, Recyclable.

Silver Nanoparticles Reinforced on Silk Fibroin/Carboxymethylcellulose Composite Films for Electrical Applications

Shivananda C S

Department of Physics, Nagarjuna College of Management Studies, Chikkaballapura, 562101, Karnataka, India

Abstract

This study proposes the fabrication of silver nanoparticles (AgNPs) on silk fibroin carboxymethylcellulose (SF-CMC) composite films for advancement in electronic device applications. Bombyx mori silk fibroin is a biopolymer that is used as a bio-template in the fabrication of AgNPs. Various silver nitrate ($AgNO_3$) combinations are added to the prepared SF solution to synthesize AgNPs. To develop stand-alone biopolymer-nanocomposite (SF CMC/AgNPs) films, SF-AgNPs colloidal solution is blended with CMC solution. UV, PL, FT-IR, XRD, SEM and AFM have been employed to the prepared SF-CMC/AgNPs composites to evaluate the physical, chemical, structural, morphological, and topographical information of the composite films. Furthermore, the composites are subjected to an LCR Hi tester and CHI equipment to analyze the AC, DC conductivity, dielectric characteristics, and electrochemical impedance analysis of SF-CMC/AgNPs composites. The UV-visible spectra reveal the formed nanoparticles in spherical shape with average particle size 35-40 nm. XRD reveals the formed AgNPs in face centred cubic structure; TEM reveals the average particle size of 35 nm. AC conductivity of the SF-CMC/AgNPs composite found to be $4.0\times10^{-4}$to 8.04×10^{-4} S/cm. In spite of the presence of AgNPs, measurements of the dielectric behaviour of pure CMC and SF-CMC materials exhibit good dielectric performance. The obtained results demonstrate that the SF-CMC films exhibit significant conductivity following AgNPs incorporation and may therefore be used in biosensor and wearable electronic device applications.

Keywords: Silk Fibroin, CMC, XRD, FT-IR, AgNPs, AC conductivity, DC conductivity.

Sustainable Removal of Arsenic from Simulated Wastewater using Waste Biomass Seed Pods Bioadsorbent

Dan Bahadur Pal
Department of Chemical Engineering, Harcourt Butler Technical University, Nawabganj Kanpur, Uttar Pradesh India

Abstract
The present study is focused to develop a new type of biomass waste based biosorbent, derived from the Cassia fistula pod. The prepared biosorbent has been characterized through different techniques including field emission scanning electron microscopy, fourier transform infrared spectroscope and X-ray diffraction to investigate the physiochemical properties which are potential for the bioadsorbent application. The experiments have been performed considering four parameters namely; pH, biosorbent dose, initial concentration of arsenic and duration in the batch reactor. The experimental results have been analysed using the design-expert software for the optimization of different parameters. The maximum removal of arsenic could be achieved ~91% whereas monolayer adsorption capacity is found to be 1.13 mg/g in one hour 20 min at pH 6.0 by using 60 mg dose of bioadsorbent.

Keywords: Arsenic, bioadsorption, Cassia fistula pods, isotherm, kinetic.

Surface Morphology Influenced in Barium Sulphate Nanostructures by Solvents with Azadirachta Indica Leaf Extract

S. Saravanan[1], B. Ananda Kumar[2], S.B. Ronald[3], Ch. Udaya Bhaskara Rao[4]

[1]Department of Physics (S&H), Swarnandhra College of Engineering & Technology (A), Seetharampuram- 534 280, Narsapur, West Godavari (AP), India

[2,3,4]Department of Chemistry, Sri YN College (A), Narsapur- 534 275, West Godavari (Dist.), Andhra Pradesh, India

Abstract

Today, synthesizing nanomaterials using plant extract is a viable and better alternative method. In this work, the co-precipitation method is a simple method for the preparation of $BaSO_4$ nanostructures with the influence of Azadirachta indica leaf extracts as organic stabilizing agent. For the synthesizing nanostructures two different solvents (Ethanol & deionized water) were taken and studied various characterization techniques. Initially, the XRD pattern revealing the orthorhombic phase structure a well-matched with JCPDS file. Next, FTIR transmission spectrum confirmed the presence of Ba and SO_4 stretching, vibration molecules. At 1 and 2 µm scale level, the SEM micrographs are evidenced the successful preparation of rice grain (or nanorods) like nanostructures with the average diameter of ~73.5 nm (Ethanol) and 222 nm (DI water). Also, the prepared sample elements were evidenced by EDX spectra. This employed method helps to yield the highest amount of $BaSO_4$ nanostructures. Future, these nanostructures can help for the better antimicrobial activity.

Keywords: Green Synthesis; Azadirachta Indica; $BaSO_4$; Nanostructures; Antimicrobial.

An assessment of the mechanical properties of a composite material composed of natural fibres and reinforced with polymer

Kamatchi Hariharan M[1], Ravikumar K[2], Haja Syeddu Masooth P[3], Anderson A[4]

[1]Assistant Professor (S.G), Department of Mechanical Engineering, SRM Institute of Science and Technology, Vadapalani Campus, Chennai, India

[2]Assistant Professor, Department of Mechanical Engineering, SRM Institute of Science and Technology, Vadapalani Campus, Chennai, India

[3]Assistant Professor (S.G), Department of Mechanical Engineering, SRM Institute of Science and Technology, Vadapalani Campus, Chennai, India

[4]Professor, School of Mechanical Engineering, Sathyabama Institute of Science and Technology, Chennai, India

Abstract

Composites are essential in contemporary engineering and production, providing a flexible and effective solution for various applications that demand lightweight materials with exceptional performance. Natural composites provide adaptable and eco-friendly solutions for various sectors and applications, promoting environmental sustainability and the preservation of resources. Further advancements in research and development in this discipline are anticipated to enhance the utilisation of natural composites across several industries. For this investigation, two types of composite materials are created: synthetic composites and Hybrid composites. The materials picked for the fabrication of synthetic composite were basalt, coconut coir and glass fibre. For the hybrid composite, basalt, coconut coir, and kenaf fibre were chosen. The mechanical properties of the composite materials were evaluated by analysing the data obtained from several tests, including tensile, compression, flexural, and impact tests. From the test results, the synthetic composite exhibited a 21% increase in tensile strength, 137% increase in flexural strength and 83% increase in impact strength over the hybrid composites.

Keywords: Composites, Synthetic composites, Hybrid composites, Fabrication, Mechanical Properties.

Thermodynamic modelling and experimental validation for long term carbon capture and storage (CCS) in Deccan basalt

Amit Kumar
National Centre of Experimental Mineralogy and Petrology (NCEMP), University of Allahabad, Bank Road, Prayagraj, Uttar Pradesh 211001, India

Abstract

Severe annual rise of 3.1% CO_2 emissions (mainly fossil fuels consumption) for the past three decades is alarming for countries like India. Thus, to limit CO2 emissions is a major concern. Fall of global temperature below 1.5 ^{o}C is possible by Carbon capture and storage (CCS) of nearly 10 Gt/year. CCS techniques by mineral sequestration needs to be greatly enhanced so that the global warming effect can diminish. CCS in geological formations is considered as one of the best options as the injected CO_2 get interlocked in the lattice structure of the newly formed carbonates. The Ca^{2+}, Mg^{2+}, and Fe^{2+} enriched thick lava flows of continental flood basalt plays a considerable role in the global carbon cycle. These lava flows offer rapid mineralization to enable mineral sequestration of CO_2. Earlier, CCS experiments on Deccan basalt rocks show formation of carbonate minerals, chiefly calcite, followed by other carbonates. But for longer period of experiments, smectite acted as barrier, thus restricted mineral carbonation. As a result, CO_2 mineralization only up to 35% was achieved. To address this issue, thermodynamic simulations and experimental work was carried out simultaneously at elevated pH and apposite pCO2, temperature and time parameters. Obtained negative ΔfG, ΔH and ΔS values suggest feasibility of plagioclase, pyroxene and magnetite dissolution and spontaneous reaction of CO_2 with the free Ca^{+}, Mg^{2+} and Fe^{2+}in solution to form secondary carbonates. A solution with pH value > 7 is pH is conducive to carbonation and rapid precipitation rate for Cal>Ank>Ara>Sid>Mag as also evidenced by SEM-EDAX, XRD and Rietveld refinement results. The crystallographic attributes of the neo-formed carbonates are identical to that of the naturally formed crystals. Also, smectite precipitation is restricted to 1-5% and leads enhancement in mineral carbonation. Mineralization rate of 55.31% was achieved in 50 hours, but an average rate of ~40% was also achieved by performing carbonation experiments between 75-50 hours at 100°C under 5 bar CO_2 and 8-9 pH. Obtained results indicate that Deccan Traps possess more CCS potential that also in less time. Additionally, the neo-formed carbonates produced as by products and find application in cement and cosmetic industries.

Keywords: CCS; Climate change; Deccan basalt; Mineral carbonation; Thermodynamic modelling.

ICCMEPR-2024/FIT/SIT/018

Anti-Corrosion Properties of Metallic Substrates via Nanocomposite Coatings

Sheerin Masroor
Department of Chemistry, A.N. College, Patliputra University, Patna, India

Abstract

High-performance materials known as nanocomposites have remarkable qualities and attributes that their constituent parts alone are unable to offer. They are beneficial in a variety of disciplines, including fuel cells, membrane processes, biomedical devices, and corrosion prevention. Customized nanocomposites show promise as materials for anti-corrosion coatings on metals and alloys, offering basic barrier defence or more sophisticated self-healing and auto responsive properties. A wide range of matrices and reinforcing materials can be used to create nanocomposite coatings, which frequently work in concert with one another. Recent developments in the creation and description of coatings for corrosion-resistant nanocomposite materials based on metallic, polymeric, and ceramic matrices—as well as the addition of diverse reinforcement components—are discussed in this context. The most common fillers (nanoparticles, nanotubes, nanowires, nanorods, nanoplatelets, nanosheets, nanofilms, or nanocapsules), as well as their combinations, are presented in this overview together with the most significant materials utilized as matrices for nanocomposites (metals, polymers, and ceramics). A brief discussion is given of some of the key traits and uses of nanocomposite coatings, along with the difficulties facing further study in this area.

Keywords: Metallic Substrates, Nanocomposite Coatings, Reinforcing Materials, and Anti corrosion qualities.

References

1. Abdeen, D.H.; El Hachach, M.; Koc, M.; Atieh, M.A. A Review on the Corrosion Behaviour of Nanocoatings on Metallic Substrates. Materials 2019, 12, 210.
2. Nguyen-Tri, P.; Nguyen, T.A.; Carriere, P.; Xuan, C.N. Nanocomposite Coatings: Preparation, Characterization, Properties, and Applications. Int. J. Corros. 2018, 2018, 4749501.
3. Muresan, L.M. Electrodeposited Zn-nanoparticles composite coatings for corrosion protection of steel. In Handbook of Nanoelectrochemistry; Aliofkhazraei, M., Makhlouf, A.S.H., Eds.; Springer: Berlin/Heidelberg, Germany, 2015; Chapter 9; pp. 333–353, ISBN 978-3-319-15265-3.
4. Kamboj, A.; Raghupathy, Y.; Rekha, M.Y.; Srivastava, C. Morphology, Texture and Corrosion Behavior of Nanocrystalline Copper–Graphene Composite Coatings. JOM 2017, 69, 1149–1154.
5. Radhamani, A.V.; Lau, H.C.; Ramakrishna, S. Nanocomposite coatings on steel for enhancing the corrosion resistance: A review. J. Compos. Mater. 2020, 54, 681–701.

Utilizing Microbial Fuel Cells to Produce Bioelectricity represents a Sustainable Energy Solution

Kumar Gaurav
Amity Institute of Biotechnology, Amity University Haryana, Gurugram-122413, India

Abstract

The urgency of finding clean and affordable energy solutions to combat energy scarcity and global warming is of utmost importance. Microbial fuel cells (MFCs) are a promising way to produce sustainable energy with fuel cells. The fuel cells have emerged as highly promising clean energy technologies that meet the multifaceted criteria of energy security, economic growth, and environmental sustainability. Microbial fuel cell (MFC), bio-electrochemical and promising technology to extract the energy of substrate and converts into electrical energy through the catalytic reaction of microorganism. It removes electron and proton from substrate through oxidation. Electrons are transferred through anode to cathode via external load, while protons are diffused through proton exchange system that separate cathodic and anodic chamber. Proton exchange membranes (PEMs) are critical components in MFCs, but the high cost poses a significant challenge. Notable commercial membranes are Nafion and Ultrex, both of which exhibit substantial promise but are constrained by high costs and lower conductivity at elevated temperatures. The newly synthesized membranes were studied for their water uptake capacity, ion exchange capacity and potential applications in MFC.

Keywords: Sustainable energy; Microbial fuel cell; Proton exchange membranes; ion exchange capacity.

Low cost nanao bio-adsorbent for Cr(VI) contaminated effluent discharge from leather Industry

Zeenat Arif
Department of Chemical Engineering
Harcourt Butler Technical University, Kanpur, Uttar Pradesh, India

Abstract

Rapid growth in urbanization and industrialisation leads to discharge of various contaminants into water bodies. There are several techniques for eliminating these pollutants from aquatic sources including membrane filtration, electrocoagulation, chemical precipitation, electrolysis, coagulation, ion exchange and adsorption. Compared to other available technologies, adsorption is a straightforward, economical, environmentally benign, and sustainable method. Also green synthesis is an easy, safe, affordable, and environmentally responsible method of creating nanoparticles. In the current study, Cajanus Cajan leaf extract was used as a capping agent to create titanium dioxide nanoparticles (TiO2 NPs) and used as filler to enhance the adsorption performance of bio adsorbent prepared using watermelon leaves (WML) for removing Cr (VI) metal from industrial wastewater. Accordingly, this article highlights the effective removal of hexavalent chromium (Cr VI) one of the major contributors causing water pollution discharged from tanneries was removed by using a low cost synthesized biowaste nano-adsorbent derived from Watermelon leaf (WML) as adsorbent material and TiO2 NPs as filler derived from extract of Cajanus Cajan. High removal efficiency for heavy metals (HMs) was found in the results, particularly when employing acid treated WML/TiO2. Nano adsorbents achieved more than 90% removal percentage in synthetic wastewater especially Cr(VI) at pH 2 ± 0.5 with a chromium metal content of 15 mg/L when compare to pristine WML.

Keywords: Adsorption; Contamination; Environment; Sustainable; Wastewater.

Recent Advancements in Polyhydroxyalkanoates and their Composites: Towards Sustainable Bioplastics and Beyond

Tan Suet May Amelia
Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia

Abstract

Polyhydroxyalkanoates (PHA) offer a prospective solution to the global environmental crisis driven by the overreliance on conventional or traditional plastics. As non-biodegradable plastics occupy landfills, cause pollution, and contribute to carbon emissions, PHA provides a promising solution since it is biodegradable and have the potential to decrease pollution and carbon footprint. The latest developments in PHA research include the manipulation of microorganisms, the investigation of sustainable resources for feedstock, the improvement of production efficiency, and the study of new applications. Genetic modification techniques are utilised to alter the PHA synthesising enzymes of PHA producers and the composition of PHA biosynthesised in order to generate PHA with desirable features such as different monomers, enhanced biodegradability, and heat resistance. Nevertheless, PHA downstream processing, biosynthesis management, economic competitiveness, and long-term evaluation of environmental effects still require future research efforts to achieve comprehensive grasp of fundamental concepts and mechanisms. The PHA biopolymer has great potential in several industrial sectors, including drug delivery, tissue engineering scaffolds, and biofuel generation, hence it is imperative for academics and industry stakeholders to actively address these shortcomings. By confronting these obstacles and capitalising on favourable circumstances, the PHA industry may progress towards a sustainable and ecologically conscious future.

Keywords: Biodegradable plastic; Biopolymer; Composite; Environmental impact; Thermoplastic.

Convection of unitary nanofluids and hybrid nanofluids in enclosures of heat transfer – An overview

T. Mahalakshmi
Sri Krishna Adithya College of Arts and Science, Coimbatore, Tamil Nadu-641 042, India

Abstract

Convective heat transfer inside enclosures utilizing unitary nanofluids and hybrid nanofluids has been numerically investigated by using finite volume method. The simulations focus particularly on the MHD effects, central heater orientation and length, heated wall section length, Rayleigh number, Reynolds number, Richardson number, nanoparticle volume fraction on the average Nusselt number along the cool, vertical side-walls of the enclosure. Regardless of the heater orientation, the heat transfer performance reduces as the magnetic field strength increases. For an increasing different nanoparticle volume fraction, the average Nusselt number increases with an pertinent parameters concerned. Notably, the use of an external magnetic field to control the convection effect has many advantages over traditional active cooling methods, including high reliability, good energy efficiency, a low maintenance cost, and a noise-free nature.

Keywords: Convection ; Nanofluids; MHD effect; Heat transfer; average Nusselt number.

ICCMEPR-2024/FIT/SIT/025

Artificial Intelligence Analysis of Corrosion Behaviour of H59 Brass Alloy in Red Sea Conditions with and without Ceramic Coating

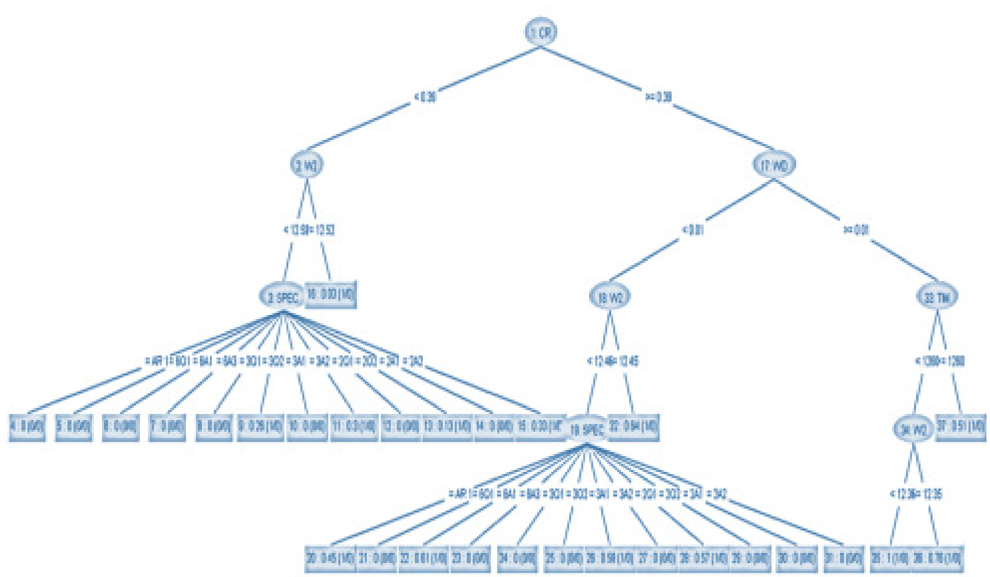
Obaid Saleh Ba Yuosef, Mohmmad Salah Eldin Haij, Abdulmajeed Sami Alnemry, Ammar Ahmed Holbah, Mohammed Fahmi Lathkani, Ibrahim Sahban Abuhayyah, Abdulaziz mahdi alameer, Turki Nasser Jraba, Rajasekaran Saminathan

Department of Mechanical Engineering, College of Engineering and Computer Science, Jazan University, Saudi Arabia

Abstract

Due to its exceptional resistance to corrosion, H59 is a marine grade alloy that is utilized widely in the maritime industry for a variety of applications throughout the industry. A scant amount of research has been done on the effects of heat treatment and ceramic coatings such as ceria on the corrosion behavior of H59 in conditions similar to those found in the Red Sea. This study aims to investigate the influence of heat treatment at temperatures of 200, 360, and 600 degrees Celsius over a range of time periods, as well as the application of a cerium oxide coating using the chemical bath technique, on the corrosion behavior of H59 alloy under conditions that are typical of the Red Sea. Furthermore, in order to acquire the artificial intelligence algorithm, the corrosion data of the alloy that has been exposed to heat treatment and surface coating is analyzed by the software that utilizes both machine learning and artificial intelligence. The use of the machine learning approach has led to the identification of the important parameters that are responsible for the corrosion behavior of the alloy that was scrutinized in this study. Heat treatment causes topographical changes in grain structures and results in the production of a metallic oxide layer on the surface of the alloy. The formation of this layer is dependent on the amount of time and temperature that the heat treatment cycle is carried out. Because of this, the corrosion behavior of the alloy specimens varies depending on the category of heat treatment that they have received. The machine learning treatment has led to the identification of the quenching treatment at 600 and 200 degrees Celsius, as well as the annealing treatment at 360 degrees Celsius, as the important processes that contribute to a greater corrosion rate with severity level 1. In addition, the coating made of cerium oxide has resulted in a reduction in the rate of corrosion to a level that is two times lower.

Keywords: H59 alloy, Corrion Behaviour, Red Sea, Heat Treatment, Artificial Intelligence, Machine Learning.



Machine Learning Algorithm of the Corrosion Behaviour of the H59 Alloy

Simultaneous dual doping with succinic and citric acid leading toward synergistic improvement of electrical and thermal characteristics

Subhendu Bhandari[1], Rushikesh S. Kothale[1], Prathamesh B. Sutar[1], Sandeep G. Kamble[1], Uday Shankar[2], Anasuya Bandyopadhyay[2]

[1]Department of Plastic and Polymer Engineering, Maharashtra Institute of Technology, Aurangabad, 431010, India

[2]Department of Polymer and Process Engineering, Indian Institute of Technology Roorkee, Saharanpur - 247001, Uttar Pradesh, India

Abstract

Polyaniline (PAni) is an important member of the class of intrinsically conducting polymer (CP) which exhibits potential applications in electronic devices. Acids are used as dopants in PAni for tuning its electrical characteristics. In this work, PAni was synthesized via mechanochemical route of polymerization. During its synthesis succinic acid (SA) and citric acid (CA) were used individually as well as in combination at different proportions. Formation of the conductive emeraldine salt form of the synthesized PAni was confirmed from FTIR analysis. A decreasing trend of crystallinity with the increase of benzenoid structure in PAni molecules was evident from the FTIR and XRD analysis. Both plate-like as well as spherical morphologies were found in synthesized PAni microstructures. Synergistic improvements in dielectric properties as well as in thermal degradation characteristics were observed for suitable dopant proportions. Synergy was also observed in the improvement of AC conductivity for a dual-doped PAni which was further confirmed from optical band gap analysis.

Keywords: Conducting polymer; Dielectric; Simultaneous dual doping; Synergy; Thermal stability.

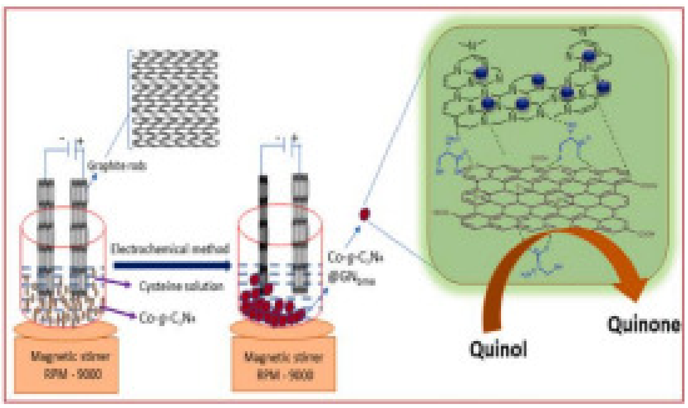
ICCMEPR-2024/FIT/SIT/027

Detection of A Skin Lightening Agent ‘Quinol’ In Whitening Cream Using Electrochemically Reduced Graphene Nanosheets Co Doped g-C_3N_4 Modified Electrode

Manorama Singh
Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur, CG-495009, India

Abstract

Quinol is a skin-lightening constituent used in some skin-whitening creams to minimize the production of melatonin in the skin. It causes several skin ailments in humans. Due to this, monitoring of its amount in cosmetic products is necessary. An electrochemical sensor is a useful approach to determine the concentration of ‘quinol’ in creams. Our group has reported the electrochemically reduced graphene oxide-based bio-nanocomposite for its determination. The bio-nanocomposite was prepared by association of electrochemically reduced GO (in the presence of ‘L cysteine’ amino acid) and Co-doped g-C_3N_4. The exfoliation was done by electrochemical anodic reduction of a graphitic anode in the solution of ‘L-cysteine’ amino acid. Further, its combination with Co-g-C_3N_4 enhances the electrocatalytic sensing of ‘quinol’. The characterization of prepared nanocomposite was performed by FTIR, XRD, Raman, XPS, SEM and TEM. The sensor was highly sensitive and highly selective with two wide linear ranges (0.0025–0.09 μM & 0.1–32 μM) and a detection limit 2.4 nM.



Keywords: Electrochemical, graphene, sensing, green, quinol.

Preparation and conductivity measurements of a new sodium ion conducting blended solid polymer electrolytes

Angesh Chandra[1], Archana Chandra[2]
[1]Government Naveen College, Saragaon – 495 686, Chhattisgarh, India
[2]Government M.M.R. Post Graduate College, Champa - 495 671, Chhattisgarh, India

Abstract

Preparation of new sodium (Na^+) ion-conducting blended solid polymer electrolytes (BSPEs): (1-x) [70PEO:30NaCl] + x PVP where 0<x<15 wt.%, are reported. A recently established hot press process was used to synthesise the present BSPEs. The composition: 98(70PEO:30NaCl) + 2PVP yielded the greatest ionic conductivity ($\sigma \sim 3.7\times10^{-5}$ S.cm^{-1}) and has been referred to as optimum conducting composition (OCC). Ionic conductivity (σ), ionic mobility (μ), mobile ion concentration (n), and ionic transference number (tion) are some of the fundamental ionic parameters that have been used to explain ion transport features. Temperature-dependent ionic conductivity tests have been performed to calculate OCC film's activation energy (Ea) value.

Keywords: Ion conducting polymers; Blended solid polymer electrolytes; Ionic conductivity; Ionic transference number.

Voltammetric estimation of thiophanate-methyl via electrochemical investigation of copper-thiophanate methyl reaction in its fungicide formulation (topsin M) and agricultural products

Chetan Chauhan
'Department of Chemistry, Sardar Patel University, Mandi, H.P, INDIA

Abstract

The electrochemical investigations were performed during the thiophanate-methyl and copper (II) perhlorate reaction in acetonitrile at DME by voltmmetric method (DPP) to optimized into well-defined diffusion-controlled peaks (vs SCE) which exhibits an approximately three-fold more sensitivity (in presence of surfactant). The method has successfully been explored to Topsin M commercial formulation and its residues analysis in agriculture produces.

Keywords: Thiophanate-methyl, DPP; DME, formulation analysis, residue analysis.

A Study of Langmuir Blodgett Technique in the Synthesis of Catalytically Active Gold Nanoparticles Nanocomposite Film by Star Block Co-polymer Mediated Synthesis

Bappaditya Naskar
Assistant Professor, Department of Chemistry, Sundarban Hazi Desarat College, University of Calcutta
South 24 Parganas, Pathankhali-743611, West Bengal, India

Abstract

Gold nanoparticles (AuNP) used in various medicinal applications due to their low-toxicity associated with anti-angiogenic and anti-inflammatory nature. Besides, AuNP has distinct size and shape dependent optical and electrochemical properties. The smaller nanoparticles are more catalytically active and better biosensor due to their higher surface area. In this perspective, the development of nanocomposite films using metal nanoparticles and block copolymer is gaining attention in research because of its diverse applications such as in catalysis, energy storage, protective coatings, etc. We herein report a gold nanoparticle synthesis on a star shaped block copolymer monolayer at the air-water interface using the Langmuir Blodgett technique. The transmission electron microscopy (TEM) images and chemical mapping proved that copolymer monolayer served as a matrix for AuNP, which became a copolymer-Au nanocomposite film. The optical properties and structures of these nanocomposites were characterized by UV-Vis, IR, and XRD measurements. The morphologies of Au nanostructures were investigated by TEM and obtained size in the range of 2–35 nm diameter. The energetic parameters and association constant of copolymer- $HAuCl_4/Au^0$ were ascertained by isothermal titration calorimetry. Finally, these copolymer-Au nanocomposite films show excellent efficiency (~97%) for the reduction of p-Nitrophenol to p-Aminophenol with sodium borohydride. In medicine, p-Nitrophenol is a well known biotoxin.

Keywords: Block copolymer, Langmuir-Blodgett technique, Gold nanoparticles, Copolymer-Au nanocomposite film, p-Nitrophenol reduction.

Characterization of natural fabrics incorporated hybrid composite laminates using industrial waste fumed silica

C. K. Arvinda Pandian
Department of Automobile Engineering, School of Mechanical Sciences,
B. S. Abdur Rahman Crescent Institute of Science and Technology, Chennai, India

Abstract

Strict regulations have necessitated the incorporation of industrial by-products as filler material in the development of novel composites, alongside the use of natural fibers for reinforcement. The recycling of industrial waste into functional components is crucial, rather than disposing of it in the environment. In this research, fumed silica, a by-product from the production of silicon metal or ferrosilicon alloys, is employed as a filler material in the composite. The composition of hybrid composite laminates involves a combination of organic natural fibers and inorganic filler material within a polymer matrix. Specifically, hybrid laminates are created by introducing 10 wt.% of linen fabrics and 10 wt.% of jute fabrics into fumed silica (1 wt.%, 2 wt.%, and 3 wt.%) incorporated epoxy matrix. The formulation of polymer hybrid laminates utilizes the hand lay-up method. The evaluation encompasses mechanical properties (including tensile, flexural, and impact strengths) and the thermal stability of the resulting hybrid laminates. Morphological examination of the hybrid laminates is conducted, followed by an analysis of their dynamic and vibration properties through dynamic mechanical analysis and vibration analysis, respectively. Furthermore, the glass transition temperature is determined. Remarkably, the hybrid laminate incorporating 2 wt.% of fumed silica exhibits superior mechanical characteristics. The addition of a small amount of fumed silica leads to a significant increase in the storage modulus, loss modulus, natural frequency, and glass transition temperature of the composites. However, exceeding 2% weight fraction of fumed silica results in no further enhancement of the mentioned properties due to silica agglomeration. Notably, the hybrid laminate incorporating 3 wt.% of fumed silica demonstrates the highest onset temperature of degradation.

Keywords: Industrial by-product; fumed silica; linen; jute; thermal stability; hybrid; laminates.

Coconut Shell Pyrolytic Oil Distillate (CSPOD) as wood preservative for industrial application

Rashmi Ramesh Shanbhag[1], Shiny K.S. [1], Vani, C. N. [1], Sundararaj Ramachandran[1]
Institute of Wood Science And Technology, 18th Cross, Malleshwam, Bengaluru-560003, India

Abstract

Wood with its unique versatile nature continues to be one of the most widely used raw material in spite of the introduction many modern materials. This naturally renewable resource being an organic matter is amenable to the attack of biodeteriorating organisms and require extra protection from preservative applications. CCA (Copper Chrome Arsenic) and CCB (Copper Chrome Boric) are the world's most widely used wood preservatives with stable performance. However, excessive use of these preservatives is posing serious problems to the environment. Thus the current concern in the field of wood protection is to replace the use of toxic chemicals with natural means of wood protection. In this line, research was undertaken to utilize the Coconut Shell Pyrolytic Oil as wood preservative for solid wood and panelwood products. Coconut shell pyrolytic oil, a dark viscous liquid, was subjected to distillation at different temperatures to obataion (CSPOD) a more or less colourless liquid. A preservative formulation was prepared by mixing different inorganic salts. With this formulation solid wood is treated using dip and pressure treatment where as plywood was treated by mixing the formulation via glue line treatment methods. The grave yard test conducted as per BIS stadardes at six locations of the country. Results reveled that CSPOD and its formulations are effective wood preservatives for soild wood but for panel product the compitability issues with resin was observed.

Keywords: Coconut Shell Pyrolytic Oil, preservative, solid wood, Plywood, resin system.

Enhancing Mechanical Properties of Aluminum Alloy 7050 with Glass Particle Reinforced Composites: A Stir Casting Approach

Yalew Tamene Tadegea, Tamiru Hailu Koria, Dawit Muluneh Yonaa, A. Johnson Santhosh
Faculty of Mechanical Engineering, Jimma Institute of Technology, Jimma University, Etihopia

Abstract

Aluminum-based reinforced composites have garnered significant attention owing to their superior mechanical properties. Various reinforcement forms, including continuous/discontinuous fibers, whiskers, or particles, have been explored, with micro-sized reinforcements heralding transformative advancements in composite materials. Customization of Aluminum Matrix Composites (AMCs) for automotive and diverse industrial applications hinges on adept combinations of matrix, reinforcement, and processing routes. This study delves into the mechanical properties of aluminum alloy 7050 reinforced with ceramic composites produced via the stir casting method, utilizing varying weight percentages (4%, 6%, and 8wt%) of 225 µm glass particles. Analysis of the mechanical properties of the fabricated aluminum matrix composites, encompassing hardness and tensile strength, was conducted. Results demonstrate notable improvements in these properties with increasing weight percentage of glass particulates in the aluminum matrix. Furthermore, the fabrication process achieved a uniform distribution of glass particles within the aluminum matrix, augmenting the material's hardness. Positive correlations between the weight percentage of glass particles and both ultimate tensile strength and yield strength underscore a reinforcing effect. XRD analysis substantiates the uniform dispersion of glass particles throughout the Metal Matrix Composite (MMC), corroborating the reinforcement mechanism and the resultant composite's strength.

Keywords: Aluminum matrix composites, Glass Particle, Stir casting method.

2D nanomaterials in plasmonic sensors for medical diagnosis

Pankaj Arora
Department of Electrical & Electronics Engineering, Birla Institute of Technology & Science Pilani, Rajasthan-333031, India

Abstract

Label-free sensing methods have become imperative in biosensing mainly due to the use of intrinsic properties such as refractive index or permittivity. Surface Plasmon Resonance (SPR) is a physical phenomenon that facilitates real-time detection at the nanometer scale. In this work, we present various SPR-based sensing devices in the near-infrared region and analyze the output performances in terms of higher sensitivity, Figure of Merit (FOM), and detection accuracy. To achieve the high-performance parameters, the proposed plasmonic sensors are engineered using the transfer matrix method and finite element method after a thorough investigation. The sensing parameters are studied in terms of the reflection characteristics of light. The entire analysis is based on the near-infrared spectral regime for non-invasive and non-destructive medical diagnosis. Biorecognition elements help to enhance the sensor's performance, for which 2D nanomaterials are explored for the biofunctionalization of the top surface. This way, the unique optical properties provided by Graphene, MoS2, MXene, Antimonene, etc., are investigated, thereby envisaging 2D nanomaterials for effective biosensing. The engineered plasmonic sensors, after incorporating 2D nanomaterials, are utilized for leptospirosis detection, DNA concentration detection, and malaria detection. According to the investigation's findings, the proposed biosensor numerically exhibits excellent performance in the NIR region, making it easier to employ in the field of biomedical sensing applications.

Keywords: Nanophotonics; plasmonics; 2D nanomaterials; optical sensors; medical diagnosis.

Performance of g-CN as novel synergist for halogen free flame retardant compositions

Dr. Shilpi Agarwal
Associate Professor, Department of Chemistry, School of Advanced Engineering, UPES (Bidholi), Dehradun, 248007, India

Abstract

Polymers are the integral part of our daily lives, finding applications in textiles, plastic containers, wiring, automotive parts, and packaging materials. Their diverse properties, including lightweight, high tensile strength, flexibility, durability, and inertness, make them indispensable across various industries. However, their high flammability poses a significant risk in the event of a fire, leading to the rapid combustion of polymers and the release of toxic gases such as CO and CO2, as well as smoke and intense heat. This poses a serious threat to lives and property worldwide, resulting in substantial damage each year.

Use of flame retardants are the possible solution to mitigate this risk by delaying the combustion process in polymers through various mechanisms, including the generation of non-flammable gases, the formation of a physical barrier, and the promotion of charring. Flame retardant polymers exhibit high Limiting Oxygen Index (LOI) and low heat release rates, which hinder the spread of fire and help minimize the extent of damage caused by combustion. These properties make flame retardant polymers essential for enhancing fire safety in a wide range of applications.

In the present work, nitrogen based graphitic carbon nitride (g-CN) synergist was developed for halogen free flame retardant blends for polypropylene. The synergist was prepared by using melamine by pyrolysis. It was then mixed with polypropylene in different amounts and then tested for the flame retardancy by heat release rate, LOI and UL-94. The material showed better polymeric properties along with showing better flame retardancy. In case of fire, GCN present in polypropylene forms excellent physical barrier through the formation of compact char layer. Also, it has good amount of nitrogen which evolves during combustion and dilute oxygen in surrounding, preventing the spread of fire.

Synthesis, Characterization and Computational Insights on Molecular Structure, Electronic Properties, and Chemical Reactivity of Pyrazoline Derivative: A Combined Experimental and Computational Approach

Sandip S. Pathade[1], Bapu S. Jagdale[2]

[1]Department of Chemistry, Mahatma Gandhi Vidyamandir's Maharaja Sayajirao Gaikwad Arts, Science and Commerce College, Malegaon, (Affiliated to Savitribai Phule Pune University, Pune), Nashik, Maharashtra, 423 105, India

[2]Department of Chemistry, Mahatma Gandhi Vidyamandir's Loknete Vyankatrao Hiray Arts, Science and Commerce College Panchavati, Nashik (Affiliated to Savitribai Phule Pune University, Pune) Maharashtra, 422 003, India

Abstract

In the present work, we reported a combined experimental and computational study on the molecular structure, vibrational spectra, and FMO analysis of 5-(2,4-dichlorophenyl)-3-(4- fluorophenyl)-1-phenyl-4,5-dihydro-1H-pyrazole (DFPDP). The DFPDP was synthesized by the condensation of a corresponding chalcone intermediate with phenyl hydrazine in an alkaline medium. The synthesized compound was characterized using FT-IR, ^{1}H NMR, ^{13}C NMR, and mass spectroscopic techniques. The density functional theoretical (DFT) computations were performed using the Gaussian-03(W) package at the B3LYP level with the basis sets 6-31G(d,p) and 6-311++G(d,p) to derive the optimized geometry and vibrational wavenumbers with IR intensities of DFPDP. In addition, molecular orbital calculations such as the HOMO-LUMO energy gap and mapped molecular electrostatic potential (MEP) surfaces were also performed with the same level of DFT. The various thermochemical and global reactivity parameters were also evaluated to explore the reactivity of the synthesized compound. The UV-visible spectrum and vibrational frequencies of the synthesized compound were analyzed and compared with the corresponding experimental data. The results revealed a good correlation between the experimental and computed data.

Keywords: FMO, FTIR, DFT, Gaussian, MEP.

Structural and luminescence behavior of Tb^{3+} doped Alumino silicate phosphor

Tripti Richhariya[1], Nameeta Brahme[2]
[1]Department of Physics, Kalinga University, Raipur, C. G. India-492101
[2]SoS in Physics and Astrophysics, Pt. Ravishankar Shukla University, Raipur C. G. India 492010

Abstract

In the present scenario the need of smart lighting has been increases day by day not only for lighting purpose, but also in various fields. The other fields, which involve the smart lighting techniques are indoor farming, back lighting source, and somehow in forensic investigation also; like analysing fingerprint and anti-counterfeiting. However to fulfil all these requirements, the most important thing is the search of efficient phosphor, as nowadays phosphor converted LEDs gain lots of attention. In this context, alumino silicate phosphor plays a crucial role in lighting technology (pc-LEDs) due to their ease of synthesis, availability in abundance, high thermal and chemical stability as well as excellent water resistant property. Alumino silicate phosphor when doped with suitable host may act as a superior candidate for pc-LEDs.

Keeping this in mind, the first half of this talk deals with the general introduction about the phenomenon of luminescence and their applications in various fields. Further move to the synthesis and characterization of trivalent Terbium doped barium alumino silicate phosphor. The synthesis of phosphors are done by the conventional solid-state reaction method and x-ray diffraction tool is employed to analyse the phase of synthesized phosphors. Photoluminescence and afterglow properties are also discussed in detail. At last based on the obtained results, possible applications of synthesized phosphors are interpreted.

Keywords: pc-LEDs, alumino-silicate, XRD, indoor farming, anti-counterfeiting.

Love wave propagation in layered piezoelectric structures for sensor based applications

Sayantan Guha
Centre for Data Science, Institute of Technical Education and Research, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar-751030, Odisha, India

Abstract

Piezoelectric materials are a special type of "smart" material with mechanical-electrical energy conversion properties, which are commercially harnessed in several branches of science and engineering, like ultrasonic detectors, NDT/NDE, sensors, actuators, transducers, Surface Acoustic Wave (SAW) devices, Love wave sensors, etc. The versatility of these applications make an in-depth analysis of the internal characteristics of piezoelectric materials quintessential. This acts as a prime source of motivation to perform the present analysis, where the transference of Love wave in a layered structure comprising a piezoelectric layer overlying a piezoelectric half-space is the main point of focus, keeping Love wave sensors, among other applications, in mind. Starting with the governing equations of the system, which involves highly coupled partial differential equations, the closed-form expressions of the dispersion relations for electrically open and electrically short cases are eventually obtained analytically using admissible boundary conditions assumed at the free surface of the layer, as well as the interface of the layer and the half-space. Numerical computations and graphical illustrations are performed to observe the nature of the dispersion curves when different combinations of piezoelectric materials are considered for the layer and the half-space, e.g., PZT-2, PZT-4, PZT-5A, PZT-5H, CdSe, $BaTiO_3$, etc. The present work is validated by matching the obtained results with those found in the existing literature.

Keywords: Piezoelectricity; Love wave; Electrically Open/Short; Dispersion relation; Love wave sensor.

Polymer based smart nanoassemblies for cancer cell selective durg delivery applications

Arun Mondal, Mijanur Rahaman Molla
Department of Chemistry, University of Calcutta, Kolkata, India-700009

Abstract

A dynamic covalent poly(disulfide)s based cross-linked nanoassemblies endowed with pH and redox responsive degradation features has been prepared for stable non-covalent encapsulation and triggered guest release in a controlled manner. The bio-derived lipoic acid based amphiphile self-assembles by entropy driven self-assembly process in aqueous solution. To further stabilize the self-assembled nano assembly, the core was cross-linked by ring opening polymerization of lipoic acid attached with the amphiphilic molecule. The cross-linked nanoassembly is found to be stable in blood serum and also it maintains self-assembled structure even below its critical micellar concentration (CMC) as demonstrated by DLS experiments. The cross-linked polymeric nanoassemblies showed significant reduction in guest leakage compared to uncross-linked one as shown by release profile in absence of stimuli, indicating high encapsulation stability as evidenced by FRET experiment. The biological evaluation revealed that doxorubicin loaded cross-linked nanoassemblies (CNs-DOX) are nontoxic to normal cells, but in contrast, showed a robust apoptotic effect on cancer cells indicating excellent specificity. Thus, the fabrication reproducibility, robust stability, triggered drug release and cell selective toxicity behaviour makes this cross-linked polymeric system very promising in the field of chemotherapeutic applications. The details synthesis, self assembly, fabrication and biological evaluation will be the topic of the presentation.

Keywords: Cross-linked polymer, self-assembly, drug stabilization, triggered release, cancer cell selectivity.

Structural, morphological, dielectric and conducting properties of ZnO nanoparticles

A. G. Varshan, Anurag Yadav, Silu Nayak, Swathi Gopal, Pounraj Thanasekaran
Department of Chemistry, Pondicherry University, Puducherry 605 014, India

Abstract

Metal oxide semiconductors (MOS) are crucial in both academic and industry communities because of their unique properties that are associated with electrical, optical, mechanical, magnetic and electrochromic characteristics. In this study, we demonstrated the structural, optical, dielectric and conducting properties of zinc oxide nanoparticles (ZnO NPs) synthesized by a simple co-precipitation technique. The obtained samples were characterized by the FTIR, powder XRD, XPS and UV-vis spectral techniques. The morphological analysis as observed by field emission scanning electron microscopy, (FESEM) and transmission electron microscopy (TEM) confirmed the presence of nano-sized particles. UV-vis absorption spectrum of ZnO NPs showed an optical band gap of ∼3.16 eV. From impedance spectroscopy analysis, ZnO nanoparticles revealed that the dielectric constant (~50) remained almost stable with the dielectric loss of 0.1 at high frequencies ($>10^5$ Hz) owing to field rotation polarization and space charge. Both dielectric constant and dielectric loss of ZnO NPs indicated decreasing behavior with frequency due to the formation of boundaries between ZnO NPs. It also showed an AC conductivity of 10^{-7}–10^{-6} S/cm, which is slightly increasing at variable applied frequencies, indicating the presence of more charge carriers that are contributing to conduction process due to an increase of the absorbed energy. These important dielectric and conductivity findings obtained for the ZnO NPs make it interesting material for potential use in low-frequency devices such as UV photodetectors, optoelectronics, and spintronics.

Keywords: Conductivity, dielectric, morphology, structure, zinc oxide nanoparticles.

An effective way to generate cost-effective electrocatalysts for environmental remediation

Umesh Kumar
Catalysis and Bioinorganic Research Lab, Department of Chemistry, Deshbandhu College, University of Delhi, New Delhi-110019, India

Abstract

Fabricating cost-effective electrocatalysts in place of expensive catalyst is the always challenge for chemist. Hence herein, we have tried to design the novel molecules and materials using cost-effective metal precursors. In this regard, we synthesized and structurally characterized a novel cobalt (II) acetate complex [(3,5-Lutidine)$_2$Co(OAc)$_2$(H$_2$O)$_2$] as a promising electrocatalyst for oxygen evolution reaction (OER). It was implied that the coordinating Lewis base will provide coordination flexibility and electron rich environment around the metal center to facilitate the catalytic reaction in effective manner. The results indicates that the as synthesized cobalt complex shows even better OER activity than the state-of-the-art IrO_2 catalyst in terms of turnover frequency (TOF: 0.05) and onset potential (1.50 V vs RHE) under identical conditions. On the other hand we synthesis of a Ni(II) complex [(L)$_2$Ni(NCS)$_2$] as a single source precursor to obtain nickel sulfide nanoparticles (NiS NPs). To improve the electrocatalytic performance and durability, the functionalized multi-walled carbon nanotubes (f-MWCNTs) were used as a support material for Ni complex. The Ni complex-CNTs hybrid revealed in NiS-CNT nanocomposite after annealing at 350 °C. The comparison of OER performance in terms of their η_{10} values was found to follow the order: Ni-complex<NiS<IrO_2<Ni-complex-CNT hybrid<NiS-CNT. This study endeavors to illuminate the promising potential of these innovative results, presenting them as a more efficacious alternative and paving the effective way to generate cost-effective electrocatalysts in advancing environmental remediation.

Keywords: Cost-effective, Electrocatalysts, Cobalt(II), Nickel(II), Environmental remediation.

Portable and affordable paper-based analytical device for on-site detection of perchlorate in contaminated water

Ashish Kapoor[1], Muthukumar Raghunathan[2], Praveen Kumar[2], Dan Bahadur Pal[1]

[1]Department of Chemical Engineering, Harcourt Butler Technical University, Kanpur, Uttar Pradesh 208002, India

[2]Department of Biotechnology, School of Bioengineering, SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu 603203, India

Abstract

The development of portable and affordable analytical devices is crucial for the on-site detection of environmental contaminants. This study presents a novel paper-based analytical device (PAD) designed for the rapid, sensitive, and cost-effective detection of perchlorate in contaminated water. Perchlorate, a widespread environmental pollutant, poses significant health risks, necessitating timely and accurate monitoring. The PAD utilizes a colorimetric assay based on the reaction of perchlorate with a specific reagent, producing a visible color change that can be quantitatively measured using a smartphone-based imaging system. The device was fabricated using wax printing technology, creating hydrophobic barriers on paper substrates to define microfluidic channels. The PAD demonstrated a detection limit of 3.4 µg/L for perchlorate, with a short response time of less than 5 minutes. Validation against standard laboratory methods showed a high correlation, indicating the reliability of the proposed device. The simplicity, portability, and low cost of the PAD make it an ideal tool for environmental monitoring, particularly in resource-limited settings. This innovation has the potential to significantly enhance the capability for on-site water quality assessment, contributing to improved public health and environmental protection.

Keywords: Paper-based, analytical device, microfluidics, perchlorate, environmental monitoring.

A novel approach to synthesize nultifunctional nanopigments

Neeraj Kumari
School of Basic and Applied Sciences, K R Mangalam University, Gurugram, India

Abstract

The main aim of this study is to examine how non-biodegradable toxic dyes, Crystal Violet (CV) and Indigo Carmine (IC), interact with naturally occurring clay minerals like Montmorillonite (Mt) and their organically modified forms (organo Montmorillonite (OMt)) in batch extraction mode. The goal is to develop a new method for synthesizing value-added clay-based nanopigments without generating secondary waste. During the extraction process, it was found that CV is more readily absorbed by pristine Mt, while IC is more effectively absorbed by OMt. CV was located both in the interlayer region and on the surface of Mt, as supported by XRD data and zeta potential values, which ranged from -17.6mV to -9.42mV. For organo Mt, CV was found only on the surface. The increased particle size of both pristine and organo clays further confirmed the presence of CV. IC, on the other hand, was found only on the surface of both pristine and organo clays, with no change in interlayer spacing of organo Mt. This surface interaction of IC was further verified through zeta potential and particle size measurements. After extracting CV/ IC from aqueous media, the resulting solid residues were intensely violet (CV-treated pristine and organo Mt) and blue (IC-treated pristine and organo Mt) and are referred to as clay-based nanopigments. These nanopigments were used as colorants in a Poly(methylmeth acrylate) (PMMA) polymer matrix to create transparent polymer films. In these films, the nanopigments served a dual role: acting as reinforcement fillers to enhance various physico-chemical properties and as coloring agents to provide attractive bright colors to the polymer matrix.

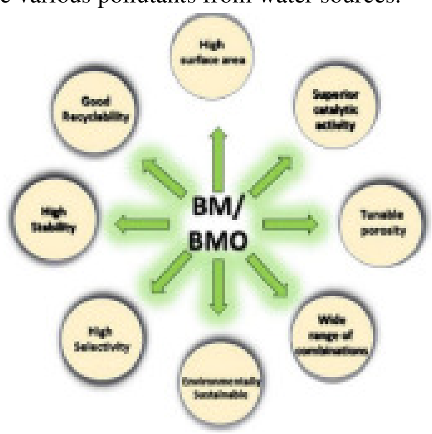
Keywords: Clay, Nanopigment, Crystal Violet, Indigo carmine, Polymer.

Advancing UN Sustainable Development Goals through Bimetallic Oxide Catalysis

Dr. Bharat Kumar Allam
Department of Chemistry, Faculty of Basic Sciences, Rajiv Gandhi University (A Central University), Rono Hills, Doimukh, Arunachal Pradesh, India

Abstract

The global shortage of clean drinking water is a pressing concern in numerous regions, stemming from factors such as rapid population growth, contamination of water sources, prolonged droughts, and increased flooding attributed to climate change and human activities. We must prioritize scientific research to create effective water purification and recycling materials. Traditional wastewater treatment methods have proven insufficient in meeting the rising demand for safe and potable water, especially considering the stringent health standards set by organizations like the World Health Organization (WHO) and the United States Environmental Protection Agency (USEPA) regarding permissible levels of contaminants in drinking water. Fortunately, the advent of affordable multifunctional nanomaterials has ushered in a new era of highly efficient wastewater treatment. One notable advancement in this field is the development of bimetallic nanomaterials, which combine two distinct metals. These bimetallic materials outperform their parent metal components due to their wide range of chemical and physical properties, synergistic effects, and diverse mechanisms of action. In the present talk, I would like to delve into some of our recent research endeavours concerning the synthesis and applications of bimetallic nanomaterials to remove various pollutants from water sources.[1–3]



References:

1. Allam, B. K.*, Musa, N., Debnath, A., Usman, U. L., & Banerjee, S.* (2021). Environmental Challenges, 5, 100405.
2. Usman, U. L., Allam, B. K.*, Singh, N. B., & Banerjee, S.* (2022). Journal of Molecular Liquids, 354, 118833.
3. Musa, N.[†], Allam, B. K.[†], Singh, N. B., & Banerjee, S.* (2023). Environmental Pollution, 328, 121639.
4. Musa, N., Allam, B. K.*, Sajad, S., Singh, N. B., & Banerjee, S.* (2023). Groundwater for Sustainable Development, 23, 101034.
5. Usman, U. L., Allam, B. K.*, Sajad, S., Singh, N. B., & Banerjee, S.* (2024). Nano-Structures & Nano-Objects, 37, 101072.

Sequence-Specific Relay Recognition of Multiple Anions: An Interplay between Proton Donors and Acceptors

Dr. Nilanjan Deya
Birla Institute of Technology and Science Pilani, Hyderabad 500078, India

Abstract

Detecting hydrogen sulfate (HSO_4^-) in water is crucial due to its role in environmental pollution, where high concentrations can lead to acidification of water bodies, adversely affecting aquatic life and water quality. Considering this, herein, we have synthesized donor-acceptor based fluorogenic probes with pyridine unit at terminal position have been synthesized. The compounds form pH-sensitive nanoscopic aggregates in the aqueous medium. The addition of HSO4- leads to shifting of both absorption and emission maxima to the longer wavelength region. The mechanistic investigations indicate the hydrogen bonding interaction of HSO_4^- ions with the pyridine nitrogen end, which can effectively alter the extent of charge transfer. Moreover, the hydrogen bonded adduct formed upon interaction with HSO_4^- resulted in aggregates with larger dimension. Further, the adduct was utilized for sequence-specific detection of fluoride ion. Since fluoride is a strong hydrogen bond or proton acceptor and bisulfate is a hydrogen bond or proton donor, hydrogen bonding and proton transfer have a vital role in the dual anions detection. The mechanism of interaction was established by various spectroscopic studies and DFT based computational investigations. Further, the applications of the chemosensors in the detection of F^- and HSO_4^- anions in real samples have thoroughly been emphasized.

Keywords: Multiple anions; Relay recognition; Dual-mode sensing; Charge transfer probe; Hydrogen bonding.

References:

1. S. Paul, M. Karar, and N. Dey,* Sequence Specific Optical Recognition of Dual Anions, Fluoride and Bisulfate Ions: An Update, J Mol Liq., 2024, 394, 123524
2. R. S. Fernandes and N. Dey*, A Combinatorial Effect of TICT and AIE on Bisulfate Detection using a Pyrenylated Charge-Transfer Luminogen, Mater. Res. Bull., 2023, 163, 112192
3. S. Paul, R. S Fernandes, and N. Dey*, Ppb-Level, Dual Channel Sensing of Cyanide and Bisulfate Ions in Aqueous Medium: Computational Rationalization of Ion-Dependent ICT Mechanism. New J. Chem., 2022, 46, 18973-18983
4. R. S. Fernandes, S. Pal, and N. Dey*, Sequence-Specific Relay Recognition of Multiple Anions: An Interplay between Proton Donors and Acceptors, ChemPhysChem., 2023, 24, e202300434

Development of novel pectin-based biofilms as food packaging materials

Bindya S[1], Shambu B S[1], Rajeshwari K M[1], Hemavathi A B[2]
[1]Department of Chemistry, JSS Science and Technology University, Mysuru, India
[2]Department of Polymer Science and Technology, JSS Science and Technology University, Mysuru, India

Abstract

In recent years, there has been a significant drive to switch from non-renewable resources to ecologically favourable renewable materials. A similar attempt was made in the current work to substitute food packaging films made of synthetic polymers with films composed of renewable materials derived from trash. The films for pectin, alginate, P/SA, and P/SA/O were produced and analysed in order to ascertain their suitability for packaging. Films composed of sodium alginate and pectin were casted using calcium chloride as crosslinker in order to improve their functionality and glycerol as a plasticizer. Essential oil sample was incorporated into the polymer blend matrix to increase the mechanical strength and thermal stability of films.

Biofilms were characterized by different spectral techniques to confirm the composition and morphology of the films. The mechanical properties of the films were measured to to assess the prepared films' appropriateness for the intended use. The biodegradation studies of prepared films revealed that, the films will decompose under ambient settings over an appreciable amount of time, suggesting that they would be a preferable choice for edible coatings and ecologically friendly food packaging.

Keywords: Pectin, Sodium alginate, Essential oil, Food packaging, Edible coating.

Composite Materials for Environment Protection & Remediation

Dr. Nirmala B, Soundaraya T.L
Department of Studies and Research in Chemistry, Tumkur University, Tumakuru-572 103, Karnataka, India

Abstract

Composite materials have emerged as promising solutions for addressing environmental challenges and remediating contaminated sites. This abstract explores the recent applications, advancements, and potential of nanocomposite materials in addressing environmental challenges. By integrating nanoscale components into composite structures, nanocomposites offer enhanced reactivity, selectivity, and efficiency in tackling various environmental issues. The abstract highlights the synthesis methodologies, characterization techniques, and performance evaluation of nanocomposite materials such as CeO2-NiO, CuO-ZnO, Bi2O3- BiFeO3, and metal-ion-doped SnO2 tailored for environmental applications such as pollutant removal from water. The synthesis methods discussed encompass techniques that minimize the use of hazardous chemicals and energy-intensive processes, thus reducing the environmental footprint of material production. Through the integration of green synthesis principles, composite materials offer sustainable solutions for environmental protection and remediation, contributing to a cleaner and healthier world. Hence, an overview of the green synthesis approaches employed in developing composite materials to address environmental challenges was presented. These nanocomposites have been studied for their photocatalytic activity in degrading organic pollutants. The key factors influencing the performance of composite materials, such as size, composition, morphology, surface chemistry, and interactions with contaminants, were studied using various parameters and identifying the reaction intermediates during the reactions. Through case studies and examples, the study showcases the promising potential of nanocomposite materials to address emerging environmental challenges and promote sustainability. Finally, future directions and challenges in developing and deploying composite materials for environmental protection and remediation are discussed, emphasizing the importance of interdisciplinary research and technological innovation in addressing pressing environmental concerns.

Keywords: Xomposite materials, environmental protection, pollutants, methods for pollution control, photocatalytic materials.

A comprehensive review on properties and applications of cationic polymers

Shagufta Jabin
School of Engineering and Technology, Manav Rachna International Institute of Research & Studies, Faridabad, Haryana, India

Abstract

The humankind firmly depend upon ecological and environmental sustainability. However, ecological sustainability depend upon pure water, air and soil. Despite the great effort, world is facing challenges with respect to water pollution. Apart from the aesthetic problems of colour, taste and odour, suspended particles pose a health hazard. Such materials need to be removed from water because they provide a surface on which microbes can be adsorbed and protected from disinfection chemicals by a coating of slime. These kinds of contaminants need to be removed from water by using sustainable materials. In conventional method, metal coagulants are utilized for water treatment. But inorganic coagulants generate lots of sludge and to dispose sludge becomes challenging task. So organic polymers can be used successfully for treatment of water. Ionic polymers are more successfully applied in water treatment as compared to non-ionic polymers. Between both anionic and cationic, cationic polymers have been used more successfully as an efficient material for water treatment. This review will include characteristics of cationic polymers and its diverse applications in the field of water treatment.

Keywords: Inorganic coagulants, cationic polymers, contaminants, suspended particles.

Promising lignin nanofibers-based materials for environmental applications

Vinay Kumar
Biomaterials & Tissue Engineering (BITE) Laboratory, Department of Community Medicine, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, Thandalam-602105, India

Abstract
The quest for sustainable production of ecofriendly biopolymers with multifarious applications has witnessed an accelerating trend in the past few decades due to the growing concern over energy and environment sustainability. Lignin, being the most abundant aromatic biopolymer on earth offers the possibility of tailoring it into fit various forms based on the application arena. Lignin nanofiber production and application has gained tremendous research focus due to their extensive use in several areas including environmental and medical applications. Lignin as a substrate for nanofiber production has a greater impact on nanomaterial field due to their improved functional properties. The present study focuses majorly on the chemistry and types of lignin, lignin extraction and characterization techniques. Further, a detailed description of the recent methods used for the nanofiber preparation is included. Finally, the study critically discusses the application of lignin nanofibers for various environmental applications along with the challenges for lignin nanofiber commercialization.

Keywords: Lignin, nanofiber, biopolymer, environment, characterization, challenges.

Effect of variation in synthesis temperature on corrosion resistant characteristics of poly(aniline-co-o-toluidine) coatings

Pritee Raotole[1], Sandip Patil[1], Amol Manke[2], Vishnu Huse[1], Abhijit Joshi[3]
[1]MGSM's Dadasaheb Dr. Suresh G. Patil College, Chopda 425 107, Maharashtra, INDIA
[2]A. P. Manake Pratap college Amalner, Maharashtra, INDIA
[3]CP.R.H.S.S. Arts, Commerce and Science College, Dharangaon Dist.Jalgaon, Maharashtra, INDIA

Abstract

The poly(aniline-co-o-toluidine) coatings were synthesized at synthesis temperature 0^0C, 15^0C room temperature (RT), 40^0C and 60^0C on low carbon steel substrates by electrochemical copolymerization of aniline with o–toluidine using sodium tartrate as supporting electrolyte. During synthesis these coatings were characterized by cyclic voltammetry. The corrosion resistant characteristics of poly(aniline-co-o-toluidine) coatings against corrosion of low carbon steel synthesized by keeping the feed ratio 50:50 of aniline and o–toluidine respectively was investigated in aqueous 3% NaCl solution by potentiodynamic polarization technique. The results of the potentiodynamic polarization measurements show that the poly(aniline-co-o-toluidine) coatings synthesized at RT provides the effective corrosion resistant characteristics than that of 0^0C, 15^0C, 40^0C and 60^0C against the corrosion of low carbon steel.

Keywords: Synthesis temperature, Copolymer coatings, Poly(aniline-co-o-toluidine), Corrosion, Cyclic voltammetry, Low carbon steel, potentiodynamic polaraization.

Computation of Key Analog Circuit Parameters Employing Different Topological Configuration of Current Mirror Circuits: A Comprehensive Analysis of Gain, Noise, and Power Consumption

Indranil Maity[1], Aheli Majumdar[2], Jayati Karmakar[2]
[1]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM), Kolkata, University of Engineering and Management (UEM), Kolkata, India
[2]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM), Kolkata, India

Abstract

Cascode current mirrors simplify the designing of complex analog circuits with an aim to maximize the vital performance metrics, considered into the simulation. The present paper focuses on designing of three cascode current mirror circuits with a 5V DC supply voltage to attain notable AC gain values. The entire simulations were performed in Cadence Virtuoso with a 90 nm technology library. Here, we considered three different cases of cascode current mirror circuits viz. (a) Case 1: Differential pair with active current mirror having 5V input voltage, which produced gain of 8.76 dB, power of 509.6 pW, and noise power spectral density (PSD) of 0.97 $\mu V^2/Hz$, followed by (b) Case 2: Differential pair with active current mirror having 1.5V input voltage, which developed gain of 14.98 dB, power of 509.6 pW and noise PSD of 24.58 $\mu V^2/Hz$, and finally, (c) Case 3: Unity gain buffer circuit, which generated the aforementioned parameters as 0.37 dB, 36820 pW and 31.70 $\mu V^2/Hz$, respectively. Different parametric simulations were conducted such as AC analysis to calculate the gain, noise analysis, and the computation of power consumption in the ADE L environment. Additionally, statistical simulation (DC analysis) was also performed to observe the circuit's characteristic outputs. Comparison of the results indicated that the second circuit configuration (Case 2) attained the highest AC gain (14.98 dB), followed by the first, and third configurations. Moreover, the first and second circuit configurations demonstrated the lowest power consumption (509.6 pW). Furthermore, the first configuration (Case 1) also exhibited the lowest noise PSD, indicating minimal distortion compared to others.

Keywords: Cascode current mirror, Noise PSD, Gain, Power consumption, Cadence Virtuoso.

A Comparative Study on Formaldehyde Detection Capabilities in Pristine Graphene and Ag-Doped Graphene Sheet

Indranil Maity[1], Souvik Bhanja[2], Soubarno Chatterjee[2]
[1]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM-K), University of Engineering and Management (UEM-K), Kolkata, West Bengal, India
[2]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM-K), Kolkata, West Bengal, India

Abstract

The present work concerns a detailed investigation of the enhanced formaldehyde (also known as methanal) detection by decorating the pristine (or bare) graphene nanosheet with silver (Ag) nano-particle (or foreign Ag atom). The bare graphene sheet was exposed to the formaldehyde vapor forming the formaldehyde-adsorbed pristine graphene sheet (taken as Case-I), and whose results were studied and compared with the outcomes obtained from the formaldehyde adsorbed Ag-decorated graphene sheet (taken as Case-II). The optimized structure of the systems were derived through the density functional theory (DFT) study, which was performed on the Gaussian 09W (for calculation purposes) and GaussView 6.0 (for visualization purposes) platforms. The highest occupied molecular orbital (HOMO), and lowest unoccupied molecular orbital (LUMO) have been analyzed along with their corresponding energy values to find the HOMO-LUMO gap for both Case-I, and Case-II. Adsorption energy was found to be stronger upon the introduction of Ag atom as a dopant into the graphene sheet. The charge density of the systems in Case-I and Case-II were revealed from the electrostatic potential (ESP) map, which provided information about the electron richness or deficiency of the surfaces. The Mulliken charge analysis was also performed, which has an influence on the dipole moment and polarizability of the structures, which in turn have a relation with the interaction energy between the adsorbent and adsorbate. The density of states (DOS) spectrum calculated from the GaussSum 3.0 software provided an insight into the semi-metallic nature of both Case-I and Case-II structures. It was noticed that the binding distance between the formaldehyde and the graphene sheet got shortened in the case of Ag decorated graphene. The above observations clearly infer that Ag-decorated graphene is a better alternative to pristine graphene for formaldehyde detection.

Keywords: Ag-decorated graphene; Formaldehyde detection; Adsorption Energy; Mulliken Charge; DOS; ESP.

Surface Plasmon Assisted Wave Theory Based Delineation in Multilayered Structure Using Gold Nanolayer with Graphene: An Approach towards Bio-sensing Applications

Nabamita Goswami[1], Samhita Das[2], Ardhendu Saha[3], Kanard Kumar[4]
Department of Electrical Engineering, National Institute of technology Agartala, India

Abstract

Analytical description of the surface plasmon enhanced wave theory based refractive index detection for bio sensing applications, using a multilayered structure comprising ZnO, Au, MoS_2 and graphene nano-layers at 632 nm wavelength. Here the Au layer is responsible for the creation of the surface plasmon resonance and the graphene layer is for proper detection of the analyte with exact change of refractive indices. Alteration of the refractive index of the outer layer, results the alteration in the resonance angle with the proposed multilayered configuration. The biomolecules acts as the outer layer of the configuration and the refractive index changes from 1.33 to 1.45, for which the resonance angle varies from 57.7º to 69.8º and the discerned sensitivity is 85º/RIU. For better correlation between the experimental results and the analytical solutions, wave theory based approach has been adapted here. Thus with high sensitivity and better performance, the biomolecule layer has been detected for different concentrations, which expedites the new avenues in the field of biosensors and other industrial applications.

Keywords: Surface plasmon resonance, Wave theory, Ray theory, Biomolecules, Nano structure.

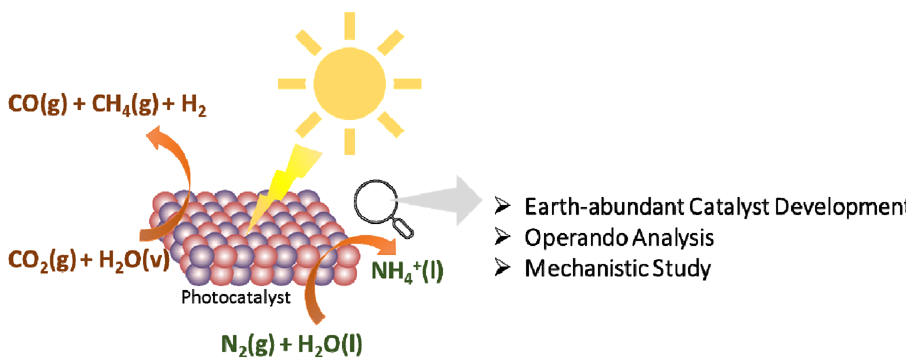
Photocatalytic CO_2 reduction and N_2 fixation for Solar Fuel Production

Niwesh Ojha
Department of Chemical Engineering, Indian Institute of Technology Roorkee, Uttarakhand-247667, India

Abstract

Solar energy is an inexhaustible, clean, and renewable natural resource, with the sunlight incident on the Earth's surface surpassing the annual global energy consumption within just one hour. Yet, the efficient utilisation of this energy is contingent upon variations in sunlight intensity dictated by geographical location, seasons, and time of day, necessitating effective conversion and eco-friendly storage methods. Within this context, photocatalytic CO_2 reduction and N_2 fixation to synthesise value-added chemicals emerge as pivotal processes, offering a sustainable pathway for solar fuel production and a means to reduce our dependence on fossil fuels. This presentation delves into the intricate concepts, strategic methodologies, and thermodynamic principles in converting CO_2 and N_2. It highlights the pivotal role of nanostructured photocatalysts in a tri-phase photocatalyst system led the process to be controlled by mass transport, which governed the product distribution and limited the kinetics of the process. Experimental results also unveil that adding transition metals improved the resulting photocatalysts' stability, charge separation, and efficiency.

The discussion primarily focuses on the sophisticated technique of Diffuse Reflectance Infrared Fourier Transform Spectroscopy (DRIFTS). These in-situ analyses are invaluable tools for elucidating the intricate charge transfer mechanisms. Moreover, it extends to comprehensive spectrometry analysis, providing a panoramic view of solar-to-fuel experiments and offering insights into the critical properties influencing product yield. It highlights the potential of solar energy storage in chemical bonds and the scope for future photoreactor advancement.



Keywords: CO_2 reduction, operando studies, green ammonia production, Photocatalysis.

Influence of environment friendly solvents and polymers upon the chemical and surface properties surface active agents for their industrial applications

Ashwani Kumar Sood
Associate Professor, Department of Chemistry, Guru Nanak Dev University, Amritsar-143005, India

Abstract
The chemical, micellar and surface characteristics of Surface-Active Agents (surfactants) are considerably significant due to their applications in industrial, pharmaceutical, drug delivery and largely rely on the solvent system in which they are utilized. Therefore, various additives as well as solvents, polymers are incorporated to the surfactant preparations to improve their surface features. Addition of solvents to the surfactant solutions bring out many changes in the micellar behaviour, which mainly occurs due to some modifications in the solvent structure and surfactant aggregates. The development of micelle mostly relies on the hydrophobic nature of surfactants as well as solvent. Due to this, it is very significant to analyze the role played by solvent media in order to figure out the micellization phenomenon. The unremitting interest in mixed surfactants also stems from their tendency to efficiently solubilize hydrophobic compounds. This property is due to their synergistic behavior and has been exploited in numerous industrial applications to optimize performance, minimize the surfactant requirement, and minimize the consequent negative impact on the environment. These mixtures are, therefore, being widely used in cleansing formulations, in synthesis of nanostructure materials and pharmaceutics, etc. In view of their enormous fundamental and commercial importance, the study of mixed surfactant systems has become a topic of pursuit for scientists.

Keywords: surfactant; Critical micelle concentration; co-solvents; micellar parameters.

Investigate the light-harvesting properties of organic dyes as an alternative to inorganic materials for reaching net zero by 2050

Kapil Dev Mahato
Department of Physics, Jamshedpur Women's University, Jamshedpur, Jharkhand 831001, India

Abstract

Researchers have found that fluorescent organic dyes can be an alternative option to inorganic materials due to their higher biodegradability, quantum yields, photostability, and lower toxicity in various engineering and medical applications. To avoid calamitous climate impacts, it is recommended that global net human-caused carbon dioxide (CO_2) emissions be reduced by 45% from 2010 levels by 2030 and that net zero emissions be achieved by 2050 in alignment with the Paris Agreement. To achieve the net zero emissions goal by 2050, investigate the light harvesting properties of two different donor-acceptor pairs (Rh-110/Rh-6G and Rh-19/Rh-B) through fluorescence resonance energy transfer (FRET) in a sol-gel medium. The sol-gel method helps maintain the orientations and spacing of the organic dye molecules, promoting rigid structure, high quantum yield, small Stokes shift, and efficient light-harvesting energy transfer. Furthermore, Homo-FRET donor dye molecules can improve energy transfer by increasing the total number of donor molecules within the system. The light-harvesting properties are also influenced by the donor-acceptor concentration ratio and the critical energy transfer distance (R_0). Looking ahead, machine learning techniques can aid in identifying suitable donor-acceptor molecules for light-harvesting properties from publicly available databases. This approach can help researchers save costs and time and reduce multitudinous attempts to discover new fluorescent organic dye materials for light harvesting.

Keywords: Net zero carbon, Organic dye, Light-harvesting, Sol-gel, FRET, Machine learning.

MOF Based Triboelectric Nanogenerator for Powering Electronics

Rojalin Sahu
School of Applied Sciences, Kalinga Institute of Industrial Technology (KIIT), Deemed to be University, Bhubaneswar -751024, India

Abstract

Harnessing mechanical energy from the surroundings shows significant promise as a power supply for micro and nanoscale devices. The triboelectric nanogenerator (TENG) operates based on the principles of triboelectrification and electrostatic induction. Metals and polymers have mostly dominated the conventional triboelectric series, but there is a need for novel materials to expand this series and enhance the TENG performance. Herein, we have synthesized a zeolitic imidazole framework (ZIF-67) via a room temperature solvent-assisted method and analyzed its structural and chemical properties. A simple vertical contact mode S-shaped TENG device was fabricated with the help of additive manufacturing process. Here, ZIF-67 served as the positive triboelectric layer, while Teflon/PDMS served as the negative triboelectric layer. The multi-unit S-TENG device was used for self-powered recognition of different gaits through digital signal processing. The device based on ZIF-67 and Teflon produced a voltage of 118 V, a current of 1.7 mA, and a power density of 15 mW cm^2 at a load resistance of 50 MΩ. By capturing the gait patterns of diverse volunteers, the S-TENG device assisted in accurately identifying various gaits to mitigate the risk of falls and injuries, particularly among children wearing flip flops equipped with the S-TENG technology while playing in a park. Furthermore, it was employed to charge a commercial capacitor to power a wristwatch and was attached to a robotic gripper for object identification.

Keywords: Metal organic framework, Triboelectric nanogenerator, Power Source, Solvothermal.

Resonance enhanced polaron interaction in magnetoactive $A^{III}B^{V}$ and $A^{II}B^{VI}$ type semiconductor plasmas

Jaivir Singh
Associate Professor, Department of Physics
J.V.M.G.R.R. College, Charkhi Dadri – 127306, Haryana, India

Abstract

Most realistic propagation of an intense hybrid pump wave in a magnetized semiconductor plasma has been considered to study some aspects of electron-LO phonon interactions. Hydrodynamic model for one component plasma along with coupled mode theory has been used to study parametric amplification due to polaron mode. Expressions for parametric gain coefficient arising due to parametric instability and threshold field required to incite parametric amplification has been derived. The $A^{III}B^{V}$and $A^{II}B^{VI}$ type compound semiconductors are unique within the universe of simple octet compounds, enable them to dominate higher performance electronics and optoelectronics. Present study aims to compare materials for which favourable magnitudes of parametric gain and threshold value could be obtained with suitable values of external parameters. Numerical estimations were carried out using the data of two different group compound semiconductors namely ZnSe and GaAs. Both the gain coefficients and threshold pump field are found to be strongly dependent on the carrier concentration of the medium. Resonance between plasma frequency and collective excitation frequency affects the process of amplification in both cases. Higher gain is achieved for GaAs which has smaller coupling coefficient as compared to ZnSe. Hybrid pump propagation is found to strengthen the electron-LO phonon coupling.

Keywords: Electron-phonon interaction; Resonance; Plasma wave; Semiconductor-plasmas.

Sustainable Synthesis and Optoelectronic Applications of Carbon Dots for Environmental and Water Remediation

Vikas Lahariya
Amity School of Applied Sciences, Amity University Haryana, Manesar, Gurugram, Haryana, India, 122413

Abstract

In recent years, there has been a significant surge in the demand for eco-friendly, bio-based smart materials due to their diverse applications and unique properties. Among them, carbon nano dots commonly known as carbon dots(CDs) stand out due to their exceptional properties and wide-ranging applications, particularly in the field of optoelectronics and luminescence. These dots possess unique properties such as high photostability, non-toxicity, water-solubility, biocompatibility, and fluorescence in visible region of spectrum, make them highly attractive for scientific research, especially in the realm of fluorometric and colorimetric sensing and photocatalytic. This study explores a sustainable approach to the synthesis of CDs, emphasizing the utilization of green precursors, bio-waste and energy-efficient methods. The resultant CDs exhibit remarkable optoelectronic properties, including strong fluorescence in visible region, excellent photostability, and tuneable emission spectra, making them suitable for a wide range of applications. This work highlights the potential of CDs in environmental monitoring and water remediation. Specifically, CDs have been effectively employed as sensors for detecting heavy metal ions including Fe^{3+} and Hg^{2+} ions, demonstrating high sensitivity and selectivity. Furthermore, their photocatalytic capabilities facilitate the degradation of contaminants in water, showcasing their utility in promoting environmental sustainability. The findings underscore the promise of CDs as a multifunctional tool in advancing green chemistry and environmental protection efforts.

Keywords: Carbon Dots; Green precursors; Fluorometric sensor; Fe^{3+} ions; Photocatalytic.

Embedment of Various types of Materials in Polyaniline Matrix for Reduction in Electromagnetic Pollutions

Dr. Rishi Pal
Department of Applied Science, Kalpana Chawla Government Polytechnic for Women, Ambala City - 134003, Haryana, India

Abstract

Due to their extensive uses in fuel cells, water purification materials, chemical/gas sensors, supercapacitors, cancer cell imaging, fuel cells, and electromagnetic interference (EMI) shielding, conjugated polymers are the most significant materials in science and industry. The efficiency of EMI shielding, or the decrease in electromagnetic pollution, is one of these applications that is crucial to daily living. The usage of the newest technology is increasing daily, which leads to a rapid growth in electromagnetic pollution that can be harmful to human health, living things, and electrical devices. Therefore, creating the right tools and materials to limit or lessen electromagnetic pollution over a broad frequency range is never easy. By employing conjugated polymers like polyaniline, polypyrrole, polythiophene, etc., this issue can be rendered intractable. Additionally, the same materials can be utilized to detect vapors because they have a sufficient detecting response to a variety of vapor types, including gases, alcohols, and chemical vapors. Additionally, these materials show excellent supercapacitor characteristics, including particular capacitance, specific energy, and power densities, which clearly indicate the need for high-quality charge storage devices. Conjugated polymers can therefore serve as multipurpose materials for the construction of devices.

Keywords: Polyaniline; Graphene; MnO_2; V_2O_5; EMI Shielding.

Carbon Nanoparticle: a boon to rice plant growth and yield in a non-transgenic manner

Aman Kumar[1], Lekshmi Manasa S[1], Gayatri Mishra[2], Jnanendra Rath[3], Gyana Ranjan Rout[4], Kishore CS Panigrahi[1], Madhusmita Panigrahy[1,4]

[1]National Institute of Science Education and Research (NISER), Khurda, Jatni, 752050, India

[2]U. S. Department of Agriculture (USDA) Forest Service, University of Utah, United States of America

[3]Department of Botany, Institute of Science, Visva-Bharati (A Central University), Santiniketan, West Bengal – 731235

[4]Institute of Agricultural Sciences (IAS), Siksha 'O' Anusandhan University (SOA-DU), 751029, India

Abstract

Expanding use of nanoparticles in the field of nanotechnology for their multidisciplinary commercial applications have heavily increased the production of engineered nanoparticles. There exist several reports demonstrating both positive and negative physiological and growth effects of the carbon nanomaterials specifically the single- and multi-walled carbon nanotubes in different crop plants. Despite these discoveries, the exact molecular mechanisms underlying the physiological and growth effects are not fully known. Details knowledge of how carbon nanoparticles can affect the physiological process of plant can help attaining sustainable production and also help combat various abiotic stresses. Understanding how carbon nanoparticles (CNP) exert the growth effects became possible when the analyses were attempted in the model dicot plant Arabidopsis thaliana with approaches based on photomorphogenic events like perception of light quality, inhibition of hypocotyle growth. CNPs' exposure to the plant induced set of responses similar to shade avoidance response by down regulating the major red-light photoreceptor Phytochrome B's transcript level. CNPs' exposure induced accelerated flowering exclusively in a photoperiod dependent manner excluding all the other pathways that regulate flowering. CNP induced effects similar to shade avoidance response (SAR) of Arabidopsis, with increase in shoot length, root length, root number, cotyledon area, chlorophyll content and total sugar content in rice seedlings. In mature plants, CNP treatment resulted several positive growth effects, improved grain traits and an average of 17.5% increase in yield per plant. Increase in plant internal temperature by 0.5 ℃ ± 0.1 ℃ induced responses similar to SAR with a significant downregulation of phytochrome B transcript in leaf. CNP treatment resulted increase in stomata size, gaseous exchange and water use efficiency. Genomic analysis resulted primary involvement of ABA pathway, stomata size, frequency genes and increased expression of ABA biosynthetic genes in both Arabidopsis and rice. Due to thermomorphogenesis, down-regulation of Phytochrome B concurrently altered the ABA pathway and stomatal distribution with size. Together these changes resulted improved water relation parameters and water use efficiency ultimately showing improvement in yield. We demonstrate that CNP treatment presents a potential non-transgenic method for improving rice yield due to moderate SAR induction.

Keywords: Carbon nanoparticle, Rice, Yield, Abscisic acid, Phytochrome B, Shade.

Synthesis and Characterization of MoO_3 supported Nanocomposites for catalytic applications

Vaishali Raut, Supriya Shukla, Sharda Gadale
Yashwantrao Mohite College of Arts, Science and Commerce, Bharati Vidyapeeth (Deemed to be University), Pune, Maharashtra, India

Abstract

In this work, transition metal salts such as Zn (II) was dopped on MoO_3 and nanocomposites were prepared with different concentrations of zinc oxide and molybdenum oxide (ZM) by using sol-gel method. These synthesized materials were characterized by X-Ray powder diffraction (XRD), Flame Emission Scanning Electron Microscopy (SEM), Energy Dispersive X-Ray analysis (EDX) technique. The effect of amount loading of zinc oxide on activity of catalyst was studied by choosing liquid phase nitration of phenol as a model reaction. For the same reaction effect of various solvents, effect of reaction time and reusability of the catalyst was also studied. Catalyst calcined at 500°C temperature with 10 wt.% ZM showed highest phenol conversion also greater o-nitrophenol selectivity is claimed over this catalyst. It was observed that high phenol conversion co-relates with the presence of greater number of strong Brönsted acid sites over the catalyst surface whereas the selectivity of o-nitrophenol is related to the pore size of the catalysts. No use of sulfuric acid along with the nitric acid used in its diluted form in the reaction makes the process safe and environmentally friendly.

Keywords: Transition metal oxides, nanocomposites, MoO3, liquid phase, environmentally friendly.

"Green Synthesis of Silver Nanoparticles: Eco-Friendly Methods and Versatile Applications"

Rakhi Khandelwal
Government Mahila Engineering College, Ajmer, Rajasthan, India

Abstract

The need for green synthesis methods in nanoparticle production stems from the imperative to address environmental, economic, and ethical concerns associated with conventional synthesis techniques. Traditional methods often involve the use of hazardous chemicals, high energy consumption, and generate toxic byproducts, leading to environmental pollution, resource depletion, and health hazards. Green synthesis offers a sustainable alternative by utilizing natural, renewable resources and eco-friendly processes to produce nanoparticles. In this study, we explore the environmentally friendly process of green synthesis, which offers a pollution free and cost-effective approach. Our focus lies in the synthesis of silver nanoparticles utilizing different plant extracts. The synthesized nanoparticles are then investigated for their medical applications. Initial confirmation of nanoparticle formation was conducted through visual observation and UV-visible absorption spectrum analysis, revealing a characteristic peak indicative of silver nanoparticles. The synthesized AgNPs have been characterized by using various techniques including UV–Visible absorption spectroscopy, XRD, EDX and SEM to study the morphology, size and phase detection. The synthesis of stable AgNPs with a size of less than 36 nanometers and FCC crystal structure was confirmed. XRD results also revealed the presence of Ag2ONPs along with AgNPs with the phase ratio 32: 68, respectively. SEM images confirmed the poly-dispersed particles. Notably, the plant extracts demonstrated a rapid reduction of silver ions. The synthesized nanoparticles demonstrated significant antimicrobial activity. Furthermore, they exhibited promising cytotoxic effects against human breast cancer (MCF-7) and mammary cancer (EVSA-7) cell lines, highlighting their potential for anti-cancer applications. This study underscores the effectiveness of green synthesis in medicinal contexts, emphasizing the synergistic effects of biomass coatings on nanoparticle efficacy compared to bare metal nanoparticles.

Keywords: AgNPs, UV-Vis. Absorption spectroscopy, XRD, SEM, Antimicrobial activity, Anticancer.

Beneficiation of iron ore by selective flocculation using surface-active agent, settling study and characterization of the beneficiation waste for value addition

Sanchayita Rajkhowa
Department of Chemistry, Haflong Government College, Dima Hasao 788819, Assam, India

Abstract

Obtainability of high quality of Indian iron ore fines is becoming diminishing and slime is not carefully examined for the good end use. These fines and slime need beneficiation prior to blast furnace processing. In this context surface active agents were found to play a vital role during washing of iron ore fines and slimes against water washing alone. Surface active agents at very low concentration disperse the gangue minerals and flocculate the iron ore fines following the science of adsorption and flocculation phenomena. The stability of dispersed phase (DP) was evaluated by determination of the percentage solid content in the DP. Settling tests were performed. First order kinetic model have been applied to the dispersion-cum-settling behaviour of both the samples and evaluated kinetic parameters were found to have good agreement with experimental data. Removal of gangue minerals from iron ore depends on the pH of the slurry, concentration of the slurry as well as concentration of the surface-active agent used. The concentrates collected satisfies the required specifications ($Al_2O_3/Fe < 0.05$ and $Al_2O_3/SiO_2 < 1$).The gangues in the dispersed phase as characterised by 'SEM-EDXA' are mostly clay bearing minerals like kaolinite, goethite, chlorite and alumina-silicate minerals.

Keywords: Flocculation, adsorption, surface-active agent.

Fabrication, structure and optical properties of 1wt% Dy doped BZBS double perovskite material for application in solar cells

R. Barik[1], Manas. R. Panigrahi[2]
[1,2]Department of Physics, Veer Surendra Sai University of Technology (VSSUT), Burla (768018), India

Abstract

Double perovskite is a highly potential photoactive material. Doping of various cations further improves its optical characteristics. Ba1-xZxBi1-ySy (for x=y=0.2) and Dy doped Ba1-xZxBi1-ySy Materials were prepared by the modified sol gel method. The structural study was carried out using PXRD and it suggests that the material crystalizes in orthorhombic structure. The structural parameters are estimated to be 12.01Å, 10.65Å, 6.855Å for BZBS and 9.752Å, 9.49Å, 5.10Å for Dy doped BZBS in the Imam space group. Further the analysis was conducted to study the physical, and optical aspects of the synthesized materials using UV-Vis spectrophotometer. The various linear optical parameters like optical bandgap, refractive index, extinction coefficient, dielectric constant, interband transition strength etc. were determined. The bandgap for BZBS material was estimated as 2.46 eV using Tauc plot, which after Dy doping reduced to 02.36 eV. Additionally, the dispersion parameter of refractive index was examined using Wemple- DiDomenico's single oscillator model. Urbach energy, oscillation energy and dispersion energy were calculated. Urbach energy for undoped and Dy doped BZBS material were found to be 0.29 and 0.22 eV. respectively. Oscillation and dispersion energy for BZBS material were estimated to be 5.7 and 43.85 eV respectively, and for Dy doped BZBS it was 4.85 and 41.17 eV. respectively. In addition to this, estimation of reflection loss and electrical susceptibility were also made for the material under investigation.

Keywords: band gap; Urbach energy; reflection loss; SELF; VELF.

Synthesis and Characterization of Cadmium Sulfide Nanoparticles

A. P. Manake[1], S. R. Patil[2], P. M. Raotole[3]
[1]KES's Pratap College (Autonomous), Amalner
[2]MGSM's Arts, Science and Commerce College, Chopda

Abstract

Nanomaterials are the leading edge of Nanoscience and nanotechnology. To found efficient method is a big challenge in nanotechnology. Herein we develop a green method to synthesize CdS nanoparticles. Cadmium sulfide (CdS) nanoparticles were synthesized by ultrasonication method using sodium sulfide and various salts of Cadmium. Current synthesis saves considerable energy which essential for formal synthesis. The synthesized nanoparticles were characterized by UV-Visible, XRD and STA analysis.

Keywords: Nanomaterial; Cadmium sulfide; Bath Ultrasonicator.

Gold-Zinc oxide composite structures: Insights into preparation method and photocatalytic activity

S. Girish Kumar
Department of Chemistry, RV College of Engineering, Bengaluru-560059, Karnataka, India

Abstract

Plasmonic Au particles decorated over the wide gap semiconductor photocatalyst surface have triggered immense interest owing to their ability to induce visible light response for the composite and also for their catalytic properties. In this context, depositing the Au particles over the diverse morphological features of ZnO surface are of paramount importance as they result in the formation of stable heterostructure which finds applications in mediating the photocatalytic reactions. The distribution of Au over the ZnO surface is critically dependent on the preparation methods which further impacts the optical and photocatalytic properties. Thus, this presentation emphasizes the various methods for the deposition of Au on the ZnO surfrace and their photocatalytic reactions for the pollutant degradation reaction is highlighted. The contribution arising from both Au and ZnO as well as the interface of the heterostructure is discussed under the light of migration of charge carriers. The participation of free radicals in the degradation mechanism specific to the reaction conditions are discussed.

Keywords: Au-ZnO; Heterostructure; Deposition methods; Charge carrier dynamics; Photocatalysis.

An Extensive Examination of Multi-Level Feature Extraction Approaches for High-Dimensional Data

Kattinti Mahesh Babu[1], Dr MVSS Nagendranath[2]
[1]JNTUK, Kakinada, Andhra Pradesh, India
[2]Sasi Institute of Technology & Engineering, Tadepalligudem, Andhra Pradesh, India

Abstract
The vast proliferation of high-dimensional datasets across various scientific and commercial sectors has necessitated advancements in data reduction and feature extraction methodologies. This survey scrutinizes the myriad of techniques deployed to manage and interpret voluminous data, facilitating a deeper understanding and efficient utilization of data. Starting with traditional linear techniques such as Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA), these methods are admired for their straightforwardness and computational efficiency. Yet, they often fall short in grappling with the inherent non-linear complexities of many contemporary datasets. To address these challenges, novel non-linear dimensionality reduction techniques like t-SNE, Isomap, and Locally Linear Embedding (LLE) have emerged, focusing on the preservation of both local and global data structures. These methods are adept at unravelling intricate patterns in high dimensional spaces, but sometimes at the expense of computational intensity. The realm of deep learning has ushered in sophisticated multi-tier feature extraction mechanisms. Complex neural network architectures, especially, autoencoders and convolutional networks excel at hierarchically distilling essential data features. These techniques, though computationally demanding, have exhibited unparalleled performance in diverse applications. Additionally, this survey sheds light on hybrid models, amalgamating classical and deep learning techniques, encapsulating the strengths of both paradigms.

Keywords: Dimensionality Reduction, Feature Extraction, Principal Component Analysis, Multilevel Factor Analysis, Cross level Integration.

The parthenium biosorbents for removal of chlorides and hardness from water

Subhashish Dey
Civil Engineering Department, Gudlavalleru Engineering College, Gudlavalleru, Andhra Pradesh, India

Abstract

One of the most significant problems facing the environment is caused by the presence of contaminants in aqueous solution, most notably dangerous heavy metals. In rural places, hardness and chlorides are two of the most dangerous toxins in groundwater or surface water. It is largely because excessive quantities might cause sickness that it is controlled in terms of the quality of drinking water. Because of its alkaline nature, water may be irritating to the eyes, respiratory system, and skin problems, and the higher its concentration of hardness and chlorides, the greater the risk of these irritations. Biosorption is a naturally occurring physiochemical mechanism that enables specific biomass to passively bind toxins to its cellular structure. In this study, five distinct biosorbents, including rice husk, rapeseed straw, parthenium, sawdust, and egg cell, were manufactured in the laboratory. With regard to the removal of hardness and chlorides from water, in these biosorbents the parthenium biosorbents shows that the highest level of effectiveness among the other biosorbents. By using plant biomass of Parthenium, the chloride and hardness removal percentage is 65% and 80% achieved respectively. After identifying the most effective biosorbents, we optimized their parameters and gathered water samples from a variety of sources. In chlorides removal over parthenium biosorbents the optimum dosage of biosorbents is 3.8gm, temperature is 35^{o}C, pH is 7, and contact time is 120min and optimum agitation speed is 120rpm. In hardness removal over parthenium biosorbents the optimum dosage of biosorbents is 5.4gm, temperature is 35^{o}C, pH is 6.5, and contact time is 90min and optimum agitation speed is 150rpm. After eliminating the chlorides and hardness ions from water by utilized biosorbents, the biosorption process may be made more cost-effective by regenerating and recycling the biosorbents.

Keywords: Hardness, Chlorides, Biosorptions, Kinetic equilibrium, Isotherm data and Regeneration.

Microwave Assisted Green Synthesis of NiO -AlPO Composites for Enhanced Photocatalytic Degradation of Methylene Blue

Shalini K S[1], Nirmala B[2]
[1]Research student, Department of Studies and Research in Chemistry, Tumkur University, Tumkur, India
[2]Assistant Professor, Department of Studies and Research in Chemistry, Tumkur University, Tumkur, India

Abstract

NiO-AlPO nanocomposites were synthesized by microwave-assisted green synthesis. Aqueous extract of Parnelia perlata is used as an oxidizing agent for oxidizing Nickel nitrate to Nickel oxide on the surface of pre-synthesized aluminophosphate zeolites. NiO-AlPO composite synthesized was characterized using XRD, FT-IR, SEM with EDAX and BET. XRD confirmed that NiO-AlPO synthesized has the tridymit phase of ALPO and the bunsenite phase of NiO. Synthesized NiO-AlPO was studied for its efficiency as an adsorbent to remove water-soluble dyes using Methylene blue as a model pollutant. NiO-AlPO was found to be an effective adsorbent, the process was found to follow monolayer adsorption with high adsorption rates at lower dye concentrations. Adsorption follows pseudo-second-order kinetics.

Keywords: Green synthesis, NiO-AlPO composites, Methylene blue, Adsorption, Waste water treatment.

Recent Developments in Multiscale Polymer Composites: Fabrication and Associated Challenges

Soma Banerjee
Department of Plastic Technology, School of Chemical Technology, Harcourt Butler Technical University
Kanpur, Uttar Pradesh 208002, India

Abstract

Multiscale polymer composites are the materials of high demand for the researcher of polymer and composite field due to attractive combination of properties in a single frame. The multiscale polymer composites are fabricated by combination of various reinforcements and fibers at different size scale to achieve synergism in properties. The mulscale polymer composites possess excellent strength due to improved interfacial contacts and proper distribution of reinforcements in the polymer matrix. These composites exhibit numerious properties such as improved mechanical strength, thermal and electrical conductivity, electromagnetic shielding, sensing, self-healing and many more. However, the fabrication of these composites are challenging. Multiscale polymer composites are fabricated by dispersing common nanomaterial in the polymer matrix followed by impregnation of conventional fibers into this nanomaterial reinforced polymeric matrices. Alternatively, the nanomaterials can be incorporated inside the fiber followed by impregnation in pure resin, etc. Solution mixing, layer-by-layer assembly, in-situ polymerization, etc. are various fabrication technologies utilized currently. The choice of fabrication techiques depends on the reinforcement form, size, volume fraction, etc. In this article, the fabrication of multiscale polymer composites by various approaches, their potential advantages, challenges are discussed. The scope of these composites in various application areas is also investigated.

Keywords: Multiscale; Polymer Composites; Fabrication techniques; Reinforcement; Dispersion.

Glass-Natural Wool Fiber and Nano Alumina Reinforced Polymer Biocomposites for Improving their Mechanical and Water-Absorsion Properties

Yohanes Abebe, Sivaprakasam Palani, Belete Sirahbizu
Department of Mechanical Engineering, College of Engineering,
Addis Ababa Science and Technology University, Addis Ababa, P.O. Box 16417, Ethiopia

Abstract

Greater possibilities for natural fiber have hybridization in the industrial sectors, through the use of thermosets and thermoplastics polymer. This research focused on investigates nano Al_2O_3 effects on the mechanical and water absorption properties polymer bio composites. The natural wool, E glass fiber and nano alumina reinforced on polyester matrix through hand lay-up process. 2% of Al_2O_3-NPs are incorporated as reinforcement to enhance the composite's properties. Mechanical performance such as tensile strength, compression, flexural, impact tests and water absorption test has been performed. The fractured surface has been characterized scanning electron microscopy (SEM). This research finding indicated that the addition of Al_2O_3-NPs to wool-glass fiber bio composites holds promise for enhancing both the mechanical properties and water absorption resistance of the composite materials.

Keywords: Bio composites, Nano alumina, water absorption, glass fiber, wool fiber.

Evolution of Magnesium Aluminate by chemical route, modified solid state process and its characterization

Soumya Mukherjee
Department of Metallurgical Engineering, Kazi Nazrul University-713340, Asansol, India

Abstract

Spinel is a high temperature resistant material with verstalile application ranging from refractories in Steel Industries, Cement, to coatings for various reactors, calatalysts. Moreover, transitional, rare-earth doped spinel based material is also noted for semiconductors. For critical applications, synthesis methodology plays a vital role in terms of phase purity. In the present article, a comparative studies on chemical process (combustion solution based on sol-gel) uing different fuels and modified solid state process is adopted. Requisite AR grade precursors are used for both process methodology to perform synthesis. Thermal analysis is carried for both process route to study the zone of crystallization for spinel formation which will provide an idea for heat treatment schedule with focus on dfferent precursors for 2 different process routes. Phase analysis confirms the spinel phase evolution with crystallite size estimation using XRD. Bonding analysis by FTIR exhibits information on M-O co-oridinations for both processes. Morphological analyses by SEM, FESEM reveals the particle packing nature of the synthesized particulates. Interconnected agglomerates are noted for solution chemistry route while modified solid state process reveals cubic structure with some flakes. Densification is noted for both. Microhardness for solution route is evaluated to be around 10.52 GPa (1073 HV), 4.087 GPa (416.7HV) and 5.079 GPa (517.9HV). Band gap is estimated for modified solid state process using Tauc relation and noted to be about 2.85 to 3eV showing variations with soaking temperature and duration.

Keywords: Solution route, Solid State process, Spinel, Phase analysis, Morphology, Thermal analyses.

The influence of process parameters and Al_2O_3 Nano-particles on the Mechanical and Microstructural properties of Dissimilar aluminum alloys - A Comparative study

Getachew Gebreamlak, Sivaprakasam Palani, Belete Sirahbizu
Department of Mechanical Engineering, College of Engineering,
Addis Ababa Science and Technology University, Addis Ababa, P.O. Box 16417, Ethiopia

Abstract

Additive mixed friction stir welding is an innovative and novel method for enhancing the friction stir welding process. This research aimed to investigate and compare the influence of FSW process parameters and Nano-sized Al_2O_3 particle additions on the mechanical and microstructure properties of the FSWed joints made between dissimilar aluminum alloys, AA2024-T351/AA7075-T651. The FSWed joints without reinforcement were compared with the joints of Nano-particle reinforcements. The investigation employed three varying input parameters (Rotational speed, Welding speed, and Tool plunge depth) at three levels (800-1200rpm, 20-60mm/min, and 0.2-0.4 mm) and fixed volume percentages of Al2O3 nano-particles (8%) respectively. Mechanical testing (Tensile and micro-hardness) and microstructural investigation have been done to assess the weld quality and examine the microstructure of the FSWed joint. The addition of nano alumina has enhanced the weld properties of FSW. The main reason behind the improvement was that the nucleation sites leading to the recrystallization mechanism were enhanced by the presence of nano-particles in the weld zone.

Keywords: Friction Stir Welding; Dissimilar Aluminum alloys; Al_2O_3 Nano particles, Tensile strength, Micro-hardness.

Removal of Lead (II) ions from Water by using green nano Trimanganese Tetroxide

Sreekala.G[1*], Beena.B[2]
[1]Department of Chemistry, BJM Govt. College, Chavara, Kollam, Kerala, India
[2]Department of Chemistry, KSMDB College affiliated to University of Kerala, Sasthamcotta, Kerala, India

Abstract

Inorganic pollutants like heavy metal ions and organic pollutants like pesticides and dyes are the main causes of water pollution. These contaminants cause serious issues for the environment and public health when they are present. Reverse osmosis, adsorption, membrane separation, ion exchange, chemical precipitation, and other techniques are used to remove these pollutants from water bodies. Due to its ease of use, great efficiency, abundance of adsorbents, and low sludge creation, adsorption is the most advantageous method for purifying water. Activated carbon made from various waste materials, single- and multiwall carbon nanotubes, nanoscale metal oxides, chitosan and its derivatives, graphene and its derivatives, and cellulose and its derivatives are just a few of the many adsorbents that have been effectively used for the removal of heavy metal ions in recent years. Nevertheless, a lot of these adsorbents necessitated the subsequent separation steps,which raised the expenses of operations. Therefore, using an external magnetic field to remove magnetic nanomaterials from solution can be a potential approach.The scientific community is very interested in magnetic nanopart icles as an adsorbent for treating contaminated water.The current study looks onthe efficient removal of lead (II) ions from waste water using green produced Mn_3O_4 nanoparticles.A straightforward, nontoxic, environmentally acceptable, and economical green technique was used to create Mn_3O_4 nanoparticles by mixing an aqueous extract of Simaro uba glauca plant leaves with a solution of manganese (II) acetate. Powder X-ray diffraction technique (XRD), Fourier transform infrared spectroscopy (FT-IR), UV-Visible spectroscopy (UV). Scanning electron microscopy (SEM) and Transmission electron microscopy (TEM) were used to analyze the produced nanoparticle. These findings demonstrated that the Mn_3O_4 nanoparticles that were produced had a tetragonal hausmannite spinel structure and were spherical in shape. The produced Mn_3O_4 nanoparticle is an effective adsorbent for the removal of heavy metal ions and for the purification of waste water, according to adsorption studies conducted on lead (II) ions.

Keywords: Hausmannite; Simarouba glauca; green method, Adsorption; Magnetic nanoparticle.

Bismuth Ferrite Oxide decorted Titanium Dioxide and Silver Sulfide nanocomposites as a Turn-Off Fluorescent Sensing Probe to Organochlorine Pesticides

Parimaladevi R
Department of Physics, Mother Teresa Women's University, Kodaikanal-624101, India

Abstract

Rhodamine B(RhB) functionalized Bismuth Ferrite Oxide (BFO)/Titanium dioxide(TiO_2)/Silver disulfide(AgS) nanocomposites (NCs) were used to build a fluorescent turn-off sensor for the detection of Chlorpyrifos(CLP). The fluorescence was drastically quenched by the RhB fluorescence resonance energy transfer to the surface of BFO/TiO_2/AgS NCs via electrostatic interactions. Then the addition of CLP to RhB@BFO/TiO_2/AgSNCs initiates the loss of fluorescence by the adsorption of CLP molecules to the turn-off sensor probe. Under favorable conditions, the linearity between the fluorescence quenching and the concentrations was monitored and the limit of detection was estimated to be 0.006ppm, 0.004ppm for 2:1 and 3:1 ratio, with the fluorescence quenching efficiency ranges from 92.9 to 94%.

Keywords: Composite Materials; Electron Microscopy; X-ray Technique; Structural; XPS.

Optical properties of $Ba_2Ca(PO_4)_2$: RE (RE = Dy^{3+}, Eu^{3+}) phosphor for ecofriendly lighting technology

A. N. Yerpude[1], C. M. Nandanwar[1], S. J. Dhoble[2]
[1]Department of Physics, N.H. College, Bramhapuri, Dist-Chandrapur - 441206, India
[2]Department of Physics, RTM Nagpur University, Nagpur -440033, India

Abstract

The $Ba_2Ca(PO_4)_2$:RE (RE = Dy^{3+}, Eu^{3+}) phosphors were synthesized by wet chemical method and structural and photoluminescence properties were systematically investigated. When excited at 350 nm wavelength, the $Ba_2Ca(PO_4)_2$:Dy^{3+} phosphor showed an emission peak at 475 nm (blue) and 572 nm (yellow). The $Ba_2Ca(PO_4)_2$:Eu^{3+} phosphor displayed an emission peak at 591 and 615 nm when excited at 394 nm wavelength. The emission intensity of the $Ba_2Ca(PO_4)_2$:RE (RE = Dy^{3+}, Eu^{3+}) phosphor could reach a maximum of 0.5 mol % and then concentration quenching occurs. The result indicates that $Ba_2Ca(PO_4)_2$:RE (RE = Dy^{3+}, Eu^{3+}) phosphors with excellent photoluminescence properties will be used as a component in n-UV based solid state lighting applications.

Keywords: Phosphor, Ecofriendly, Optical properties, Orthophosphate.

Green synthesis of iron alginate nanogels by microemulsion method and Taguchi-assisted encapsulation of Candida rugosa lipase for butyl butyrate ester synthesis

Soumya Sharma, Rachana Sahney, Praveen Dahiya
Amity Institute of Biotechnology, Amity University Uttar Pradesh, Noida, India-201303

Abstract

The synthesis and optimization of butyl butyrate, short-chain flavored esters by green chemistry are critical for its application in food industry. The current study includes green synthesis where iron-alginate nanogel is synthesised by microemulsion method utilizing food grade oil to immobilize lipase from Candida rugosa. The nanogels were morphologically characterized by scanning electron microscopy & dynamic light scattering. The long tube-like alginate nanogels showed the average diameter (100 ± 2 nm) with a negative zeta potential of -28 ± 4 mV. Higher immobilization efficiency (98%) was observed in the iron alginate nanogels. Taguchi robust design method was used to optimize the immobilization parameters for Candida rugosa lipase on the iron-alginate nanogel. After optimization and validation, maximum lipase activity was observed at 0.7 µgm/ml of substrate concentration, at temperature and pH of 53^0C and 8.5 for 20 minutes time. Butyl butyrate is a pineapple-flavor ester ($C_8H_{16}O_2$), and it possess applicability in the cosmetic, food, pharmaceutical, and beverage industries. The highest percentage yield (90%) of butyl butyrate is perceived at optimum conditions in 6 hours' time, further confirmed via gas chromatography and Fourier transform infrared spectroscopy. Also, the optimization of butyl butyrate is integrated using response surface methodology. After optimization and validation of process parameters, the highest ester yield in the case of butyl butyrate was perceived at substrate molar ratio of acid: alcohol (1:4), at 45°C, 200 rpm with 6 hrs of incubation time. Furthermore, the reusability of Candida rugosa lipase upto 7 cycles for synthesis of butyl butyrate contributes to the sustainability of ester synthesis processes. The immobilized Candida rugosa lipase is a stable and economically feasible biocatalyst for ester synthesis, offering a green and more sustainable alternative to traditional chemical synthesis methods.

Keywords: Lipases; Taguchi optimization; Esterification; Immobilization; Response surface methodology.

GIS based Multi-variate Analysis of Groundwater Uranium in the Central Ganga-Yamuna basin of India

Manjeet Singh Barwa[1], Balaram Pani[2]
[1]Zakir Husain Delhi College, University of Delhi, Delhi
[2]Bhaskaracharya College of Applied Sciences, University of Delhi, Delhi

Abstract

Present investigation was carried out to detect and monitor the seasonal variation of uranium in water of Ganga-Yamuna basin region. Water samples were collected in different regions of pre-monsoon and post-monsoon periods from the designated locations along the flow of river at different places. Samples were processed and measured for uranium level using LED fluorimetric technique. Results showed that uranium level in the river was found in the range of 0.10 to 63.19 ppb. The studies shows that 5.45% of groundwater samples exceeds the WHO permissible uranium limit (30 ppb) and also 12.07% of Lower region groundwater samples exceeds the WHO limits. Ca2UO2(CO3)3 was found as dominating uranium species. GIS based groundwater uranium and other physico-chemical parameters pH, oxidation reduction potential, temperature, chloride, fluoride, nitrate, sulphate, phosphate, total hardness, calcium, magnesium were analyzed in the region of Ganga-Yamuna basin of India.

Keywords: Uranium, LED fluorimeter, Ganges river, Seasonal variation, Water.

Highly Efficient Sericin Derived Carbon Quantum Dots as Metal Free Green Photocatalyst for Degradation of Dyes

Anita. B. Padasalagi[1], M. K. Rabinal[2]
Department of Physics
[1]Rani Channamma University, Belagavi-581196, Karnataka, India
2Karnataka University, Dharwad-580003, Karnataka, India

Abstract

The demand for wastewater treatment for sustainable future has provoked the development of ecologically acceptable photocatalytic approach. However, exploration of highly efficient green metal free catalyst for photocatalytic dye degradation under normal light is yet challenging. Here, it is initially demonstrated the effective utilization of sericin, a huge biowaste of silk industries. Sericin is used to produce nitrogen rich fluorescent carbon quantum dots through green thermal decomposition method. By engineering the size from 5.6 nm to 9.1 nm well as composition through optimizing the reaction conditions, a tuneable fluorescence from blue to orange has been achieved, which is confirmed from the detailed characterizations studies such as transmission electron microscopy, Raman Spectroscopy, X-ray diffraction, UV-Visible spectroscopy, and Photolumiscence spectroscopy. These optically stable prepared biomass derived carbon quantum dots implemented as green photocatalyst for the degradation of well-known hazardous dyes namely crystal violet and Rhodamine-B under normal light. Using several radical scavenging agents, the mechanism involved in photocatalytic activity of carbon quantum dots was demonstrated. The degradation efficiency of crystal violet and Rhodamine B was obtained up to 97% and 71% within 70 min. A faster degradation, better reusability, and stability of the carbon quantum dots photocatalysts under normal light signify the importance of present work for sustainable environment in the concern human being, aquatic plants and animals. “Conversion of Waste valuable material is beneficial for economy and environment”.

Keywords: Sustainable Environment, Wastewater purification Remediation, Biowaste, Green quantum dots, Photocatalysis.

Sustainable Environmental Remediation using Green Routes

Shubhra Barwa[1], Balaram Pani[2]
[1]Gargi College, University of Delhi, Delhi-110049, India
[2]Bhaskaracharya College of Applied Sciences, University of Delhi, Delhi-110075, India

Abstract

The Transport sector accounts for 13 percent of the country's energy-related CO2 emissions (MoEF, 2010). The transport sector's share of country's total primary consumption will increase from 8.1% (2010) to 11.3 percent in 2030. India is the world's fourth-largest consumer and net importer of crude oil and petroleum products after the United States, China, and Japan. India's petroleum product demand reached nearly 3.7 million barrels per day, (EIA, 2014). However, India's growing transport sector can become more sustainable and climate compatible. Global transport emissions can be reduced by adopting a sustainability approach, which includes measures such as increased public transport use, higher utilization of biofuels, and enhanced vehicle efficiency. Unless alternative fuels based on indigenously-produced renewable feedstock are developed to substitute or supplement petro-based fuels, India's energy security will remain vulnerable.

Biofuels are emerging as the most promising alternative options to conventional fuels, as they can be produced locally, and can substitute diesel or gasoline to meet the transportation sector's energy requirements. Biofuels could have positive implications for national energy security, local air quality and GHG mitigation, employment generation and rural development. Sweet sorghum, for example, has advantages that make it a potential source of raw material for commercial ethanol production (Basavaraj et al., 2013). Second-generation biofuels are derived from agricultural residues and by-products, organic wastes, and materials from energy plantations, using a variety of woody, grassy, and waste materials as a feedstock. These new fuels offer considerable potential for promoting rural development and improving economic conditions in emerging and developing regions. Some other alternative fuel sources such as alcohol and ethanol are commonly derived from molasses, a by-product of sugar production. Sustainably produced, second-generation biofuels can potentially promote rural development and improve economic conditions in developing regions.

This paper looks at the status and potential of biofuels in India, identifies key challenges in achieving the country's biofuel targets, and analyses their role in India's long-term transport scenarios and aims to search for alternative biofuel feedstocks.

Keywords: Biofuels, First and Second-generation fuels, sustainability, economic returns, environment remediation.

References:

1. Singh, V.V., Sustainable Nanotechnology for Environmental Remediation, chapter in Book titled, "Green nanotechnology for environmental remediation", Micro and Nano Technologies, 2022, Pages 31-61.
2. Dhar, S., Shukla, P.R. 2015. "Low Carbon Scenarios for Transport in India: Co-Benefits Analysis," Energy Policy, 81: 186–198.
3. Fairley, P. 2011. "Introduction: Next Generation Biofuels," Nature 474 (7352): S2–S5
4. IEA. 2010. "Sustainable Production of Second-Generation Biofuels: Potential and Perspectives in Major Economies and Developing countries," International Energy Agency (IEA), Paris.
5. Raju, S.S., Shinoj, P., Joshi, P.K. 2009. "Sustainable Development of Biofuels: Prospects and Challenges," Economic and Political Weekly, 44 (52): 65-72.
6. REN21. 2015. "Renewables 2015 Global Status Report," REN21 Secretariat, Paris.
7. Shinoj, P., Raju, S.S., Chand, R., Kumar, P., Msangi, S., 2011. "Biofuels in India: Future Challenges," Policy Brief No. 36. National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi.

Exploiting Citral-Tryptamine Conjugated Silver NanoparticlesforAntibacterial, Anticancer and Sensor application

Nagendra Prasad, H. S.[1], Sundaravadivelu Sumathi[2], Sangamesha, M. A[3], Ananda, A.P[4]
[1]Department of Chemistry, Sri Jayachamarajendra College of Engineering, JSS ScienceandTechnology University, Mysuru-570006, Karnataka, India
[2]Department of Biochemistry, Biotechnology and Bioinformatics, AvinashilingamInstituteforHome science and Higher Education for Women, Coimbatore- 641043, Tamil Nadu, India
[3]Department of Chemistry, The National Institute of Engineering, Mysuru-570008, Karnataka, India
[4]Ganesh Consultancy and Analytical Services, Hebbal Industrial Area, Mysuru-570016, Karnataka, India

Abstract

The present study reports the synthesis of multi-functional silver nanoparticles usingcitral tryptamine (CT@AgNPs). In this approach synthesis of citral-tryptamine based Schiff base(CT)and characterize using various spectral studies such as NMR, FTIR and LCMS. Investigatedthevarious biological properties using ADME, Bioactive and molecular docking analysis of CTcompound. Interaction and binding affinities towards protein ids 6SJA and 3DAQweresignificant. Silver nanoparticles were synthesized by reduction method using CT compoundandconfirmed by XRD, EDX, SEM, and DLS analysis. Herein, CT@AgNPs with an averagediameter of 52nm. The silver nanoparticle exhibited enhanced antibacterial activity against methicillin resistant staphylococcus aureus (MRSA), the MIC value is 15±0.50µg/mL. Thesenanoparticles showed remarkable toxic effect against SiHa cervical cancer cell line andobtainIC_{50} value is 100 µg/mL. additionally, we propound the rapid, sensitive and cost-effectiveelectrochemical approach for detection of nitrite with linear dynamic range of 0.4mMto 4.0mMwith a lower detection limit of 0.4mM.These results advocate promising antibacterial andanticancer properties of CT@AgNPs for futuristic therapeutics and sensor application.

Keywords: CT@AgNPs, Molecular docking, Methicillin resistant staphylococcus aureus, SiHacellline, Electrochemical sensor.

High Frequency Dielectric properties of ZSM zeolite at room temperature

A.A. Joshi[1], P.M. Raotole[2]

[1]Department of Physics, PRHSS ACS College, Dharangaon Dist. Jalgaon Maharashtra

[2]MGM's Dadasaheb Dr. Suresh G. Patil College, Chopda, Dist. Jalgaon Maharashtra

Abstract

Zeolite are microporous crystalline materials with a uniform pore size distribution at molecular scale, a well-defined ordered structure, tuneable pore structure and exchange capacity. Synthesized zeolite is characterized by XRD, IR, SEM. The dielectric spectra of (ε',ε'') of dehydrated ZSM zeolite were measured at room temperature in the frequency range 75 KHz to 15 MHz. The sorbed water contained inside zeolites assists greatly the proton mobility and the ion mobility and hence enhance the electrical conduction. The difference in dielectric constant dielectric loss for H-ZSM and Nd-ZSM shows that the ionic exchange is accountable for it.

Keywords: ZSM, XRD, IR, Dielectric spectra.

Enhancing Supercapacitor Performance with innovative doping: Electrochemical investigation of Phosphorus Supported MnO_2- Metal organic frameworks

S. Manikandan
Department of Physics, Muthayammal College of Arts and Science (Autonomous), Rasipuram 637 408, Namakkal, Tamilnadu, India

Abstract

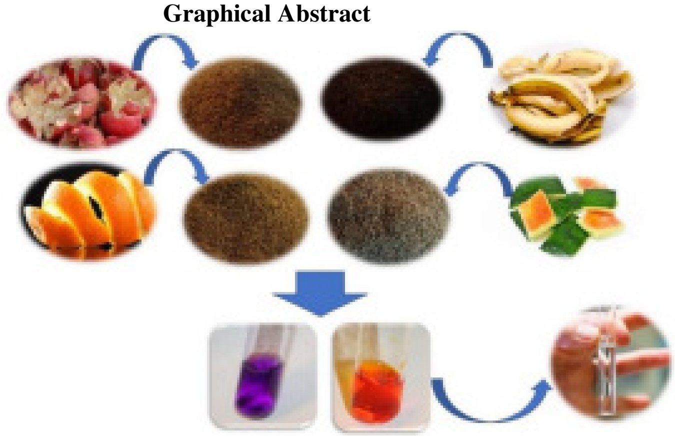
Phosphorus and its compound species have made significant contributions to electrochemical performance. The hydrothermal approach was used to create pure and P-MnO_2 nanoparticles in this study. Phosphorus is uniformly distributed and makes good contact with MnO_2. The XRD diffraction results verified the synthesis of a well-defined tetragonal phase of pure and P-MnO_2. FTIR research revealed the bonding of functional groups Phosphorus band is tightly associated with the Phosphorus-oxy complex (P-O-C). SEM, FESEM, and TEM images were used to investigate the morphology of pure and P-MnO_2. Using energy-dispersive X-ray spectroscopy, the existence of all component atoms in the crystal structure of all samples is confirmed. MP 6 (P-MnO_2) surface area was investigated using BET analysis. Remarkably of MP 6 NPs have a surface area of 66.8 m^2g^{-1}. The chemically binding and surfaces of the materials were investigated using XPS techniques. Mn2p, P2p, and O1s have high resolution spectra. The high resolution Mn 2p spectrum shows the spin-orbit doublet states of Mn 2p3/2 and Mn 2p1/2, which correspond to two peaks at 639.8 eV and 651.8 eV. Phosphorus (P 2p1/2 and P 2p3/2) peaks at 130.1 and 131.0 eV. The MP 6 electrode material exhibits a high specific capacitance of 281.1067 Fg^{-1}at 0.5 Ag^{-1}current density and an excellent cyclic stability of 87.3% after 10000 charge-discharge (GCD) cycles at 6 Ag^{-1}. Furthermore, this study, which focuses on increased capacitive characteristics with P dopants, might serve as a model for future research on the doping of other metallic elements.

Keywords: Phosphorus, Supercapacitors, Specific capacitance, Energy density and Power density.

Harnessing the Power of Agricultural Waste Peels: A Renewable Biomass for Sustainable Water Purification

Jayashree Avvadukkam[1], Sruthi V[2], Arun Krishna Kodoth[3], Suphiya Khan[4]
[1]Department of Industrial Chemistry, Mangalore University, Karnataka-574199, India
[2]Environmental Science Division, Department of Biosciences, Mangalore University, Karnataka 574199, India
[3]Dr. Bansi Dhar Institute, Sector-18, Gurugram, Haryana-122007, India
[4]Shriram Institute for Industrial Research, Sector-18, Gurugram, Haryana-122015, India

Graphical Abstract



Abstract

The utilization of agricultural waste for sustainable water purification is an innovative and promising approach to addressing the global water crisis. Agricultural wastes, such as peels from fruits and vegetables, present a significant environmental challenge with the large quantities generated daily. By harnessing agricultural waste peels as a renewable biomass for water purification purposes, not only can we address the issue of waste management but also contribute to providing safe drinking water to communities in need while promoting sustainability. This study investigates the efficacy of orange peel, watermelon rind, pomegranate peel, and banana peel, in removing dyes (crystal violet and methyl orange) from water. Our objective was to determine the maximum adsorption capacities of these waste materials for each dye. The results revealed the following maximum amounts of crystal violet adsorbed by each waste material: banana peel (0.6836 mg/g), orange peel (0.8155 mg/g), pomegranate peel (0.3576 mg/g), and watermelon rind (0.6896 mg/g). Similarly, the maximum amounts of methyl orange adsorbed were as follows: banana peel (0.4727 mg/g), orange peel (0.4501 mg/g), pomegranate peel (0.4727 mg/g), and watermelon rind (0.3776 mg/g). These findings demonstrate the use of these agricultural waste materials as effective adsorbents for the removal of dyes from water.

Keywords: Agricultural waste; Dye adsorption; Kinetics; Isotherm models; Thermodynamics.

Nature inspired versatile superhydrophobic nanocomposites for oily wastewater remediation

Monika Joshi[1], Sbhasha Nigam[2]
[1]Amity institute of Nanotechnology, Amity University Uttar Pradesh Noida
[2]Amity institute of Biotechnology, Amity University Uttar Pradesh Noida

Abstract

The worldwide economic development has exaggerated the necessity of oil, as it is one of the main resources of energy and basic material of several industries suvh as electroplating, oil, textile dyeing, leather, tanning, food, etc.. Meanwhile, the released wastewater from these industries specifically from oil industry is the key environmental concerns due to the occurrence of highly complex compounds like oil fluids, lubricants, heavy metal ions and other toxic carcinogenic organic pollutants. The discharge of oil wastewater into the environment without any treatment or with inappropriate treatment using conventional methods adversely affects the human beings and environment. Therefore, the treatment of oil wastewater is a vital concern for diminishing the deleterious effects of oil wastewater.

Adsorption is one of the attractive methods for the industrial wastewater treatment at large scale, specifically due to its low cost, high removal efficiency, simplicity of implications. Various natural and synthetic adsorbents exploited till now are carbonaceous materials, eco friendly copolymers and organoclays, as films, porous structures, powders and A fascinating approach involve the utilization of nanosorbents that separated through magnetic separation. So, to achieve high adsorption capacity between nanosorbents and contaminants surface modification of magnetic nanomaterials is required. In the present work, we present synthesis of various nanocomposite such as magnetic nanocomposites, polymeric nanocomposites that possess high surface area, high porosity, high mechanical strength and nontoxicity. The oil adsorption capacity of the synthesized nanocomposites was examined at different adsorbent dosage, contact time, pH, oil concentration.

Keywords: Magnetic nanocomposites ; removal efficiency; polymeric nanocomposites.

Development of superhydrophopic surfaces on Copper and Brass for corrosion resistance applications: A comparative study

Konica Sharma[1], M. K. Malik[1], M. S. Goyat[2]
[1]School of Basic and Applied Sciences, Lingaya's Vidyapeeth, Faridabad, Haryana, India
[2]Department of Applied Science, School of Engineering, University of Petroleum & Energy Studies, Dehradun 248007, Uttarakhand, India

Abstract

Corrosion occurs in all main group of materials including metals, ceramics, composites and polymers. However, it is more prevelant with consequential damaging effects in metals; resulting in a huge impact on the economy and GDP. Considering the enormous economy loss, it has become necessary to develop our ability in understanding and thus, minimizing the occurance of corrosion on various surfaces through the science of corrosion. Tremendous efforts have been made by the researchers to limit the effect of corrosion by using inhibitors, surface-coatings and adhesives. Among these surface-coatings, the development of superhydrophobic coatings has gained a lot of attention due to its various advantages. The present study reports the successful development of superhydrophobic coating on the surfaces of Copper and Brass as substrates. A low surface energy composite was used to synthesise the superhydrophobic coating using two step sol-gel technique. The properties of the developed superhydrophobic coatings were studied using contact angle measurements, Atomic force microscopy (AFM), Scanning electron microscopy (SEM) and Electrochemical impedance spectroscopy. The morphology and roughness of the substrates were studied with the help of SEM and AFM. The result showed the development of the micro-nano heirarchial structures favourable for superhydrophobicity on both the substrates. The superhydrophobic properties for both the substrate were further studied and characterized in terms of contact angle measurements, sliding angle measurements, jet spray analysis, and electrochemical polarization tests. Our results showed that the coated films exhibit a better superhydrophobic behaviour on the surface of copper as campared to brass. Possible reasons have been discussed in the reported work.

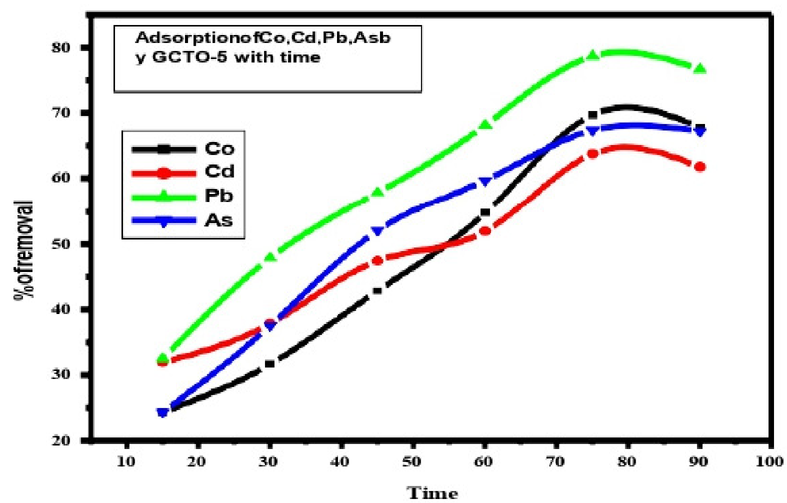
Keywords: Metal; Alloy; Coatings; Corrosion; Superhydrophobic; Surface Roughness.

Synthesis, Characterizations, and Application of rGO-CeO_2-TiO_2 Composite for the removal of heavy metal ions from Contaminated water

Murarilal Barik, Debashis Das, Sandhya Rani Mishra, Pramoda Kumar Satapathy
P.G. Department of Chemistry, MSCB University, Baripada–757003, India

Abstract

Modified CeO_2-TiO_2 mixed oxides have attracted much interest in different catalytic applications because of their improved properties. Graphene is a semiconductor having zero band gap and a plate-like structure. Due to planar exposure of the carbon atoms graphene possesses a theoretical surface area > 2500 m^2/g. [1] It also possesses very unique electronic and mechanical properties. The delocalized pi electrons available are also responsible for various interactions between graphene layers and substrate. Graphene can be coupled with a metal oxide to form nanocomposites [2]. Due to a huge amount of oxygen-containing functionalities at the surface, graphene oxide provides sufficient reactive sites for chemical modification. As a result, the charge transfers through the metal-oxide graphene interface result in a synergistic effect to enhance the performance of the composite significantly [2-4]. Graphene was synthesized from Graphite by the modified Hummers method. A series of CeO_2-TiO_2 mixed oxide was prepared by varying CeO_2 content, by sol-gel method. Finally, graphene-CeO2-TiO2 nanocomposites were prepared by chemical reduction method. The composites were characterized by XRD, FTIR, BET, Surface Area, UV-Vis DRS, etc. The adsorptive properties of the composites were studied for the removal of heavy metal ions like Co^{3+}, Pb^{2+}, Cd^{2+}etc by varying the parameters like concentration of metal ions, pH of the solution, etc. This adsorption process obeys both Langmuir and Freundlich isotherms and obeys pseudo 2nd-order kinetics. Among the different samples, the sample containing 5wt% CeO_2 shows the best adsorptive properties.



	LangmuirModel			FreundlichModel		
	Q_{max}	K_L	R^2	n	K_F	R^2
Co	22.42	2.655	0.998	2.67	19.54	0.960
Cd	17.33	3.798	0.993	2.23	16.59	0.980
Pb	40.16	1.238	0.991	3.59	23.12	0.950
As	82.16	0.584	0.995	4.40	27.16	0.925

References:

[1] Barik M, Das D, SatapathyPK, Mohapatra P. Graphene supported ceria-titania mixed oxide composite-An effective photo catalyst for methylene blue (MB) dye degradation. Environ. Eng. Res.2023; 28(6):220586.

Material Synthesis by Sol-gel Method and Investigation of Luminescence Properties of the Trivalent Rare Earth Doped Garnet Phosphors

Anita Verma[1], Ravi Sharma[2], D.P.Bisen[3], Nameeta Brahme[3]
[1]Department of Physics, Kalinga University, Raipur (C.G.)-492101, India
[2]Department of Physics, Govt. Arts and Commerce Girls College, Devendra Nagar, Raipur, C.G., India
[3]SoS in Physics and Astrophysics, Pt. Ravishankar Shukla University, Raipur (C.G.)-492010, India

Abstract

In this present article a series of MgY2Al4SiO12:xEu^{3+} (x = 0.01, 0.03, 0.05 and 0.07) phosphors were synthesized by sol-gel method. X-Ray diffraction (XRD) technique was used for the study of crystal structure of the synthesized phosphors. Photoluminescence (PL) properties were also studied. When the MgY2Al4SiO12:xEu^{3+} phosphor was excited with 395 nm wavelength then optimum emission peak centred at 592 nm was found. The calculated CIE coordinates from the photoluminescence emission spectra lie in the orange-red region of the visible spectrum. To determine the optimum doping concentration the variation in the luminescence intensity with different Eu^{3+} concentration in the MgY2Al4SiO12 host lattice was also studied. Photoluminescence (PL) emission intensity increases up to 5 mol % and after that it decreases due to non-radiative energy transfer of exchange interaction. Orange - red emission of phosphor and its color purity indicates that it can be employed in WLED's applications. Calculated correlated colour temperature (CCT) of the phosphor reveals warm appearance and can be used for warm white LED.

Keywords: Sol-gel method, Phosphor, Photoluminescence, XRD, CIE Chromaticity co ordinate.

Utilization of Discarded Animal Cartilage for Cartilage Tissue Engineering Applications

Piyali Das[1], Mangal Roy2, Piyali Basak[1], Partha Roy[3], Samit Kumar Nandi[4]
[1]School of Bioscience and Engineering, Jadavpur University, Kolkata, India
[2]Department of Metallurgical and Materials Engineering, IIT-Kharagpur, WB, India
[3]Department of Biotechnology, IIT- Roorkee, Uttarakhand, India; [4]Department of Veterinary Surgery and Radiology, West Bengal University of Animal and Fishery Sciences, Kolkata, India

Abstract

It is said that any substance can be considered as 'waste', which is discarded after primary use, or it is worthless, defective and of no use. Going beyond imagination, using a particular body part of animal which is so far considered as a discarded material with no particular use, has been taken as the prior source material, developed, harvested and processed for a noble work like articular cartilage repair and reconstruction. Articular cartilage has poor intrinsic healing potential. Consequently, traumatic and degenerative lesions of articular cartilage eventually progress to osteoarthritis, a leading source of disability worldwide. It is believed that a decellularized xenogenic tissue may be a viable option as a replacement tissue, as the antigenic cellular material will be removed while preserving the relatively nonimmunogenic extracellular matrix (ECM). Therefore, the aim of our research area is broadly based on developing decellularized xenogenic cartilage matrices by using some chemical agents to attain cost effective, nonimmunogenic, biocompatible, mechanically stable, cell free biomaterials for successful tissue engineering and clinical applications. The study was initiated by harvesting freshly collected full thickness caprine ear cartilage from nearby slaughter house and immediately processed in the laboratory by rigorous PBS washing followed by treatment with hypotonic- hypertonic solution followed by characterization by histology, SEM, swelling property, hemocompatibility, biochemical and biomechanical analysis and also prepared for in vitro and in vivo analysis. The histological study by H&E showed absence of cellular materials. Along that, staining of collagen and elastic fibers revealed unaffected and unaltered fiber alignments, similar to the native matrix. Likewise, the high resolution SEM images also indicated unaltered ECM structural orientation and absence of cellular materials. On contrary, sGAG was observed to be significantly reduced as assayed by alcian blue staining. The quantification of DNA, sGAG and collagen depicted significant loss of DNA and sGAG post decellulization, whereas there was no noticeable difference in the collagen content in comparison to the control. The biomechanical property of the acellular matrix was not much affected, in fact, the elastic modulus, hardness and stress relaxation of the acellular matrices gave slightly increased data compared to the untreated. The in vitro cell culture was initiated by culturing the C3H10t1/2 cells and cellular attachment and morphological examination was performed using SEM after 3rd and 14th day of culture. The SEM images revealed well attachment of the adherent cells to the acellular matrices by the end of 14 days. To investigate whether the scaffold supports cell proliferation, MTT assay was performed. The increasing cellular viability suggested biocompatibility of the acellular matrices towards the growing cells. Contrarily, the decreasing cytotoxicity study revealed that the acellular matrices did not show any toxic and immunogenic effects on the cells. Additionally, C3H10t1/2 cells were incubated for 28 days in proliferation media (PM) and chondrogenic media (CM) to test whether this acellular cartilage materials support the chondrogenic differentiation. The sGAG and collagen were also quantified by DMMB and Sirius red assay respectively after 1st and 28th day. The acellular matrices might support the cellular growth on the chondrogenic differentiation media causing production of collagen. The sGAG and collagen content were also found in increasing rate at the end of 28 days compared to day 1. Next, the materials were prepared for in vivo applications in rabbit knee joints where, osteochondral defects were created and acellular cartilage matrices were implanted into the site. After 3M, bone constructs were collected and further studied for histology and microCT. The staining images depicted regeneration cartilage and healing of the defects along with subchondral bon tissues. The microCT images also showed defect healing properties by the end of 3 months.Therefore, it can be summarized that hypotonic and hypertonic solution could significantly eliminate cellular components from the ear cartilage without alterations in the ECM structure. Also, the successful in vitro and in vivo analysis proved that this newly developed material does not show any cytotoxic effect on cells and on host animals respectively. In addition, the decellularized matrices were observed to support the growth of C3H10t1/2 cells in chodrogenic differential media. Besides, microCT and histological assessments of the defects represented regeneration of cartilage along subchondral bone tissues and healing of the defects by the applications of these acellular materials. Thus, it is expected from this study that the developed material will provide satisfactory activity in cartilage regeneration in much cheaper cost compared to those that are currently available commercially. This developed acellular material could be substituted as an alternative implant in cartilage regeneration and healing.

Sustainable Synthesis of Imine Derivative from Furan 2- carbaldehyde: A Single-Step, Environmentally Benign Method with Antioxidant Assessment

Prakash Gadipelli, Dr.Muralasetti Nookaraju, Mummidi Siva Sankar
Aditya College of Engineering and Technology (A), Surampalem, India - 533437

Abstract

In this study, sustainable synthesis, single step method is used to synthesize imine derivative from non conventional lignocellulosic biomass furan 2-carbaldehyde and 7- aminodeacetoxy cephlospornic acid. Furan 2-carbaldehyde, derived from biomass that is lignocellulosic, holds a crucial position in this environmentally sustainable methodology. Furan 2-carbaldehyde, derived from lignocellulosic biomass, plays a pivotal role in advancing environmentally conscious methodologies. Rooted in the principles of green chemistry, this approach employs ethyl alcohol as a solvent, reducing the environmental impact of conventional synthetic processes in an efficient manner. The materials and procedures used in pharmaceutical research demonstrate a dedication to sustainability. Focusing on the utilization of 7-amino deacetoxy cephlospornic acid and furan 2-carbaldehyde for synthesizing Schiff Base. The resulting imine derivative underwent thorough characterization using diverse analytical techniques, including melting point analysis, FT-IR spectroscopy, and Nuclear Magnetic Resonance spectroscopy. The synthesized derivative manifested as a finely powdered substance with a brown hue, exhibiting a melting point of 159°C. The average particle size was determined to be 450nm, displaying an agglomerated form with a spherical shape. The overall yield of the process reached 71%. These results support sustainable methods in pharmaceutical research as well as strategies for producing sustainable goods. Furthermore, they shed light on the potential applications of furan 2-carbaldehyde-derived imines in pharmaceutical and materials science, contributing to the ongoing efforts to integrate eco friendly practices into these fields.

Keywords: Environmental footprint, Green chemistry, Non Conventional, Schiff base, Sustainable synthesis.

A highly efficient Photocatalytic system for rapid Degradation of organic Pollutants

Supriya Kumari[1], Sunil Kumar[2]
[1]Department of Chemistry, SherShah College, Sasaram (Rohtas) , 821115, India
[2]Department of Chemistry, J.J College, Gaya, Bihar 823003, India

Abstract

The rapid degradation of organic pollutants is a critical challenge in environmental remediation.This study presents a highly efficient photocatalytic system designed to address this issue. A novel composite photocatalyst, doped with nanoparticle was synthesized which exhibits superior photocatalytic activity under visible light irradiation. The as prepared composite was characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), and UV-Vis spectroscopy, confirming its enhanced light absorption and charge separation capabilities. Photocatalytic degradation experiments were conducted using dye as a model organic pollutant. The results demonstrated that the prepared composite achieved over 95% degradation of dye within 60 minutes. The enhanced performance is attributed to the synergistic effects of nanoparticles, which enhance electron transfer and reduce electron-hole recombination rates. Additionally, the photocatalyst showed excellent reusability and stability over multiple cycles. This work highlights the potential of nanocomposites for efficient organic pollutant degradation, providing a promising approach for environmental cleanup applications.

Keywords: Novel Composite, Photocatalyst, Photocatalytic degradation, Synergistic effect.

Energy Harvesting Circuits with Piezoceramic Material: Design, Integration and Optimization

Bomkesh Bhoi, Bidya Bedant Joshi, Pranati Purohit
School of Physics, Gangadhar Meher University, Sambalpur, Odisha, India

Abstract

Piezoelectric energy harvesters (PHE) have drawn significant interest as a method of harvesting environment energy to power because of its compatibility and high energy density. Piezoelectric energy harvesters can be integrated into other technologies such as wireless sensor networks, Internet of Things (IoT)) devices, and wearable electronics. This integration can be lead to the development of self-powered devices that can operate continuously without the need for external power sources. The main disadvantages of PEH are low level of harvested power and the need for rectification, maximum power extraction and output voltage regulation. So piezoelectric energy harvester or transducer cannot be used alone to harvest mechanical energy. To increase the output voltage and power it is necessary to choose a piezoelectric material, piezoelectric transducer as well as an electric circuit. In this paper, we discuss different circuits such as switch only rectifier circuit, voltage multiplier based energy harvesting circuit, synchronised switch harvesting on inductor (SSHI) and synchronous electrical charge extraction (SECE) to harvest piezoelectric energy. The design and optimization of the circuits were done by using multisim software. Physically, a stack transducer is developed by using PZT piezoceramic materials and integrated into the electrical circuit. The output voltage of 1.2 V to 1.9 V is recorded by using the human thumb impression to piezoelectric element and this voltage is sufficient to glow an LED bulb.

Keywords: Energy harvesting; Piezoelectric energy harvesters (PEH), Piezoceramic material; Electric circuit.

How to Control the Diameter and Wall Thickness of Carbon Nanotubes

T. Somanathan[1], A.R. Sasieekhumar[2]

[1] Department of Chemistry, School of Basic Sciences, Vels Institute of Science Technology and Advanced Studies, Chennai, Tamil Nadu, India – 600 117

[2]Department of Chemistry, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed to be University), Sankari Main Road, Salem, Tamilnadu, India.

Abstract

Carbon nanotubes (CNTs) exhibit unique properties that make them promising candidates for various applications in nanotechnology, electronics, and materials science. The control over their diameter and wall thickness is critical as these parameters significantly influence their mechanical, electrical, and thermal properties. This abstract discusses the key factors and techniques involved in controlling the diameter and wall thickness of CNTs during synthesis and post-processing. Firstly, synthesis methods such as arc discharge and chemical vapor deposition (CVD) offer distinct advantages in tuning CNT dimensions. Catalyst control, including the size and composition of catalyst particles, plays a pivotal role in determining CNT diameter. Temperature and gas composition during synthesis also influence growth kinetics and ultimately affect CNT dimensions. Moreover, post-synthesis treatments such as purification and functionalization further refine the diameter and wall thickness of CNTs. Advanced characterization techniques like transmission electron microscopy (TEM) and scanning electron microscopy (SEM) enable precise measurement and analysis of CNT dimensions. Understanding and manipulating these factors not only enhance fundamental understanding but also broaden the scope for tailored applications of CNTs in diverse fields. This work underscores the importance of controlling CNT dimensions and highlights the interdisciplinary approaches that contribute to advancing nanotechnology and materials science.

Keywords: SWCNTs; DWCNTs; MWCNTs; CVD; Catalyst.

Green synthesis and anti microbial investigation of pyridine-2- carbaldehyde based chalcones under aqueous condition using functionalized MCM-41 materials

Nookaraju M, Prakash G, Siva Sankar M
Deaprtment of Chemistry, Aditya College of Engineering & Technology(A), Surampalem, India-533437

Abstract

Multicomponent one-pot synthesis has been emerged as an economical and efficient protocol in obtaining ecofriendly and biologically active organic compounds. A simplistic one-pot synthetic protocol was performed using aromatic ketones and substituted pyridine-2-carbaldehydes to obtain various subsstituted chalcones. The synthesis was catalyzed by various metal incorporated (Ti, Co) and Sulfonicacid functionalized MCM-41 materials, under solvent free and refluxing conditions. All the derivatives were obtained in greater yields, with the functionalized Mesoporous silica materials, than with the pure MCM-41. All the functionalized MCM-41 were found to have similar catalytic performance, whereas M-MCM-41, the Co incorporated material has shown slightly higher catalytic performance. The catalytic performance of the synthesized MCM-41 materials was found to be very high in the presence of aqueous conditions. The anti-microbial and anti-fungal activities of the synthesized derivatives have been was investigated on the selected micro- organisms.

Keywords: MCM-41, Functionalized MCM-41, One pot synthesis, biological activity.

Annealing Effects on 100 keV Silicon Negative Ions Implanted SiO_2 Thin Films

S. B. Vishwakarma[1], S. K. Dubey[2], R. L. Dubey[3], A.Yadav[3], I. Sulania[4], D. Kanjilal[4]
[1]Vidyavardhini's College of Engineering and Technology, Vasai, Palghar-401 202, India
[b]Department of Physics, University of Mumbai, Vidyanagari, Mumbai-400 098, India
[3]Department of Physics, St. Xavier's College, 5 Mahapalika Marg, Mumbai-400 001, India
[4]Inter University Accelerator Centre, Aruna Asaf Ali Marg, New Delhi 110 067, India

Abstract

In recent years silicon nanocrystals grown in insulating host materials have become the subject of prime interest due to the possibility to develop silicon-based photonic devices. The aim of the present work is to grow silicon nanocrystals in SiO_2 thin films with the scope of future silicon-based LEDs, Lasers, and various other photonic devices. SiO_2 thin film of thickness 300 nm grown on p-type silicon substrate was implanted with 100 keV silicon negative ions for the fluences of 1×10^{16}, 5×10^{16}, and 1×10^{17} ions cm^{-2}. The implanted samples were investigated using an energy-dispersive X-ray (EDX) spectroscopic technique and the samples were annealed at the temperature of 900 ^{o}C under N_2 ambient. Ultraviolet-visible near-infrared (UV-Vis-NIR) spectroscopy technique has been used to investigate the implanted SiO_2 thin film samples before and after thermal annealing. EDX results revealed the increase in the atomic percentage and weight percentage of silicon ions as compared to oxygen ions in SiO_2 thin film. This may be due to the increase in the concentration of silicon ions with the increase of implanted ion fluences within the SiO_2 thin film. UV-Vis-NIR studies showed higher transmittance for thermally annealed samples as compared to non-annealed samples. This may be attributed to the creation of a new SiO_x phase in the SiO_2 matrix at higher temperatures. UV-Vis-NIR studies also exhibited an increase in the energy band gap value after thermal annealing. This effect may be related to the formation of silicon nanoclusters in SiO_2 thin film.

Keywords: SiO_2; Thin films; Thermal annealing; Silicon-nanocluster.

"EcoNano": Harnessing Bio-Waste for Sustainable Nanoparticle Solutions in Pharmaceutical and Biomedical Industries

Sourav Mohanto
Project Associate-II, Science and Engineering Research Board
(SERB), Department of Science & Technology (DST), Govt. of India
Department of Pharmaceutics, Yenepoya Pharmacy College & Research Centre, Yenepoya (Deemed to be University), Mangalore, Karnataka, 575018, India

Abstract

India, as one of the world's most populous countries with a large agricultural sector, generates substantial amounts of biowaste every year. In addition, household waste and its management have also been an alarming concern in recent times. In this context, "EcoNano" proposes a paradigm shift in nanoparticle development by harnessing bio-waste as a feedstock. The development of nanoparticles from biowaste is an emerging area of research with significant implications for sustainability, waste management, and nanotechnology. This approach leverages the abundance of biowaste materials to produce high-value nanoparticles, thus addressing environmental concerns and contributing to the circular economy. Converting these bio-wastes into valuable nanoparticles offers a solution for waste management and provides an eco-friendly alternative to conventional nanoparticle synthesis methods, which often involve toxic chemicals and non-renewable resources. Our sustainable technology reduces greenhouse gas emissions, conserves natural resources, and mitigates pollution, contributing to a healthier planet and a more sustainable future for future generations. The "EcoNano" materials have been further tested for various applications, including biomedical, cosmeceuticals, biosensors, diagnostics, forensic science, etc. In this presentation, the fundamental challenges of biowaste and its management will be discussed, followed by the sterilization process and development of several nanoparticles from the biowaste in our laboratory will be further comprehended. The current challenges and regulatory policy related to nanoparticle development from the biowaste will also be discussed along with our future roadmap.

Keywords: Biowaste; Nanoparticles; Biomedical applications; Sustainability; Waste management.

Ultrasmall Metal Nanoclusters as Multifunctional Applications

Bharat Kumar
Department of Chemistry, M V College Buxar (Veer Kunwar Singh University Ara) Bihar, India

Abstract

Since last two decades, nanomaterials and their technology has shown tremendous application due to their realize downsizing, high activity and efficiency[1] for many applications. The decrease in the size of nanoparticles below ~ 2 nm shows distinct effects of electron energy quantization and exhibit unique size-dependent physical and chemical properties[2, 3]. Among these nanoclusters, monodisperse thiol (HSR) protected gold nanoclusters are promising materials and generated considerable interest as photoluminescence, redox behavior, and catalytic activity, which are absent in bulk gold[4,5]. We had synthesized various nanostructured materials depending on their size, shape, morphology, compositions and studies electrocatalytic, photocatalytic, organic catalytic and magnetic properties. We had worked on monodisperse atomic precise gold and mixed metal gold nanoclusters studied each of the four aspects (Charge, Doping, Size and Ligand) of these nanoclusters on electrochemical catalysis[6]. We achieved strong effect of each aspect of nanostructured and nanoclusters on the above said properties. It is observed that these materials were found to be suitable as multifunctional catalysts and improve catalysis in fundamental as well industrial applications.

Reference:

[1] N. S. Lewis, D. G. Nocera, Proc. Natl. Acad. Sci., 2005, 43, 15729-17335.
[2] Y. Negishi, T. Tsukuda, J. Am. Chem. Soc., 2003, 125, 4046-4047
[3] Y. Negishi, K. Munakata, W. Ohgake, K. Nobusada, J. Phys. Chem. Lett.,2012, 3, 2209–2214.
[4] Y. Niihori, M. Eguro, A. Kato, S. Sharma, B. Kumar, W. Kurashige, K. Nobusada, Y. Negishi, J. Phys. Chem. C, 2016, 120, 14301-14309.
[5] S. Hossain, W. Kurashige, S. Wakayama, B. Kumar, L. V. Nair, Y. Niihori, Y. Negishi
[6] B. Kumar, J. Maekawa, Y. Niihori, S. Hossain, W. Kurashige, Y. Negishi (under preparation).

Sustainable approach for synthesis of Natural Dye from Dried Flower Waste of Azadirachta Indica

Meena Choudhary, Priyanka Singh
Department of Biotechnology, Nims Institute of Allied Medical Science and Technology, NIMS University (Rajasthan), India, 303121

Abstract
The different parts of Azadirachta indica has significant medicinal values in Ayurveda field. They are commercially ued for synthesis of different therapeutic drugs in pharmaceutical sector. In thiss study, dried flowers of Azadirachta indica RUBL21378 has been used for ssynthesis of natural dye. The phytochemical screening was performed in different extract of their dired flower in organic solvents like methanol, ethanol, and acetone. These phytochemical screening had confirmed the presence of different bioactive components like saponins, quinone, flavonoids, and alkaloids. They showed specific antimicrobial property with effective zone of inhibition 0.5mm and 16mm against Escherichia coli and Staphylococcus aureus respectively. Copper sulphate was added as mordant during incubation period of dying process of cotton fabrics with flower extract. These fabrics exhibited a significant level of natural dye absorption at 50°C after incubation period up to 3 hours. The colour fastness was observed after treating them with sunlight at different interval of time period for 24, 48, and 72 hours. These fabrics showed stability in detergent solution (2%) for 30 minutes at 50°C. These fabrics showed equal colour intensity after dyeing with green tea as mordant. Their color intensity was increased after dyeing with flower extract of Acacia catechu as bio mordants. The functional groups are investigated by FTIR spectrum analysis. This methodology for synthesis of natural dyes could be efficiently employed in textile industry for colouring cotton fabrics at large scale.

Keywords: Azadirachta indica, natural dye, dried flower, cotton fabrics.

Digital Modules of the Green Buildings to Study Protection of Air Quality

Natalia Shushunova[1], Dmitry Korolchenko[2], Tatiana Shushunova[3]
[1]Department of Integrated Safety in Construction, Moscow State University of Civil Engineering, Yaroslavskoye Shosse, 26, 129337 Moscow, Russia
[2]Department of Integrated Safety in Construction, Moscow State University of Civil Engineering, Yaroslavskoye Shosse, 26, 129337 Moscow, Russia
[3]State University of Management, Ryazan Ave., 99, 109542, Moscow, Russia

Abstract
The aims of this study are to simulate air flows inside and around multi-storey green building spaces together with the distribution of concentrations of harmful substances and microorganisms to increase the sustainability of design solutions for green modules. Among the objectives of the study are assessment of bioclimatic comfort, risk analysis of bioclimatic eco-safety in the framework of aeration and pollution modeling, as well as eco-optimization of building design, which corresponds to Sustainable Development Goal 11 (SDG 11), sustainable cities and communities, and is essential for promoting healthy urban communities. The methodology is based on sequential Computational fluid dynamics (CFD) of air flows around and inside buildings with the determination of aggregate stagnant air zones, after which the concentrations of harmful substances and microorganisms are simulated based on the database of air samples and concentration calculations taking into account the influence of air flow directions and green modules. The data obtained on the areas and forms of stagnant air zones with the accumulation of concentrations of harmful substances and microorganisms allow us to consider various design approaches to building facades, floor plans and to reconsider the role of green spaces depending on the technology of the cultivation green modules to improve bioclimatic comfort and bioclimatic eco-safety.

Keywords: Digital model; Modeling of sanitary and hygienic environment; Ecology; Harmful substances;Green buildings; Air quality; bioclimatic comfort; Eco-safety; Green modules.

Photocatalytic and Cyclic voltammetry of Nickle Pyrophosphate Nano-Particles

Mahatta Oza[1], P.D.Solanki[2], M.J.Joshi[3]
[1]The Maharaja Syajirao University of Baroda, Vadodara- 390002, Gujarat, India
[2]Crystal growth laboratory, Department of Physics, Saurashtra University, Rajkot - 360005, Gujarat, India
[3]Atmiya University, Kalawad road, Rajkot - 360005, Gujarat, India

Abstract

Nickel pyrophosphate ($Ni_2P_2O_7$) is an interesting material with use in energy storage devices and super-capacitors. The surfactant – mediated approach is used to synthesis nickel pyrophosphate nano particles and further analyzed by using Powder XRD and TEM for confirmation of nano-structured nature. Methylthioninium chloride or popularly known Methylene blue (MB) organic dye is chosen for the photo-catalytic study using nickel pyrophosphate nano-particles. Due to large industrial use the MB is found in wastewater and hence the decomposition of MB has become a degradation standard practice. For photo degradation of MB by nickel pyrophosphate nano-particles is confirmed through several analyses, viz., wastewater analysis, total organic carbon (TOC) analysis, ion chromatography and UV -Vis. The results indicate that MB degrades in lower molecular leuco-dye. This gives an important application of synthesized nickel pyrophosphate nano-particles in an organic pollutant removal. To evaluate the electro-chemical properties of nickel pyrophosphate nano particles the electro-chemical impedance (EIS) spectral analysis is reported. Nickel pyrophosphate nano-particles are found to be potential photo-catalysts for MB dye degradation. The cyclic voltammetry study was carried out to ascertain the application potential for supercapacitors.

Keywords: Nickel pyrophosphate nano-particles, photo-catalytic activity, Wastewater treatment, Dye degradation, EIS spectroscopy.

Synthesis of Dihydropyrrolidine via Visible-Light-Promoted Click [3+2] Cycloaddition of Aziridine with Alkyne

Twinkle Keshari
Assistant Professor, University Department of chemistry, Veer Kunwar Singh University, Arrah, Bihar, India

Abstract

A photocatalytic [3+2] cycloaddition of aziridines with activated alkynes is reported under visible-light irradiation in the presence of ruthenium catalyst. This chemical transformation provides polysubstituted pyrrolidines in good yields based on the click chemistry philosophy. Using cycloaddition processes, click chemistry creates carbon–hetero atom bonds in an environmentally friendly manner. It is a broad-based technique that is quick, modular, effective, dependable, and easy to execute that may be utilized for the synthesis of new compounds with required functionalities. In this context, photocatalytic cycloadditions generated by visible light have been effectively used to synthesize a variety of carbo- and heterocyclic compounds. The reaction successfully represents a primary trial of cyclocarboamination through photocascade catalysis combining energy transfer and redox neutral reactions. method has yet been reported for producing 2,3-dihydropyrroles by visible-light photocatalysis and [3+2] cycloaddition of alkynes with aziridines.The reaction is scalable, uses low catalyst loadings, is highly regioselective, and provides a variety of polysubstituted dihydropyrroles in moderate to high yields. Visible light as a clean energy source makes this route a good substitute to the existing synthetic protocols.

Keywords: Aziridine; alkyne; dihydropyrrolidine; visible light; click chemistry; photoredox catalysis.

Exploring the potential of biomass-based composites for wastewater remediation: A sustainable approach towards contemporary problems

Surender Kumar
Department of Chemistry, Chaudhary Bansi Lal University, Bhiwani, Haryana, India 127031

Abstract

The growing environmental concerns and the pressing need for sustainable solutions have shifted attention to biomass-based composites for wastewater remediation. However, a lots of processes such as advanced oxidation, reverse osmosis, coagulation, flocculation, fenton oxidation, adsorption etc. have been utilized, but adsorption using biomass-based composites have shown promising results due to their high efficacy and low cost. This paper explores the potential of biomass-derived composites as eco-friendly alternatives for remediating wastewater. The bio composites of Saccharum munja were prepared, characterized to explore the morphological as well as physicochemical properties; and their efficacy was evaluated for removal of dyes and heavy metals. These synthesized bio composites demonstrate a good potential towards the removal of contaminants. Moreover, the overall impact of the process aligns with circular bioeconomic approach providing the sustainable solution involving the valorisation of waste biomass as an adsorbent, which not only helps to reduce waste but also provides a cost-effective solution for wastewater treatment. Thus, bio composites stand as a potential candidate for wastewater treatment and provides a sustainable solution.

Keywords: Adsorption; Biomass-based adsorbents; Circular bioeconomy; Contaminant removal.

Quantum corrections on optical phase conjugation via stimulated Brillouin scattering in ion-implanted semiconductor plasmas

Dr. Manjeet Singh
Department of Physics, Government College, Matanhail (Jhajjar) – 124105, Haryana, India

Abstract
Quantum effects (QEs) on the threshold and reflectivity characteristics of the optical phase conjugate mode (OPCM) in ion-implanted semiconductor plasmas are analytically investigated using coupled mode theory. Taking into account that the origin of stimulated Brillouin scattering lies in nonlinear induced polarisation of the medium, expressions are derived for complex effective Brillouin susceptibility (due to electrons and implanted colloids) and consequently the threshold pump intensity and the reflectivity of OPCM. Inclusion of QEs is done via quantum correction term in the hydrodynamic model of semiconductor plasmas. QEs modify the threshold and the reflectivity characteristics of OPCM in ion implanted semiconductor plasmas. Finally, an extensive numerical study of the n- InSb/CO2 laser system is performed for two different cases: (i) without QEs and (ii) with QEs. In both cases, the analysis offers two achievable resonances, at which an enhancement of reflectivity of OPCM is obtained at excitation intensities well below the optical damage threshold if ion-implanted semiconductor-plasma is used as an optical waveguide with an interaction length of a few millimetres. When QEs are included in the analysis, the entire spectrum shifts towards decreased levels of electron and colloidal carrier concentration. The results suggest that a high reflectivity optical phase conjugate mirror can be fabricated using n-InSb-CO2 system as the outcome of this research work.

Keywords: Optical phase conjugation; Quantum effets; Ion-implantation; Semiconductorplasma.

The Parthenium Biosorbents for Removal of Chlorides and Hardness from Water

Subhashish Dey
Civil Engineering Department, Gudlavalleru Engineering College, Gudlavalleru, Andhra Pradesh, India

Abstract

One of the most significant problems facing the environment is caused by the presence of contaminants in aqueous solution, most notably dangerous heavy metals. In rural places, hardness and chlorides are two of the most dangerous toxins in groundwater or surface water. It is largely because excessive quantities might cause sickness that it is controlled in terms of the quality of drinking water. Because of its alkaline nature, water may be irritating to the eyes, respiratory system, and skin problems, and the higher its concentration of hardness and chlorides, the greater the risk of these irritations. Biosorption is a naturally occurring physiochemical mechanism that enables specific biomass to passively bind toxins to its cellular structure. In this study, five distinct biosorbents, including rice husk, rapeseed straw, parthenium, sawdust, and egg cell, were manufactured in the laboratory. With regard to the removal of hardness and chlorides from water, in these biosorbents the parthenium biosorbents shows that the highest level of effectiveness among the other biosorbents. By using plant biomass of Parthenium, the chloride and hardness removal percentage is 65% and 80% achieved respectively. After identifying the most effective biosorbents, we optimized their parameters and gathered water samples from a variety of sources. In chlorides removal over parthenium biosorbents the optimum dosage of biosorbents is 3.8gm, temperature is 35^{o}C, pH is 7, and contact time is 120min and optimum agitation speed is 120rpm. In hardness removal over parthenium biosorbents the optimum dosage of biosorbents is 5.4gm, temperature is 35^{o}C, pH is 6.5, and contact time is 90min and optimum agitation speed is 150rpm. After eliminating the chlorides and hardness ions from water by utilized biosorbents, the biosorption process may be made more cost-effective by regenerating and recycling the biosorbent.

Keywords: Hardness, Chlorides, Biosorptions, Kinetic equilibrium, Isotherm data and Regeneration.

ICCMEPR-2024/FIT/SIT/286

Local thermal non-equilibrium effects on instability of hybrid nanofluids

Jyoti Sharma
University Institute of Engineering and Technology, Panjab University, Chandigarh-160014, India

Abstract

The hybrid nanofluid convection problem is studied under local thermal non-equilibrium (LTNE) model. The partial differential equations based on various conservation laws are reduced to ordinary using method of normal modes. The expression of thermal Rayleigh number is found to be a function of many non-dimensional numbers introduced due to LTNE and the hybrid character of the fluid. For thorough investigation of the problem, various nanoparticles are considered in base fluids for numerical computations of the problem. The LTE effect of nanoparticles destabilizes the system and the additional impact of LTNE tends to delay the onset of instability significantly. For deep insight into the convection process, various values of parameters are calculated and presented in the tables along with stability curves for nanofluids using the software Mathematica.

Keywords: Local thermal non-equilibrium model, Conservation equations, Hybrid nanofluids, Linear stability analysis, Rayleigh number, Metallic and non-metallic nanoparticles.

A Review: Fibre metal laminates for advanced aerospace applications

Gurmail Singh Malhi[1], Shneha Borah[2], Sonu Sharma[3], Ajin Branesh[4], Arundhati[5]
[1-4] Department of Aerospace Engineering, Chandigarh University, Gharuan, Punjab, India
[5]Department of Civil Engineering, Chandigarh University, Gharuan, Punjab, India

Abstract

The aviation sector has become more and more dependent on lightweight, high-performance structures over the past few decades, which has significantly accelerated the development of improved models for fiber-metal laminates (FMLs). Fibre-reinforced adhesives and thin metal layers that interlace to form fiber-like composite materials are called fiber-metal laminates (FMLs). The chapter also covers ARALL and GLARE composites, which are among the most popular and technologically advanced materials available today. The mechanical characteristics and manufacturing process of GLARE (glass-reinforced aluminium laminate) and ARALL (aramid reinforced aluminium laminates) have been studied). Comparing GLARE and ARALL to the other classical materials, the findings show their better behavior.FMLs are a very desirable candidate material for future aircraft structures due to its inherent corrosion resistance, superior fatigue behavior, damage tolerance, reduced component count and significant weight reductions. It is a remarkable accomplishment to combine these elements into a single substance. The article compares different high-performance aerospace structural materials with fiber metal laminates to characterize the impact qualities of the former. The review also examines the crucial implementation of FML-based solutions and sheds light on recently developed ones as well as on some other emerging technologies. In a nutshell, the paper provides a thorough overview of FML in the context of contemporary aviation by highlighting its compositions, properties, advancements, existing weaknesses, and recommendations for new lines of inquiry.

Keywords: FMLs, Aerospace structures, GLARE, ARALL, aviation industry.

Green Development of ABS Nanocomposites through Reduced Graphene Oxide (rGO) extraction from Plastic Waste

Alok K Sahu, Rajshree Vijayvargiya
Central Institute of Petrochemical Engineering & Technology (CIPET), Raipur, India

Abstract

The escalating global demand for plastics has led to a troubling increase in plastic waste, posing a serious environmental threat. Materials like PP, PE, and polystyrene are recognized for their potential to produce carbon nanomaterials from plastic waste. This research explores the influence of reduced graphene oxide (rGO) derived from plastic waste on thermoplastic nanocomposites, emphasizing their multifunctional applications and properties.

In this study, Acrylonitrile Butadiene Styrene (ABS) based nanocomposites were developed, reinforced with varying loads of rGO (0.50%, 0.75%, 1%, 1.5%, and 2%) through a melt mixing method. The mechanical, thermal, and electrical properties were assessed using Universal Testing Machine (UTM), Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA), and Dielectric Breakdown Tester. These properties were compared with those of virgin ABS material.

The investigation of ABS/rGO nanocomposites demonstrated significant enhancements in tensile and flexural strength, along with modulus, with the most notable improvements at 1% rGO loading, surpassing other compositions. This strength increase is attributed to improved stress transfer from the polymer matrix to the nanofiller. DSC analysis showed higher glass transition temperatures in all ABS/rGO nanocomposites compared to virgin ABS, due to better interfacial interaction and restricted thermal vibrations. However, a slight decrease in dielectric strength was observed as the rGO concentration increased, attributed to the induced polarization effect and the intrinsic high dielectric constant of rGO. Despite this, the nanocomposites exhibited exceptional mechanical properties even at low rGO levels, offering cost-effective solutions for the plastics industry and as materials for 3D printing.

Keywords: Plastics waste; rGO; Nanocomposites; Mechanical properties, ABS.

Record sensitive nanowire based bio-nanosensor for environmental monitoring created using using 3 D mechanical bottom up nano-assembling

Svetlana von Gratowski[1], Victor Koledov[1], Ngo Thi Hong Le[2]
[1]Kotel'nikov Institute of Radioengineering and Electronics Russian Academy of Sciences, Moscow, Russia
[2]Vietnam Academy of Science and Technology, Institute of Materials Science, Hanoi, Vietnam

Abstract

The environmental pollution, highlighting need to be studied using monitoring of contaminants in the real environment with reliable devices such as biosensors. In this matter the biosensors are one of the most important aspects in environment protection and remediation. Last time variety of biosensors gained high attention and employed as in-situ application, quick and cost-effective analytical tools for healthy environment. For environmental monitoring, it is necessary to have for portable, cost-effective, quick, and flexible biosensing devices. We report about the design and testing of the new record small and highly sensitive bio-nanosensors base on individual nanowires using new nano technological approach –namely 3D bottom up mechanical nano-assembling. This new bottom up nanotechnology involves the use of the smallest and fastest nanogripper with a composite shape memory effect (SME). Nanogripper carries out operations of selection, capture, pick up and place and transfer of single nano-objects. Those operations are the basis for nano assembly of single nanodevices. These nano-objects are transferred to a substrate, where nanoassembly of single nanodevices occurs. Nanodevices are not only very light and small in size, due to which they can be integrated into macrosystems. The created bio nanosensors have significantly higher sensitivity, up to femtomolar. Such bio-nanosensors can very quickly harmful recognise very small amount of environmental pollution. Nanogrippers created from composite with shape memory effect (SME) can provide record sensitive bio-nanosensors for environment protection and remediation.

This work was supported by RSF grant No 22-19-00783.

Keywords: bio-nanosensors for environment protection, individual nanowires, composite shape memory alloys, nanogripper, 3 D bottom up mechanical nanoassembling of single nanodevices

Natural convection of rigid-free nanofluid layer in high porosity: Jeffrey model

Poonam Kumari Gautam
Department of Mathematics, Bahra University, Waknaghat, Solan, (Himachal Pradesh), India

Abstract

This paper deals with the natural convection of rigid-free nanofluid layer in porous medium. The behavior of nanofluid is described by Jeffrey fluid model. The employed model incorporates the effects of Brownian motion and thermophoresis. The momentum-balance equation is modified due to the presence of Jeffrey parameter and nanoparticles. The rigid-free boundaries are used here. The Eigen-value problem is solved analytically as well numerically using Normal mode analysis and Galerkin Weighted Residuals Method (GWRM). Mathematica version 12.0 is used to calculate the values. The effects of the Jeffrey parameter, Lewis parameter, modified diffusivity ratio, Nanoparticles' Rayleigh number and medium porosity are discussed analytically and numerically. Outcomes are also presented graphically.

Keywords: Convection, Nanofluid, Brownian Motion, Galerkin Weighted Residuals Method, and Porosity.

Faculty / Scientist Talks

Synthesis and Property Analysis of Graphene Oxide in Metal Matrix Composites

M.K. Satya Sai
Associate Professor, Department of Mechanical Engineering,
Vignana Bharathi Institute of Technology, Hyderabad, Telangana, India

Abstract

Graphene oxide (GO) is a promising twolayered material that displays one-of-a-kind properties like high mechanical strength, high electrical conductivity, and huge surface region. Lately, GO has drawn extensive consideration in different fields, including hardware, energy capacity, and biomedical applications. In this review, we present a point-by-point union and portrayal of GO. The amalgamation of GO includes the oxidation of the graphite chip's areas of strength for utilizing specialists, trailed by the shedding of the subsequent graphite oxide to shape GO. The integrated GO was portrayed utilizing different strategies like Scanning Electron Microscopy (SEM), X-beam diffraction (XRD), Fourier Transform infrared (FTIR) spectroscopy, Raman spectroscopy, and UV - Visible Spectroscopy. Taking everything into account, the blend and portrayal of GO were effectively performed utilizing different insightful procedures. The outcomes got give valuable experiences into the properties of GO, which can be additionally investigated for different applications.

Keywords: Graphene Oxide; Scanning Electron Microscopy (SEM); Fourier Transform Infrared Spectroscopy (FTIR); Raman Spectroscopy; UV – Visible Spectroscopy.

Investigation of ultra-sensitive wave theory based analytical approach using BG beam

Bijaya Saha[1], Nabamita Goswami[2], Ardhendu Saha[2]

[1]Department of Electrical Engineering, National Institute of Technology Andhrapradesh, Tadepalligudem, Andhra Pradesh, Pin: 534101, India

[2]Department of Electrical Engineering, NIT, Agartala, Barjala, Jirania, Pin: 799046

Abstract

In the present study, an analytical study of a wave theory-based fiber optic biosensor using Bessel-Gauss beam is investigated for the detection of Bilirubin. The sensor structure consists of an unclad multimode fiber of core diameter 100 µm and followed by 90 µm of Bilirubin layer. Here Bilirubin is used as a sensing layer and a method based on wave theory is used to analyze the high-order modes in the optical fiber and to achieve the theranostics application in hyperbilirubinemia. Here, wave theory-based strategy has been adopted which can facilitate the convergence of analytical and experimental results. To increase the sensitivity of these devices, the method entails modifying the shape of the sensor probe to create higher-order modes, which in turn generate more evanescent waves. The sensor achieved a sensitivity of 0.7567 dB/nm, 6017.73 dB/RIU, and 24.65 dB/mm, with a resolution of 1.66×10^{-6}, which is 10.16 times better than the proposed sensor using Gaussian beam as a source. The proposed idea will result in a better screening platform to identify the hyperbilirubinemia by optically assessing the earlier stage of the hyperbilirubinemia.

Keywords: Fiber optic Sensor; Wave Theory Based Approach; Evanescent wave; Ray Theory; Hyperbilirubinemia.

Polymer Brushes: Role in Stabilizing Colloidal Suspension

Dr. Tanmoy Lahiri
P. G. Department of Physics, Magadh University, Bodh Gaya, Bihar, 824234

Abstract

Nanoparticle (NP) dispersion, either in isotropic or anisotropic fluid, leads to severe agglomeration due to strong Van-der-Waals attraction resulting into unstable colloidal suspension. This instability creates considerable hindrances in the potential applications of colloidal suspensions. For example, when Carbon Nanotubes (CNTs) are dispersed in liquid crystal (LC) medium, which acts as an anisotropic solvent, strong aggregation among CNTs leads to phase separation and therefore, the desired goal of amplifying the electro-optic behavior of LC, necessary in display applications, remains unfulfilled. One of the possible remedies, which is envisaged over the years, is to graft polymer chains on the surface of NPs. The underlying idea behind this envision is the following: when two NPs, having polymer chains grafted on their surface, approach each other, strong steric repulsion between polymeric chains counteracts against the Van-der-Waals attraction and therefore, NPs remain dispersed in the solution maintaining a desired distance to reduce the overall free energy of the medium. This leads to uniform dispersion of NPs and greater stability in the suspension. Grafting polymer chains on flat or curved surfaces induces substantial stretching under the both melt and solvent conditions. This stretching phenomenon, which crucially depends on the grafting density at the interface, creates the visible character of a brush and plays a pivotal role in stabilizing the colloidal suspension. Here, strong stretching theory, which remarkably simplifies the theoretical rigor of polymer physics, will be utilized to obtain analytical results for polymer brushes. The emphasis will be to calculate the change in free energy when two NPs having grafted polymeric chains on their surfaces, reminiscent of polymer brushes, approach each other. Crucial to this end, will be the Gaussian chain approximation, generally used for flexible polymeric chains. The subtlety of the theory can be simplified using the Derjaguin approximation, which relies on expressing the potential between two finite size bodies, which for the present case may be considered as two spherical NPs, in terms of the potential acting between two flat, almost infinite surfaces. It will be shown that the stability of the colloidal suspension depends greatly on the curvature of NPs.

Keywords: Nanoparticle; Colloidal Suspension; Polymer Brush; Gaussian Elasticity; Derjaguin Approximation.

Biogenic Leucas aspera fuelled CdS NPs: Characterization, investigation of catalytic and biological activity

Aisha Siddekha[1], H. S. Lalithamba[2], G. K. Prashanth[3]
[1]Department of Chemistry, Government First Grade College, Tumkur, India
[2]Department of Chemistry, Siddaganga Institute of Technology, Tumkur, India
[3]Research and Development Centre, Department of Chemistry, Sir M. Visvesvaraya Institute of Technology, Bengaluru, Karnataka, India

Abstract

In the present study we report a novel method for synthesizing cadmium sulphide nanoparticles (CdS NPs) using the extracts from Leucasasperaleaves (locally known as Tumbe plant) and cadmium nitrate tetrahydrate as precursor. The synthesized CdS NPs were characterized using commonly used characterization techniques. Purity of the CdS NPs were confirmed by FTIR and EDX. X-ray diffraction patterns and SEM verify thatCdS NPs are spherical. To establish the application of these NPs as heterogeneous catalyst the synthesis of tetrahydrobenzopyrans by a multicomponent reaction was carried out successfully and some of the synthesized molecules show good antifungal and antibacterial activity. Production of biodiesel from milk scum waste puts further emphasis on the catalytic application of these CdSNPs. Corrosion inhibitory ability of theCdS NPs for the mild steel yielded good results and reported herein.

Keywords: CdS nanoparticles; Leucas aspera; benzopyrans; antibacterial and antifungal activity; biodiesel production from milk scum; corrosion inhibition.

Sol-Gel synthesis of silica nanoparticles and their applications: A review

Navneet Singh
Assistant Professor, Department of Physics,
Rajiv Gandhi Government College for Women, Bhiwani – 127021, Haryana, India

Abstract

Due to their adaptable morphology and potential uses in numerous new fields, silica nanoparticles, or SNPs, have garnered significant attention recently. In the past ten years, noteworthy research has been conducted to find new processing techniques for SNPs, which has improved the physio-chemical properties and allowed for greater control over the SNPs' size, shape, and porosity. Numerous articles have been produced as a result of the various methods for creating SNPs, including flame spray pyrolysis, chemical vapour deposition, micro-emulsion, ball milling, and sol-gel. Research has concentrated on sol-gel preparation among these since it is a simple, scalable, and controllable synthesis. Thus, the latest developments in the synthesis of SNPs with organized mesoporous structure, their dispersion pattern, morphological characteristics, and applications are the main topics of this review. Both organic and inorganic templates have been effectively used to create mesoporous silica nanoparticles (MSNPs) with high dispersion, varied shape, narrow size distribution, and homogenous porous structure. A review has been conducted on the use of surfactants in soft template assisted synthesis to achieve desired morphologies, pores, shapes, and processes. In addition to single templates, there has been extensive discussion of double and mixed surfactants, electrolytes, polymers, etc. as templates. There has also been discussion on the impact of reaction circumstances, including temperature, pH, reagent concentration, drying methods, solvents, precursor, aging period, etc. These MSNPs can be used in drugs delivery systems, biosensors, high performance liquid chromatography (HPLC), cosmetics, and building materials, among other uses. Additionally, a brief overview of these SNPs' application has been provided.

Keywords: Silica nanoparticles; Solgel; Bio-sensors; Drying techniques.

Red emissive MSA capped CdTe quantum dots for cell imaging

Nideep T K[1,2], Ramya M[1], Aiswarya Deepti[3], Prabha Prakash[3], Baby Chakrapani P S[3], Kailasnath M[1]
[1]International School of Photonics, CUSAT, Kochi, Kerala, India
[2]PTM Government College, Perinthalmanna, Malappuram, Kerala, India
[3]Department of Biotechnology, CUSAT, Kochi, Kerala, India

Abstract

The changes in the optical and electronic properties of the materials due to the quantum confinement effect in semiconductor nanoparticles have attracted huge interest in the scientific community. Within the semiconductor nanoparticles, the quantum dots (QDs) deserve a special position due to their high quantum confinement effect and unique optoelectronic properties. Among the semiconductor quantum dots, CdTe attracts more attention due to its easy manufacturing, large Bohr exciton radius, and wide range of absorption and emission tunability. These unique properties make them useful in a wide range of areas, like solar cells, sensing, bioimaging, lasing, nonlinear optical applications, etc. In the present work, MSA-capped water soluble CdTe QDs are prepared using a simple colloidal method for cell imaging. The XRD spectrum, UV-vis absorption spectrum, PL spectrum, DLS analysis, and HR-TEM analysis are applied for the characterization of synthesized CdTe QDs. Here, we synthesized red emissive spherical CdTe QDs of average size 6nm. The bioimaging efficiency of MSA-capped CdTe QDs is examined on N2A Cells. These results show that CdTe QDs are a promising material for cell imaging.

Keywords: Quantum dot; CdTe; MSA; Water soluble; Bioimaging.

Synthesis and Characterization of L-alanine passivated ZnS Nanoparticles

Y. S. Tamgadge[1], P. P. Gedam[2], R. Y. Bakale[1], R. P. Ganorkar[3], S. V. Khangar[4], G. G. Muley[5]
[1]Department of Physics, Mahatma Fule Mahavidyalaya, Warud, Dist. Amravati (MS), India
[2]Department of Physics, Shri R. L. T. Science College, Akola (MS), India
[3]Department of Chemistry, Mahatma Fule Mahavidyalaya, Warud, Dist. Amravati (MS), India
[4]Department of Physics, Science College, Nagpur (MS), India-440012
[4]Department of Physics, Sant Gadge Baba Amravati University, Amravati (MS), India 444602

Abstract

We report synthesis and characterization of ZnS nanoparticles (NPs) passivated using l alanine amino acid by simple co-precipitation method at room temperature. The samples in powder form were characterized by X-ray diffractometry (XRD), Energy dispersive X-ray spectroscopy (EDS), ultra-violet visible (UV-vis) spectroscopy and fourier transform infrared (FT-IR) spectroscopy. XRD and EDS confirms the formation of ZnS NPs with desired phase and purity and ZnS NPs with average particle size of 4nm were observed for l-valine capped NPs. UV-vis spectra show strong blue shift in the maximum absorption peaks and the shift upto 295nm was observed for the ZnS sample prepared using highest concentration of alanine justifying its role in the efficient surface passsivation. FT-IR spectrum confirms the presence of amino-acid group.

Keywords: ZnS nanoparticles; XRD; L-alanine; FT-IR.

Structural Materials Relaxation Behavior of Polymer Thin Film

R Y Bakale[1], Y G Bakale[2], Y S Tamgadge[1], R P Ganorkar[3], S V Khangar[4]
[1]Department of Physics, Mahatma Fule Arts, Commerce and Sitaramji Chaudhari Science Mahavidyalaya, Warud, Maharashtra, India
[2]Department of ESH, Kavikulguru Institute of Technology and Science, Ramtek, Maharashtra, India
[3]Department of Chemistry, Mahatma Fule Arts, Commerce and Sitaramji Chaudhari Science Mahavidyalaya, Warud, Maharashtra, India
[4]Department of Physics, Shri Shivaji Education Society Amravati, Science College, Congress Nagar, Nagpur, India

Abstract

Thin films of composites PVC-PMMA doped with iodine, and cinnamic acid are prepared using the isothermal evaporation technique. Current time characteristics, by application of direct and reverse polarities in succession, were continued until the conduction current reached a steady state. The relaxation time Ꞇ obtained from these plots is from the time required for the current to reach maximum value. Values of drift mobility 'Ꞇ' and density 'n' of charge carriers obtained from theoretical relations. The magnitude of time, found in the present composite system, agrees quite well with that reported in the literature. The increase in the concentration of dopants adversely affects mobility while favors charge carrier density.

Keywords: Polyvinyl chloride (PVC); Polymethyl methacrylate (PMMA); Composites; Relaxation time.

Nano material Synthesis & Controlling Aspects: A State-of-the-art Review

Reena Kumari
Assistant Professor, Chemistry Department, Government College, Bahadurgarh, Haryana, India

Abstract

Nanomaterials have acquired significance from revelation of hazardous explosive gunpowder in fourteenth century with expansion in activity when finely grounded. Numerous long periods of crushing brought about fine particles of saltpeter and sulphur occupying the interstitial site of the charcoal .The very excellent properties displayed by nanomaterials enhancing their exhibition when contrasted with their macrosize sample are subject of much interest for current time researchers. Nanomaterials can be delivered with different strategies: Mechanical processing, Electrospinning, Chemical vapour deposition method, laser pyrolysis, solvation method, hard and soft template strategy and Reverse micelles. This review explicit different thermodynamic elements and controlling variables influencing the nano-scale development of nanomaterials. This survey addresses comparative examination of different strategies of synthesis of nanoparticles ,class of compounds developed and comparative advantages . In this review procedures and principles engaged with different techniques for union of nanoparticles have additionally been examined. The different stage progress processes with their thermodynamic and dynamic bases are likewise included to have a reasonable comprehension of development of nanomaterials. This review is at last finished up by referencing the different difficulties in developing nanomaterials to be handled and consolidation of future procedures zeroing in on green union and high efficiency.

Keywords: Saltpeter; Synthesis; Reverse micelles; Solvation; Electrospinning.

Nanomaterials in optoelectronics - An overview

Aisha Siddekha[1], H. S. Lalithamba[2], G. K. Prashanth[3]
[1]Department of Chemistry, Government First Grade College, Tumkur, India
[2]Department of Chemistry, Siddaganga Institute of Technology, Tumkur, India
[3]Research and Development Centre, Department of Chemistry, Sir M. Visvesvaraya Institute of Technology, Bengaluru, Karnataka, India

Abstract

Energy conversion and conservation are the most sought-after technologies in the present scenario where the world is dealing with the energy crisis and exploring the new technologies for the generation of energy. Nanomaterials with their broad and interdisciplinary areas of research have touched every walk of human life and are seeing an exponential growth worldwide in the past few years. Optoelectronics is an emerging technology where the devices are being used in telecommunications, solar cells, photodiodes, LEDs, OLEDs etc. Nanoparticles have unique optical, mechanical and electrical properties owing to their morphology and structure. These are being used in optoelectronic devices to generate and detect light. This article discusses the features of the nanomaterials being used in optoelectronics making the world brighter, colorful, and energy efficient.

Keywords: Nanomaterials; optoelectronics; optical devices; energy storage and energy conservation.

CuO/Polyaniline/Multiwalled Carbon Nanotube Composites for Hydrogen Gas Sensing Using Macaranga Indica Leaf Extract

Shivaprasad Chalawadi[1], Rajashekhar Bhajantri[1], Malatesh S Pujar[2]
[1] Department of Studies in Physics, Karnatak University, Dharwad-580003, Karnataka, India
[2]Departmernt of Physics, KLE Technological University's, Dr. M. S. Sheshgiri Campus, Belagavi – 590008, Kanataka, India

Abstract

In this study, hydrogen gas sensors are produced in the form of nanocomposites involving copper oxide (CuO), multi-walled carbon nanotubes (MWCNTs), and polyaniline (PANI) using Macaranga indica (M. indica) leaf extract as a reducing and stabilizing agent for copper oxide nanoparticles (CuONPs). The sample underwent analysis using various techniques to ascertain its physicochemical, morphological, and elemental composition. The X-ray diffraction (XRD) data indicated that the sample corresponds to a CuO/PANI/MWCNTs nanocomposite, based on the best match with reported data. Scanning electron microscope (SEM) images revealed a consistent distribution of MWCNTs and spherical CuO nanoparticles measuring 30–40 nm throughout the CNT network. Energy-dispersive X-ray spectroscopy (EDX) confirmed that the prepared sample comprises a pure combination of Cu, O, C, and N. Due to the presence of bioactive elements and PANI, we observed weight losses of 17% and 25% for CuO and CuO/PANI/MWCNTs, respectively. It was observed that this composition of materials can detect H2 gas at concentrations ranging from 110 ppm to 2 ppm at temperatures of 200°C and 250°C. As the H2 concentration increased, sensitivity varied from 5% to 20%, with response and recovery times of approximately 290 s and 500 s, respectively for 40 ppm H2 gas. A logistic function fit to Ra/Rg versus H2 was applied using Y = A2 + (A1 − A2) / (1 + (x/x0)p. The energy bands among the CuO/PANI/MWCNTs heterointerfaces were utilized to demonstrate improved H2 gas sensing properties.

Keywords: Hydrogen gas sensors; Macaranga indica; Physicochemical analysis; Sensitivity; Recovery time.

Treatment of college canteen sullage using microcosm phytorid system

Madhumati S. Dhaduti[1], Sandeep C. Dhaduti[2], Sandhya Jalgar[3]
[1]Department of Civil Engineering, K. L. E. Institute of Technology Hubballi 580027
[2]Department of Mechanical Engineering, K. L. E. Institute of Technology Hubballi 580027
[3]School of Civil Engineering, KLE Technological University, Hubballi 580030

Abstract

Wastewater is commonly characterized as 'sullage' and 'blackwater', Reuse of sullage is possible only after proper treatment. Amongst available sullage treatment methods, Phytorid method which works on the principle of natural wetlands prove to be cost-effective and simple in monitoring. In this study, the treatment of college canteen kitchen sullage is done using Phytorid technology, a pilot scale reactor setup with plants like Canna Indica, Moses in the cradle, Spider plant, Golden Duranta and Beach spider lily are planted in separate containers filled with layers of gravel (bottom), sand (middle) and garden soil (top). The sullage was passed through five containers containing plants and the control. The raw sullage and the effluent were analysed for pH, electrical conductivity, TDS, Chlorides, Phosphates, Sulphates, BOD and COD for 7, 14 and 21-days intervals. The characterization of the sullage sample from the college canteen kitchen had pH ranging from (6.98 to 7.80), electrical conductivity (1560 to 1600 μS/cm), TDS (1150 to 1210 mg/L), Chlorides (345.43 to 387.50 mg/L), Phosphates (12.43 to 13.63mg/L), Sulphates (136.25 to 142.1 mg/L), BOD (398 to 416 mg/L) and COD (489 to 535mg/L). The results showed that Beach spider lily showed higher re- duction efficiency for Electrical conductivity (15.94%), Chlorides (87.68%) and Phosphates (79.43%). Spider plant showed higher reduction efficiency for Sulphates (38.69%), TDS (30.17%) and COD (75.05%) whereas, Golden Duranta was efficient in reducing BOD (88.94%). All the plants were efficient in neutralizing the pH. From the study, it can be concluded that a phytorid system consisting of Beach Spider lily, Spider plant and Golden Duranta will be efficient in reducing the physio-chemical parameters of sullage. Reusing treated sullage for flushing and gardening will promote water recycling and conservation.

Keywords: Sullage treatment; phytorid system; reduction efficiency; TDS; BOD.

Antifungal Potential of Phyllanthus niruri -Derived Nanoparticles: A Novel Therapeutic Approach

Neha Nidhi Tirkey
Department of Zoology, Jagannath Nagar College, Dhurwa, Ranchi, Jharkhand, India

Abstract

The increasing prevalence of fungal infections and the emergence of antifungal resistance underscore the urgent need for novel and effective antifungal agents. This study investigates the antifungal potential of nanoparticles synthesized from Phyllanthus niruri, a plant renowned for its medicinal properties. The research encompasses the green synthesis, detailed characterization, and evaluation of these nanoparticles against a range of pathogenic fungi. Antifungal efficacy is assessed through in vitro assays, including disc diffusion and the determination of minimum inhibitory concentration (MIC), alongside mechanisms of fungal inhibition such as cell wall and membrane disruption. Results demonstrate that nanoparticles derived from Phyllanthus niruri exhibit significant antifungal activity, attributed to their distinctive physicochemical properties and the plant's bioactive compounds. These findings suggest that Phyllanthus niruri-derived nanoparticles present a promising natural alternative for antifungal therapy, potentially addressing the limitations of conventional antifungal agents. Future research should aim to optimize the synthesis process, elucidate the molecular interactions with fungal cells, and assess the safety and efficacy of these nanoparticles in clinical settings. This study highlights the potential of plant-based nanoparticles in developing innovative antifungal treatments.

Keywords: Nanoparticles; Fungi; Antifungal.

Photocatalytic degradation of aqueous dyes by TiO_2/Fe_2O_3/Starch nanocomposites

Mahesh Bhat, Ramya, Rangaswamy J, Suparna
Department of Chemistry, Poornaprajna College (Autonomous), Udupi-576101, Karnataka, India

Abstract

Mixed nano composites of TiO_2 /ferric oxide /starch was synthesized by the solution phase method. The synthesized nano composites was characterized by SEM and particle size analyser. SEM Shows that TiO_2 and Fe_2O_3 phases within the composite and polymer act as the binding material between the metals, shows uniform distribution of the particle. Particle size distribution shows that particle size slightly below the 100nm, with needle rod shaped nono titanium is dispersed in the phase. Aqueous solution of dyes solution of dyes are prepared at 50 ppm. Batch experiments are carried out for the study of photocatalytic oxidation of dyes. The Synthesized nanocomposite shows superior photocatalytic activity on food colour yellow with photocatalytic activity of 49.2 % oxidation of dyes. The synthesized nanocomposites are moderately act as photocatalytic for the oxidation for the Eriochrome Black T and methylene Blue dues in aqueous dyes.

Keywords: Nanocomposites; TiO_2; Photocatalysis; SEM; Eriochrome Black T.

Magnetic and dielectric behaviour of PVP capped $Cu_{1-x}Fe_xO$ (x = 0.2- 0.10) nano-composites

Sushil Kumar[1], Harish Garg[2], Ankita Taneja[1], Rajwinder Singh[3], Hardev Singh[2], Sanjeev Kumar[1]
[1]Department of Physics, Goswami Ganesh Dutta Sanatan Dharama College, Sector 32, Chandigarh, India
[2]Department of Physics, Kurukshetra University, Kurukshetra, India
[3]Department of Physics, Panjab University Chandigarh, India

Abstract

Pure and $Cu_{1-x}Fe_xO$ (x = 2, 4, 6, 8 and 10) nanocomposites capped by polyvinylpyrrolidone (PVP) were synthesized by chemical co-precipitation method. The synthesized nanocomposites were characterized using powder X-ray powder diffraction (XRD), high resolution transmission electron microscope (HRTEM), energy dispersive X-ray (EDX) mapping, energy dispersive X-ray fluorescence (EDXRF), diffused reflectance spectroscopy (DRS), dielectric and vibrating sample magnetometer (VSM) measurements. HRTEM analysis confirmed the synthesis of small agglomerated and elongated nanoparticles with average crystalline size of ~10-28 nm. The purity and successful incorporation of Fe dopant atoms in CuO nanostructured were established from EDX mapping and EDXRF measurements. The optical properties were determined from the analysis of DRS spectra and results showed variable bandgap of ~2.0–2.56 eV. The dielectric properties viz. dielectric constants and dielectric losses of synthesized nanocomposites were studied in frequency range ~1 kHz–5 MHz and temperature range ~25 ^{o}C–300 ^{o}C. The observed variation in dielectric properties with frequency and temperature are attributed to relaxation processes resulting from inter-granular activities and grain boundary effects. The VSM measurements showed week room temperature ferromagnetism in the form of small hysteresis loops for synthesized nanocomposites tailored by Fe^{3+}ion substitutions and attributed to exchanged interaction between localised d-spins of Fe^{3+}ions and electron/hole charge carriers. The present experimental results confirm that synthesized $Cu_{1-x}Fe_xO$ (x = 0, 2, 4, 6, 8 and 10) multifunctional nanocomposites can be a credible candidate for spintronics and optoelectronics.

Keywords: Nano-composites; Functional materials; Room temperature ferromagnetism; Dielectric behaviour; Adsorption capacity.

Enhancement of mechanical strength and durability properties of LC3 concrete incorporating TiO_2 and Lathe Fibers

Tejas D. Doshi[1], Malatesh S Pujar[2]

[1]Department of Civil Engineering, KLE Technological University, Dr. M. S. Sheshgiri Campus, Belagavi, Karnataka, India

[2]Department of Physics, KLE Technological University, Dr. M. S. Sheshgiri Campus, Belagavi, Karnataka, India

Abstract

In this study, Lime calcined clay cement (LC3) samples are prepared using different percentages of clay and lime. The LC3 concrete is mixed with TiO_2 nanomaterial and Lathe fibers to increase the mechanical strength and reduce the reliance on steel in structures. The addition of TiO_2 nanomaterials also improved the durability of the concrete. The prepared samples are subjected to microstructural studies using techniques such as X-ray diffraction (XRD) to confirm the mixture, Fourier transform infrared spectroscopy (FTIR) to analyze the functional groups present, and scanning electron microscopy (SEM) to examine the well mixers. The combinations of LC3 series samples are optimized based on their initial and final setting time test results. LC2 combination exhibited the highest optimal compressive strength of 36.07 N/mm^2. Comparing LC nanomaterials and fibers showed no remarkable decrease in compressive strength. The Mix-LCNF exhibited a 9.23% increase in split tensile strength. Both nanomaterials and fibers displayed good flexural strength with LC3 samples even after 28 days. In the durability test, the LCNF sample showed significantly lower water absorption, 50.76% less than the NM-Mix sample. Additionally, the addition of Lathe fibers effectively reduced sorptivity. LC3 samples with fibers and nanomaterials demonstrated excellent resistance to chloride penetration. Finally, the LC3 samples with Lathe fibers and nanomaterials composites showed strong resistance to water penetration, with a depth of 20 mm, meeting acceptable limits. As a result, it is suggested that the Lathe fiber and nanomaterial mixed LC3 samples can be effectively used for commercial structures to enhance mechanical properties and durability.

Keywords: LC3; Lathe fiber; TiO_2 nanomaterial; SEM; XRD; FTIR.

PI3Kδ and mTOR dual inhibitors: design, synthesis and anticancer evaluation of 3-substituted aminomethylquinoline analogues

Digambar Yevale[1,2], Chetan B. Sangani[1,2]
[1]Department of Chemistry, Shri M.M Patel Institute of Sciences and Research, Kadi Sarva Vishwavidyalaya, Gandhinagar- 382016, Gujarat, India
[2]Department of Chemistry, Government Science College Sector-15, Gandhinagar-382016, Gujarat University, Gujarat, India

Abstract

Phosphatidylinositide-3-kinase (PI3K) and the mammalian target of rapamycin (mTOR) have recently been identified as potential cancer targets. In our work, a new family of quinoline analogues was designed, developed, and evaluated as dual inhibitors of PI3Kδ/mTOR. The preliminary biological activity analysis led to the discovery of the lead compounds 5h and 5e. Compounds 5h and 5e exhibited excellent anti-tumor potency with IC_{50} of 0.26 µM and 0.34 µM against Ramos cells, respectively. Importantly, based on the enzymatic activity assay results, compounds 5h and 5e were identified as dual inhibitors of PI3Kδ and mTOR, with IC_{50} values of 0.042 µM and 0.056 µM for PI3Kδ and 0.059 µM and 0.073 µM for mTOR, respectively.

Keywords: PI3Kδ/mTOR inhibitors; apoptosis; docking; metabolic stability.

Fluoride removal from aqueous solution using granular natural soil and activated charcoal

Madhumati S. Dhaduti[1], Anand M. Hunashyal[2], Rajappa S K[3]
[1]Department of Civil Engineering, K L E Institute of Technology, Hubballi -580027
[2]School of Civil Engineering, K L E Technological University, Hubballi -580030
[3]Department of Chemistry, Karnatak Science College Dharwad-580001

Abstract

In this work, thermally treated granular medium adsorbent prepared using combination of Black Cotton soil clay, red soil clay and activated charcoal (BRC) are tested for removal of fluoride from synthetic water. The fluoride reduction after 1h was 70% with an initial concentration of 5 mg/L. Adsorption of fluoride was significantly observed for a pH range of 2 to 14 highest fluoride reduction was observed at pH range of 6 to 10. The isotherm model study gave better fit for Langmuir isotherm with regression parameter (R2= 0.98) than the Freundlich isotherm (R2 = 0.84) which signifies monolayer adsorption. From Kinetic studies it was observed that the adsorption followed pseudo second order kinetics. The surface morphology of the granular medium is also studied using SEM and EDAX and due to fluoride ions adsorption on the adsorbent surface there was textural change observed. This study indicated that locally available Black cotton soil, red soil and activated charcoal in combination in granular form are good in the defluoridation of water.

Keywords: Adsorption; Fluoride; Soil; charcoal.

Green Solvent Mediated Solution Combustion Synthesis of Photocatalytic Active Copper Doped Zinc Oxide Nanoparticles and its Antimicrobial Activity Study

Vinisha Valsaraj P[1], Ashna P[2], Anagha Rajan[2], Sreshma Rajan[3]
[1]Department of Chemistry, Sree Narayana College, Kannur
[2,3]Department of Physics, Sree Narayana College, Kannur

Abstract

Environmental concerns over water pollution, particularly from chemical and biological sources, have become increasingly pressing in contemporary society. One of the grand challenges of the 21st century is ensuring safe and affordable water for all. This study investigates the effectiveness of solution combustion synthesised pure and copper doped zinc oxide nanoparticles in photocatalyticaly degrading dye pollutants focusing on methylene blue. Using green solvent solution combustion process, copper doped zinc oxide nanoparticles were prepared and tested for their ability to degrade methylene blue dye. Parameters influencing the photodegradation efficiency including catalyst concentration, ph levels and dye concentration were systematically evaluated. Results indicate that the photocatalytic degradation of methylene blue dye increase with irradiation time, achieving up to 94% degradation in just two hours. The nanoparticles were characterized using XRD, UV-Visible diffuse reflectance spectroscopy, photoluminescence and SEM. The antimicrobial activity of synthesized nanoparticles was evaluated against gram positive and gram-negative bacteria. The copper doped zinc oxide exhibited significant antimicrobial activity, with zone of inhibition measuring 12 and 17 mm against E.coli and staphylococcus aureus respectively. By leveraging their multifunctional properties, these nanoparticles not only contribute to improving public health through their microbial properties but also play a crucial role in environmental remediation by breaking down harmful organic compounds. Thus, they represent a promising innovation in the fields of medicine and environmental science, offering sustainable solution to mitigate pollution caused by organic dye.

Keywords: Solution combustion synthesis; doping; photocatalytic activity; antimicrobial acitivity.

High Ionic Conductivity in Sodium Titanate: Na_4TiO_4

K.M. Mishra[1], P.K. Pandey[2], Apara Tripathi[3], F.Z. Haque[4]
[1,2,3]Department of Physics, D. D.U. Gorakhpur University, Gorakhpur-273009, India
[4]Department of Physics, MANIT Bhopal, India

Abstract

Na_4TiO_4 have been prepared using high temperature solid state reaction technique employing Na_2CO_3 and TiO_2 as starting materials. Electrical conductivity (σ) and thermoelectric power (S) of pressed pellet of Na_4TiO_4 have been measured in the temperature range of 440K to the melting point of the material. Results have been reported as logσT Vs T^{-1} and S Vs T^{-1} plots. It has been observed that σ jumps by a factor of 10 at a particular temperature and reaches the value of the order of 10^{-1} around 1100 K. S value show anamoly at the same temperature. This temperature has been referred to as phase transition temperature (T_P) of that solid. The ionic (σ_i) and electronic (σ_e) parts in total conductivity have been evaluated using time dependence study of dc electrical conductivity. It has been observed that contribution of σ_i to σ above TP is more than 98%, below TP it decreases but remain close to 94% up to 500K. From these data it has been concluded that the material exists in two phases. The phase above TP is high ionic phase and below TP is mixed conductor. In these phase one can expect the existence of Frankel defect and they are probably, the entity of electrical conduction.The enthalpy for the migration of these defects and heat of transport also been evaluated.

Keywords: Electrical transport; phase transition; electrical conductivity; thermoelectric power; heat of transport.

Host polymer matrix dependent significant improvements in electro optical switching of polymer dispersed liquid crystal films

M. K. Malik[1], Konica Sharma[1], R. R. Deshmukh[2]
[1]Department of Physics, School of Basic & Applied Sciences, Lingaya's Vidyapeeth, Faridabad – 121002
[2]Department of Physics, Institute of Chemical Technology, Matunga, Mumbai - 400019

Abstract

Polymer dispersed liquid crystals (PDLCs) have attracted a great deal of interest due to their unique characteristics of electrically controlled switching in, for instance, large-area displays, spatial light modulators, light valves, diffractive optics and flexible displays. However, there exist a number of issues which need to be solved in connection with commercial use of PDLC devices. These issues include high driving voltage, large decay times, memory and/or hysteresis effects and instability over external parameters such as temperature. Over the years, efforts have been devoted to the computational and experimental studies to have a better control over the process parameters during synthesis and optimization of the electro-optical switching of PDLCs. Incorporation of some unique structures such as hydroxy, epoxy, branched methylene/methyl, cyclic methylene, phenyl, bisphenol, liquid crystalline polymers, electro-chromic molecules and various other additives into the conventional acrylates have been reported with an aim to improve the electro optical characteristics. However, such methods feature a multi-step PDLC film preparation approach that often lead to relatively complicated film preparation methods, free-radical generation affecting the PDLC performance adversely, reduced life times of the films, higher large-area manufacturing expenses, poor control over the hysteresis and memory effects etc. In this article, we report some significant results on the electrically controllable light scattering-transmission switching of a low molecular weight nematic liquid crystal (LC) E7 dispersed in poly (methyl methacrylate) (PMMA) and poly (methyl methacrylate-co- butyl acrylate) (PMMA-BA) as host polymer matrices. The effects of the varying combinations of PMMA and PMMA-BA on the morphologies, transmittance, threshold voltage, driving voltage, response times and hysteresis effect of PDLC films were studied in detail. The switching voltages and response times were found to be greatly improved maintaining a good overall contrast ratio with varying host matrix combinations. The hysteresis effect was significantly reduced for the PDLC films in addition to low OFF-state transmittance measured with increasing temperature values. The results were interpreted in terms of aggregation structure, interfacial interaction, and distribution of phase-separated of LC in polymer matrices. Our results showed the successful formulation based on the suitable constituent combinations of a host polymer matrix to prepare PDLC composite films with improved electro-optical properties.

Keywords: Electro-optical; PDLC; PMMA; hysteresis; Liquid crystal.

Mechanistic Insight into Zr-O Imprinted Pyrolytic Agricultural Biomass Char for Adsorptive Defluoridation from Aqueous Environment

Vandana Saxena[1], Atul Srivastava[2] Anushree Srivastava[1]
[1]Department of applied science and Humanities, IIMT College of Engineering, Greater Noida, India
[2]Centre of Environmental Science, Institute of Interdisciplinary Studies, University of Allahabad, Prayagraj, Uttar Pradesh, India

Abstract

This study investigates the development of a cost-effective and sustainable adsorbent for fluoride removal from water. Crop residue of Vigna mungo, a readily available and low-cost agricultural waste, was pyrolyzed to create biochar. This biochar was then modified with biogenically synthesized nano-zirconium oxide (Zr-O) using leaf extract of the black gram for enhanced functionality. The use of agricultural waste for biochar production minimizes the need for virgin materials and promotes waste valorization. The synthesized biochar was characterized using Scanning Electron Microscopy (SEM), Energy Dispersive X ray spectroscopy (EDX), X-ray Diffraction (XRD), and Point of Zero Charge (PZC) analysis that provided the physio-chemical characteristic of the developed adsorbent involved in the mechanism of fluoride removal.Batch adsorption experiments were conducted to optimize the removal process under various conditions. The effects of initial fluoride concentration, biochar dosage, contact time, and solution pH were investigated. The results indicated that the maximum fluoride adsorption capacity (56 mg/g) was achieved at neutral pH with an initial fluoride concentration of 20 mg/L, using a biochar dosage of 2 g/L and an equilibrium time of 60 minutes.Isothermal modeling was performed using Langmuir and Freundlich isotherms. The Langmuir model exhibited a higher correlation coefficient, suggesting monolayer chemisorption as the primary mechanism for fluoride removal. This finding was further supported by kinetic modeling, where the pseudo-second-order kinetic model demonstrated a better fit with the experimental data.The effectiveness of the developed biochar was further evaluated using real water samples. The adsorbent displayed a high removal efficiency of 89.8%, indicating its potential for practical application in fluoride remediation.

Keywords: Vigna mungo; agricultural residues; fluoride; Adsorption; Zr-O; water remediation.

Experimental Study On Chemical Resilience Of Glass Reinforced Polymer Pipes For Sewage Applications

Devanand Chelot[1], Vijaya Lakshmi Mishra[2], Priyank Upadhyaya[1]

[1]Department of Mechanical Engineering, Birla Institute of Technology and Science Pilani, Dubai Campus, UAE, PO Box 345055

[2]Adjuct Faculty, Department of General Science, Birla Institute of Technology and Science Pilani, Dubai Campus, UAE, PO Box 345055

Abstract

In-depth understanding of composite pipe corrosion behavior is necessary due to their exposure to diverse chemical environments. Our study centers on Glass Reinforced Plastic (GRP) composites, designed for underground construction and industrial applications, including aging sewage pipelines. We assessed the chemical durability of these GRP materials, specifically those reinforced with polyester. We scrutinized the mechanical, physical, and chemical properties of both individual layers and the composite itself before and after immersing them in various chemicals for durations of 30, 60, 90, and 180 days. The chemical environment closely mimics the in-service conditions of these composite pipes which include Sulphuric acid (H_2SO_4), Sodium hypochlorite (NaClO), Methyl ethyl ketone peroxide (MEKP), distilled water, Sodium chloride (NaCl), Propanone (C_3H_6O), Cobalt Octate, and Dimethylacetamide (DMA). We investigated the impact of these chemicals on surface morphology and chemical composition, utilizing mass loss measurements. The objective was to assess alterations in tensile strength and gauge the extent of composite degradation resulting from the chemical exposure. This research significantly contributes to the understanding of GRP composites' resilience, crucial for the development of robust infrastructure and industrial applications in challenging corrosive environments.

Keywords: Chemical Resistance; Glass Fiber Composites; Sewage; Mechanical Properties.

Optical band gap study of $Bi_{(1-x)}Ca_xFeO_3$ nanoparticles for photovoltaic applications

Manoj K. Singh[1], Preeti Yadav[1], Arushi Pandey[1]
[1]Centre of Material Sciences, University of Allahabad, Prayagraj -211002, India

Abstract

Multiferroic BiFeO3 (BFO) with bandgap energy (Eg) between 2.2 eV to 2.7 eV is a potential candidate for photovoltaic (PV) application. In this context, the structural and optical properties of $Bi_{1-x}Ca_xFeO_3$ (x = 0,5%,10%) nanoparticles synthesized via sol gel method are investigated. For 10% Ca-doping, a phase transition from the rhombohedral R3c structure to orthorhombic Pbnm structure is observed, which is analysed from the XRD pattern[1,2]. The average particle size of the doped samples is reduced in comparison of the pure sample. The average crystallite size has been calculated using the Scherrer's formula. The same has also been calculated using Williamson-Hall (W-H) plot along with the strain developed in the lattice due to substitution. The average grain size of all the samples is estimated from FESEM images. Energy dispersive spectroscopy showed the existence and atomic % of Bismuth (Bi), Calcium(Ca), Iron (Fe) and Oxygen (O) elements in Bi(1-x)CaxFeO3 samples. FTIR spectra in transmittance mode give a brief idea of vibrational modes around Fe–O–Fe stretching bonds. With the increase of Ca^{2+} dopants, the oxygen vacancies increases while the content ratio of Fe^{2+} maintains constant. Due to the increase of the oxygen vacancies, the optical band gap in the visible region of the specimens decreases. This small band gap energy makes it a potential candidate for photovoltaic cells.

Keywords: Bismuth Ferrite; Sol-gel; Nanoparticles; Band gap; Photovoltaics.

New approach for electrochemical studies of polymer based composite membrane

Mohammad Mujahid Ali Khan
Applied Science and Humanities Section, University Polytechnic, Faculty of Engineering and Technology,
Aligarh Muslim University, Aligarh, 202002- India

Abstract

The new PVC based composite membrane was prepared by co-precipitation method and characterized by thickness, porosity, moisture content and ion-exchange capacity etc. and further surface and structural characterization by SEM, TEM, XRD and FTIR. The membrane was found to be crystalline in nature and ion selective with uniform particles arrangements. The membrane potential values of the composite membrane for various electrolytes followed the order LiCl < $NaNO_3$ < KNO_3 and follow reverse order for charge density. Thus, the stable membrane may be utilized for the efficient removal of heavy toxic metal ions from waste water.

Keywords: PVC; electrical potential; electrochemical parameters; charge density; transport number.

Electric Polarisation Studies of Oxide-Polymer Composite

Ranjit Kumar
Department of Physics, Dr. Kalaignar M. Karunanidhi Government Institute for Postgraduate Studies and Research, Karaikal (UT of Puducherry), India – 609605

Abstract

The electric polarisation studies of oxide-polymer composite are studied. The Lithium Zirconate is taken as oxide and Polyvinylidene Difluoride is taken as polymer. The Lithium Zirconate-Polyvinylidene Difluoride composite was prepared by selecting Polyvinylidene Difluoride as matrix material and Lithium Zirconate as filler. The amount of filler is chosen as 1wt % of matrix material. The solution casting method was used to prepare composite at 60°C. The electric polarisation studies are carried out by measuring the dielectric properties. Before dielectric measurement, the samples are electroded with silver paste. The data are collected with respect to frequency under DC bias at room temperature. The factors responsible for the observed electric polarisation are analysed.

Keywords: Electric polarisation; Polyvinylidene Difluoride; Lithium Zirconate.

Development and Characterization of Citric acid and Heat moisture Modified jicama (Pachyrhizus, spp.) Starch-Based Biodegradable Films

Anand Kishore[1], Anupama Singh[1]

[1]National Institute of Food Technology Entrepreneurship and Management, Kundli, Sonepat, India

Abstract

The global crisis of plastic waste has catalysed a surge in research dedicated to developing sustainable and biodegradable alternatives packaging materials. Starch is the most popular bio-sourced material for biodegradable film to replace synthetic polymers due to its abundant availability, low cost, biodegradability, and better film forming ability. Considering this, Jicama starch (JS) was modified by citric acid (CA) and heat–moisture treatment (HMT), and the effectiveness of modification techniques in starch properties and the development of the biodegradable film was explored. The pasting temperature, and transition temperature increased after HMT and CA treatment, while the reverse was observed for swelling power , solubility , peak viscosity, breakdown viscosity, final viscosity and setback viscosity compared to the native starch. HMT resulted in an increase in amylose content, while CA decreased as compared to native starch. SEM analysis showed the overlapping and formation of clusters of the granules in all the modified starch. In comparison to native starch, the crystallinity percentage of all modified jicama starch decreases (34.45-28.53%). Furthermore, Native and modified JS starch was used to develop starch based biodegradable films using the solvent-casting method. The modification of the starches with different HMT and CA treatment had a significant impact on the physical properties of film. Lower moisture content, water solubility, water vapour permeability and oxygen permeability coefficient were observed in the modified film. The highest tensile strength was found in modified film, however the elongation at break of the JS increases after HMT treatment while decreases for CA-modified starch. The SEM showed that modified starch based film had a smoother and more homogeneous surface. The finding of the study shows that HMT and CA treatments had a significant impact on starch properties and improved the film quality for further application.

Keywords: Underutilized Starch; Physicochemical properties; Structure; Film; Barrier; Mechanical properties.

ICCMEPR-2024/FT/ST/305

Synthesis of Tin Ferrite Nanoparticles and their Electrochemical Performance

Dr. Raminder Kaur, Amanpreet Kaur
Department of Physics, Punjabi University, Patiala

Abstract

Tin ferrite ($SnFe_2O_4$) nanoparticles have received great attention because of their unique functional properties, including an appealing electrical band structure, excellent chemical stability, high magnetization and excellent biocompatibility. $SnFe_2O_4$ nanoparticles have diverse applications including environmental remediation, lithium-ion batteries, supercapacitors and hydrogen peroxide sensors. $SnFe_2O_4$ nanoparticles were synthesized using sol-gel method. X-ray diffraction (XRD) analysis was performed to examine the structural properties of synthesized nanoparticles. $SnFe_2O_4$ nanoparticles are excellent material for electrochemical applications.

Keywords: Tin ferrite, Nanoparticles, sol gel method, X-ray diffraction, electrochemical impedance spectroscopy.

Student Talks

An evironmental protection through organic dissipation into admirable activated carbon employed in day-to-day utilization

Sowmiya K C[1], K A Vijayalakshmi[2]
[1]Research scholar, Research department of physics, Sri Vasavi College Erode-638316, India
[2]Assistant professor, Research department of physics, Sri Vasavi College Erode-638316, India

Abstract

An environmentally friendly method that eases the burden of biowaste disposal is turning into activated carbon. This work delivers the preparation of activated carbon from organic wastes like lemon peels. Lemon peel activated carbon (LPAC) have been prepared by physical activation method. Dried lemon peels were carbonized at 300℃ for One and a half hours, two hours, and two hours thirty minutes, and activated at 350℃ for about twenty minutes. The three different nano particles of LPAC are examined under XRD to confirm the nature and presence of carbon. FTIR analysis determines the functional group and Scanning electron microscope detects the surface of the nano powders, EDX identifies the material’s elemental composition. Raman spectroscopy confirms the molecular structure of activated carbon, and Hydrophobic nature is shown by optical imaging. At room temperature, the samples' dielectric characteristics were investigated. The results show that the LPAC's dielectric characteristics were improved in the audio frequency range after it was carbonized for two hours and thirty minutes at 300°C. The findings show that activated carbon made from organic wastes is highly useful for a variety of applications including waste water treatment, energy storage, and water filtration that leads to Environment protection and remediation.

Keywords: Organic waste; lemon peel; nanomaterial; optimization; surface analysis.

Eco-friendly plasma technology utilized to develop a highly activated carbon from porous agriculture residues applied in energy storage devices

Karthikeyan N[1],Vijayalakhmi K.A[2], Maheswari K.T[3]

[1] Research scholar, Research Department of Physics, Sri Vasavi College Erode, 638 316, Tamil nadu, India

[2]Associate professors, Research Department of Physics, Sri Vasavi College Erode, 638 316, Tamil nadu, India

[3]Assistant Professor,EEE, Bannari Amman Institute of Technology, Sathyamangalam ,Erode- 638 401, Tamil Nadu , India

Abstract

The focus of this investigation is to improve air cathode batteries, specifically aluminum-air batteries, which are well-known for their high energy storage capacity and low cost. Creating air cathodes that effectively support both charging and discharging is a significant issue. Here, carbon plays a key role in oxygen transport, conductivity pathways, and electrode hydrophilicity maintenance. Though existing technologies have limits, using agricultural leftovers such as rice husk for activated carbon offers a sustainable approach. This research looking into plasma technology for modified activated carbon as a solution to this. The manufacture and characterization of rice husk activated carbon utilizing plasma treatment, and it finds promising improvements the surface and electrochemical properties.After plasma treatment, a significant improvement in surface hydrophilicity and specific capacitance was observed. These improvements in hydrophilicity and specific capacitance are attributed to the successful attachment of NH_3 and OH groups during the plasma treatment Additionally an electrochemical assessments like CV, GCD, and EIS, analytical procedures including XRD, FTIR, Raman, contact angle measurement, FESEM with EDAX, and colour mapping are used. By merging sustainable materials with innovative modification techniques, this research advances eco-friendly and efficient energy storage solutions.

Keyword: Rice husk; Activated carbon; Aluminum-air battery; supercapacitor ; DC glow discharge plasma.

Iota carrageenan a Sustainable polymer transformed into nanogel formulation by using environment friendly method for antitumor action

Akanksha Bhatt, Priyank Purohit
School of pharmacy, Graphic Era Hill University Dehradun, India

Abstract

In the pharmaceutical field, the utilization of polymers, whether in their natural state or via chemical modification, takes pivotal significance. From decades, the polymers grafting has been done for drug delivery and research and garnered considerable attention. Carrageenan, categorized from various species of red seaweed, stands out as an anionic water-soluble gum having a rich composition of highly sulfated galactans, showing a significant ester-sulfate content ranging from 15-40 % percent. The distinct categorization of carrageenan depends on the number and positioning of sulfate groups. Polymer-based nano-formulations have gained substantial popularity due to their intriguing properties. A novel concept in this area is green nanomedicine, which joins green chemistry with nanotechnology to develop non-toxic, biodegradable materials endowed with inherent therapeutic attributes like anticoagulant, antitumor, antiviral, and immunomodulatory properties. These materials can be synergistically combined with core pharmacophores to combat specific diseases. Carrageenan's efficacy in this domain is scored by its crosslinking and biological properties that are facilitated by sulfate ions. The current study endeavors to formulate nanogels utilizing a greener approach, escaping the use of crosslinking agents, with the aim of targeting tumor cells. The procedure used was by taking 500 mg iota carrageenan in hot water further accompanied by addition of ethanol drop wise while continuous stirring up to 3 hr and nano size was confirmed by SEM. Further the characterization like spreading, viscosity, conductivity was performed selectivity towards tumor cell was confirmed via in vitro cell line studies.

Keywords: Carrageenan, Antitumor agent, crosslinking agent, greener method, cell line studies.

Enhance the Capacitance of Activated Carbon Derived from Sugarcane Waste through exposure to Cold Plasma

R.Deepa[1], K.A.Vijayalakshmi[2], K.T. Maheswari[3]

1Research scholar, Research Department of Physics, Sri Vasavi College Erode- 638 316, Tamilnadu, India

[2]Associate professors, Research Department of Physics, Sri Vasavi College Erode- 638 316,Tamilnadu, India

[3]Assistant Professor/EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode- 638 401, Tamilnadu , India

Abstract

With an emphasis on the results of plasma treatment, this study analyzes the structural and electrochemical characteristics of carbon materials made from (sugarcane)bagasse. The amorphous nature of bagasse-derived carbon is revealed by X-ray diffraction (XRD) examination, with activated samples showing improved graphitic structures. Several functional groups on the carbon surface are identified by Fourier transform infrared (FT-IR) spectroscopy, and field emission scanning electron microscopy (FE-SEM) demonstrates a change in morphology from compact to porous following plasma treatment. Because of their increased surface area and porous structure, plasma-treated samples have better specific capacitance than untreated samples, according to electrochemical performance conducted with a three-electrode setup and 2 M KOH electrolyte. The study reveals the potential of activated carbon generated from bagasse that has been plasma-treated for energy storage applications.

Keywords: Bagasse-derived carbon, Plasma treatment, Structural characterization, Electrochemical performance, Specific capacitance, Porous structure.

Effect of partial substitution of White rice husk ash, groundnut shell ash, bagasse Ash in 3DPC

N. Sai Kesava Krishna[1], Dr.Lakshmi Keshav[2], D.Ravikanth[3]
[1]M.Tech Student Department_of Civil Engineering, Velagapudi Ramakrishna Siddhartha Engineering College, Vijayawada, Andhra Pradesh
[2]Faculty Department of Civil Engineering, Velagapudi Ramakrishna Siddhartha Engineering College. Vijayawada, Andhra Pradesh
[3]M.Tech Student Department_of Civil Engineering, Velagapudi Ramakrishna Siddhartha Engineering College, Vijayawada, Andhra Pradesh

Abstract

This research delves into the feasibility of utilizing White Rice husk ash, Groundnut shell ash, and Bagasse ash as substitutes for fine aggregate in 3D-printed concrete. The objective is to assess the effectiveness of different agricultural waste ashes and determine the most suitable option for enhancing the characteristics of 3D-printed cement mortar samples. Various combinations of agro waste ash, cement, and fine aggregate were prepared and used to create cement mortar specimens through 3D printing. These specimens underwent comprehensive testing and analysis. The results indicate that Bagasse ash, when used as a partial replacement for fine aggregate in 3D-printed cement mortar, displayed superior performance compared to White Rice hull ash and Groundnut shell ash. The specimens incorporating Bagasse ash showcased enhanced mechanical properties, improved workability, and overall superior performance in terms of strength and durability. This study primarily focuses on investigating the effects of partially substituting fine aggregate with White Rice hull ash, Groundnut shell ash, and Bagasse ash in 3D-printed concrete, while also examining compression, flexural behavior, thermal conductivity, and SEM analysis of the specimens. In terms of compression and flexural behavior, the 3D-printed cement mortar specimens containing Bagasse ash exhibited better performance than those with other agricultural waste materials. Furthermore, Groundnut shell ash demonstrated remarkable thermal conductivity. These results highlight the potential of utilizing agricultural waste materials as partial replacements for fine aggregate in 3D-printed concrete, leading to enhanced mechanical and thermal properties. This research enhances our knowledge of utilizing agricultural waste ash in 3D printing concrete technology. It underscores the feasibility of producing high-quality 3D-printed concrete structures using Bagasse ash as a sustainable alternative in the construction sector, emphasizing its potential as an eco-friendly building material.

Keywords: White Rice husk ash, Groundnut shell ash, Bagasse ash, fine aggregate, 3D-printed concrete, agricultural waste, thermal conductivity, SEM analysis.

Fixing of Chloride in Alccofine Blended M-Sand Concrete With Aluminium Oxide And Lead Oxide Corrosion Inhibitors - An Experimental Study

K. Harshavardhan[1], Dr.Lakshmi Keshav[2], N. Sai Kesava Krishna[3]

[1]M.Tech Student Department_of Civil Engineering, Velagapudi Ramakrishna Siddhartha Engineering College, Vijayawada, Andhra Pradesh

[2]Faculty Department of Civil Engineering, Velagapudi Ramakrishna Siddhartha Engineering College. Vijayawada, Andhra Pradesh

[3]M.Tech Student Department_of Civil Engineering, Velagapudi Ramakrishna Siddhartha Engineering College, Vijayawada, Andhra Pradesh

Abstract

The study investigated the mechanical and corrosion properties of regular Portland cement concrete incorporating ultrafine ground granulated blast furnace slag (UFGGBS-Alccofine 1203) as a mineral admixture, along with chemical admixtures of aluminium oxide or lead oxide as corrosion inhibitors. The specimens, which included M.Sand as the fine aggregate, underwent Free Chloride Test, Rapid Chloride Permeability Test, and Carbonation of Concrete Tests. Chemical admixtures like Lead oxide and aluminium oxide were utilized in varying proportions from 2.5 percent to 17.5 percent (by weight of cement), with regular increments of 2.5 percent. Through analysis of compressive strength and free chloride reduction, an optimal chemical admixture ratio of 12.5% was determined. The Aluminium oxide and lead oxide admixtures exhibited a reduction of free chloride in concrete by 38% and 27%, respectively. Both variations showed a 20-30% increase in compressive strength across different curing intervals. The RCPT and concrete carbonation tests yielded positive results in this research. The addition of lead oxide and aluminium oxide as additives effectively mitigated free chloride in Alccofine based concrete, thereby reducing corrosion. Furthermore, the study revealed an enhancement in the compressive strength of the concrete.

Keywords: Corrosion, UFGGBS ,Alccofine 1203(A), M-sand, Lead Oxide (Pb_2O_3), Aluminium Oxide (Al_2O_3), Free chloride, Carbonation of concrete, Rapid Chloride Permeability Test (RCPT).

Curcumin-Mediated Synthesis of Copper Oxide Nanoparticles and its Photocatalytic Application

Ravi Ranjan, Madhulata Shukla
Department of Chemistry, Gram Bharti College, Ramgarh, Kaimur, Veer Kunwar Singh University, 821110, India

Abstract

Cuprous oxide (Cu_2O) has attracted significant interest due to its unique properties, including high electrical conductivity, excellent catalytic activity, and applications in catalysis, antimicrobial applications, electronics, sensors, biomedical applications, energy storage and conversion, and photocatalysis. Curcumin, a natural compound derived from the turmeric plant, has gained significant attention due to its various therapeutic properties. In this work, we report an efficient curcumin-mediated synthesis of cuprous oxide nanoparticles (NPs) and their photocatalytic degradation of organic pollutants. Density Functional Theory (DFT) calculation has been carried out to obtain the optimized geometry in the ground state and the interaction present between Cu_2O and curcumin. Mulliken charge analysis and electrostatic charge potential diagram confirm the interaction between them and the charge transfer occurring from curcumin to Cu_2O. Hence curcumin not only acts as a reducing and capping agent but also activates the Cu_2O catalysts for further photocatalytic reactions.

Keywords: Cuprous oxide, nanoparticle, photocatalyst, green reduction, DFT calculations.

Self-formation of naturally incorporated praseodymium and copper oxide/hydroxide layer on copper surface in saline solution

Hai Thi Nam Nguyen[1,2], Nhung Thi Nguyen[1,2], Nam Nguyen Dang[1,2]
[1]Future Materials & Devices Laboratory, Institute of Fundamental and Applied Sciences, Duy Tan University, Ho Chi Minh City 700000, Vietnam
[1]Faculty of Civil Engineering, Duy Tan University, Danang, 550000, Vietnam

Abstract

The improved corrosion resistance of copper alloy has been resultful via the naturally formation of an incorporated praseodymium and copper oxide/hydroxide layer on copper surface in deliberately simple exposition to 0.6 M NaCl solution containing praseodymium chloride (PrCl3). It was found that an addition of 1.21 mM PrCl3 to 0.6 M NaCl solution exhibited a great corrosion resistance of copper alloy due to the formation of the compact and adhesive layer of the incorporated praseodymium and copper oxide/hydroxide. Energy-dispersive X-ray spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS) results suggested that the layer mainly included copper and praseodymium oxides/hydroxides that uniformly contributed to the copper surface. Electrochemical impedance spectroscopy (EIS) results indicated that formation of layer depended on PrCl3 concentrations in 0.6 M NaCl solution and immersion time due to the significant changes of film (Rfilm) and charge transfer (Rct) resistances. Both Rfilm and (Rct) values increased with and increase in immersion time and PrCl3 concentrations in 0.6 M NaCl solution from 0 to 1.21 mM, they were then decreased when PrCl3 concentrations increased to 2.43 and 4.10 mM. Potentiodynamic polarization results indicated that the oxide/hydroxide layer formation depended on both cathodic and anodic processes of electrochemical corrosion reaction, but more significance was observed on cathodic process. That was also confirmed by cathodic polarization and the changes of impedance and capacitance with cathodic potentials. Importantly, wire beam electrode (WBE) indicated random corrosion depth formed through the copper surface in 0.6 M NaCl solution containing 1.21 mM PrCl3. Therefore, the work suggests an approach of the incorporated oxide/hydroxide film formation on the copper surface to protect against corrosion in saline environments.

Keywords: Copper; Praseodymium chloride; Oxide/hydroxide formation; Saline corrosion; Corrosion protection.

Investigation of Local Structure by XAFS and Magnetic Properties of $CoMn_2O_4$ Nanoparticles

Sanjna Rajput, Chandana Rath
School of Materials Science and Technology, Indian Institute of Technology (BHU), Varanasi, Uttar Pradesh, 221005, India

Abstract

The local structure and magnetic properties of CoMn2O4 nanoparticles prepared by coprecipitation method has been examined. X-ray diffraction pattern shows mixed phase of tetragonal and cubic phase at room temperature with crystallite size of 42 nm. While Fourier transform infrared spectrum shows the bands corresponding to tetrahedral and octahedral site of spinel. Pre-edge feature from XANES and Fourier transform (FT) EXAFS spectra at Co and Mn K-edge confirm that majority of Co and Mn occupies A and B site respectively, while small amount of Co and Mn occupies the B and A site respectively. The spin dynamics of these nanoparticles shows the dispersion of ac susceptibility (χ'') with frequency, confirm the spin glass like behaviour. Surprisingly, we observe a progressive increase in vertical magnetization shift while measuring magnetization under field cooled condition. Remarkably, a maximum vertical magnetization shift of 2.45 emu/g and exchange bias of 888.5 Oe observed under a 10,000 Oe cooling field. Such shift is intricately linked to the Yafet-Kittel spin structure of Mn^{3+} localized in B site and the exchange bias could be due to the interaction between ferrimagnetic and spin glass like phase.

Keywords: Spinel, Exchange bias, Vertical Magnetization Shift (VMS), Yafet-Kittel (Y-K) Spins.

Optimizing Dye Sensitzed Solar Cells with Reduced Graphene Oxide and Macrocyclic Cerium Complex Counter Electrode

Kirandeep Kaur, Nidhi Gupt, Meenakshi Patyal, Arushi
Department of Chemistry, Punjabi University, Patiala, India

Abstract

Dye-sensitized solar cells are a popular type of photovoltaic cell that use dye molecules to absorb light on a nanocrystalline titanium dioxide film. These cells have garnered significant research interest due to their low production costs and high power conversion efficiency. In our study, we developed an innovative composite material using graphene oxide and macrocyclic cerium metal complexes. These composites were synthesized via a straightforward redox reaction between graphene oxide and a substituted diimine macrocyclic metalcomplex.The resulting materials were utilized as counter electrodes in DSSCs. We experimented with different ratios of GO and macrocyclic metal complexes and characterized the composites using spectral technique. The characterization results indicated a complete reaction between GO and the macrocyclic Ce complexes, with the complexes uniformly grafted ontothe graphene surface. The electrochemical catalytic capacity of the CEs was significantly enhanced due to the redox properties of the macrocyclic metal complex, the high surface area, and the excellent conductivity of graphene. These CEs underwent various performance evaluations, including current density-voltage measurements, incident photo-to-current conversion efficiency and electrochemical impedance spectroscopy. The performance of these GO and macrocyclic Ce complex-based CE's was compared to that of traditional platinum CE.s.Due to their lower cost and excellent performance, these composites represent an ideal replacement for expensive platinum counter electrodes in DSSCs.

Keywords: Graphene; Dye sensitized solar cell; Photovoltic; Nanocrystalline Structure; Macrocyclic complex.

Photonic Crystal Fiber Based Refractive Index Sensor: An Approach of Bio-molecule Testing application

Kanard Kumar, Nabamita Goswami, Ardhendu Saha
Department of Electrical Engineering, National Institute of technology Agartala, India

Abstract

In this simulation, a model has been developed to create a fiber core, with the analyte surrounded by a high sensitivity on the surface utilizing Photonic Crystal Fiber (PCF).This sensor employs a combination of a perfect match layer, enhancing sensitivity by elevating the refractive index from 1.30 to 1.40 over a wavelength range of 640 nm to 1016 nm. Notably, the sensor exhibits an impressive sensitivity of 1625.9 dB/(RIU) and a resolution of 9.68×10-6 RIU. Such sensitivity enables the detection of changes in refractive index, rendering the sensor applicable in biomedical research and biosensor fields. The proposed sensor relies on a Photonic Crystal Fiber (PCF) composed of a lattice of three layers of air holes, all filled with fused silica. Only the first layer of air holes is designated as the sensing channels for refractive index measurement. The sensor design features holes in the air that have a diameter of 0.76 µm and a pitch of 5.4 µm between them. The architecture of the PCF-SPR sensor integrates circular air apertures of varying sizes to focus energy into the core. Cladding is marginally lower than that of the fiber core, a result of the arrangement and presence of air apertures within the PCF. To absorb radiation energy and enhance computational accuracy, the layer that is perfectly matched (PML) is utilized instead of a simulated boundary condition in the designed structure. In this designed PCF sensor demonstrates potential for application in higher refractive indices and holds promise for enhancing biosensor sensitivity.

Keywords: Photonic Crystal Fiber, Surface plasmon polariton, Fiber sensor, Reflective index sensor, Biosensor.

Pt-Citrate/Au Nanostructured Electrodes: A Highly Sensitive Voltammetric Platform for Cadmium Detection

Monika Antil[1,2], Babankumar S. Bansod[1,2]
Department of Materials Science & Sensor Applications (MSSA)
[1]AcSIR -CSIR-Central Scientific Instrument Organisation, Chandigarh 160030, India
[2]CSIR-Central Scientific Instrument Organisation, Chandigarh 160030, India

Abstract

This study presents a novel electrochemical sensor for cadmium (Cd) detection using nanostructured electrodes modified with citrate-capped platinum nanoparticles (Pt Citrate). Square Wave Voltammetry (SWV) serves as the detection method. The sensor offers superior sensitivity and selectivity compared to traditional techniques, effectively mitigating interferences from co-existing metal ions commonly found in environmental samples. The Pt-Citrate electrode demonstrates exceptional performance with a low detection limit of 0.041 µM, high sensitivity of 30.04 µA µM-1, and a linear detection range of 0.1 to 0.5 µM. These qualities make it a promising candidate for real-time environmental monitoring of Cd contamination. Selectivity validation confirms minimal response towards interfering ions, while real world applicability is established through successful Cd detection in groundwater samples from a polluted region in Haryana. The sensor also exhibits excellent repeatability. Notably, the achieved detection limit (0.041 µM) falls well below safe levels for human exposure, highlighting the sensor's high sensitivity for Cd monitoring.

Keywords: Pt-Citrate, Cadmium, Voltammetry, Selectivity, Sensitivity.

Hybrid diamond/graphite film as electrochemical sensor for voltammetric detection of toxic paraquat

Yogesh Chaudhary[1,2], Kamatchi Jothiramalingam Sankaran[1,2]
[1]CSIR-Institute of Minerals and Materials Technology, Bhubaneswar 751013, India
[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad 201002, India

Abstract

Paraquat (PQ) is one of the most hazardous herbicides, posing serious risks to human health due to its potential to cause organ failure and neurological damage upon exposure. Addressing the need for precise and sensitive on-site detection of PQ, an electrochemical sensor emerges as a viable solution. Hybrid diamond/graphite nanostructured film as electrodes were synthesized using the microwave plasma-enhanced chemical vapour deposition (MPECVD) method by varying the concentration of CH4 from 1% (3 sccm) to 15% (45 sccm) in CH4/H2/N2 gas mixtures, keeping N2 constant at 3% (9 sccm), H2 flow rate of 300 sccm, at 3000 W microwave power, with the total pressure in the chamber of 65 Torr under optimum temperature. Characterization via scanning electron microscopy (SEM), transmission electron microscopy (TEM), Raman spectroscopy, and X-ray diffraction (XRD) confirms the film's microstructure and composition. Notably, films deposited under high methane levels in hydrogen plasma exhibit desirable conductivity and electrochemical activity, attributed to the co-presence of diamond and graphite phases. Utilizing these hybrid electrodes, Differential Pulsed Anodic Stripping Voltammetry (DPASV) in a phosphate buffer solution (PBS) yields impressive PQ detection capabilities, with a detection limit of 0.002 µM and sensitivity of 2.97 µA/µM at an optimized pH of 6. Linear detection ranges from 0.1 µM to 0.8 µM, establishing hybrid diamond/graphite nanostructured as a superior choice for on-site PQ monitoring, excellent repeatability, selectivity, and remarkable detection sensitivity.

Keywords: Paraquat; electrochemical sensor; differential pulse voltammetry; hybrid diamond; sensitivity.

Bioinspired ZnO nano-catalysts: A sustainable approach for dye wastewater treatment

Jyoti Gaur[1], Mohinder Pal[1], Sanjeev Kumar[2]
[1]School of Basic and Applied Sciences, RIMT University, Mandi Gobindgarh - 147301, Punjab, India
[2]Department of Physics, Chandigarh University, Gharuan Mohali 140413, India

Abstract

This work presents a sustainable approach for dye wastewater treatment using bioinspired zinc oxide (ZnO) nano-catalysts. Hexagonal wurtzite-structured ZnO nanoparticles (NPs) were synthesized via a green method using Carica papaya leaf extract as a reducing agent. These NPs exhibited a crystallite size of ~25 nm and a band gap energy of 2.71 eV, ideal for photocatalytic degradation. Fourier transform infrared (FTIR) analysis confirmed the presence of organic moieties from the papaya extract on the ZnO surface, potentially influencing their photocatalytic activity. High-resolution transmission electron microscopy (HRTEM) revealed diverse morphologies, including spherical, semi-spherical, hexagonal, and rod-like shapes. The ZnO NPs demonstrated exceptional photocatalytic efficiency under UV irradiation, achieving a remarkable 99% degradation of Congo Red (CR) dye (100 mg L^{-1}) within just 60 minutes. Additionally, the study explored the photocatalytic degradation pathways of CR using gas chromatography-mass spectrometry (GC-MS) analysis. These findings demonstrate the promising potential of ZnO NPs synthesized using Carica papaya leaf extract for efficient and sustainable treatment of dye contaminated wastewater.

Keywords: Sustainable wastewater treatment, Bioinspired zinc oxide nano-catalysts, Carica papaya leaf extract, Photocatalytic degradation, hexagonal wurtzite-structured ZnO nanoparticles, Congo Red dye degradation.

Innovative hydrothermal synthesis of clove extract-mediated cobalt oxide nanoparticles for enhanced photocatalytic dye degradation and environmental remediation

Arshdeep Kaur[1], Sanjeev Kumar[2], Prit Pal Singh[3]

[1]Department of Physics, Sri Guru Granth Sahib World University, Fatehgarh Sahib-140406, India

[2]Department of Physics, Chandigarh University, Gharuan Mohali-140413, India

[3]Department of Chemistry, Sri Guru Granth Sahib World University, Fatehgarh Sahib 140406, India

Abstract

This study introduces an innovative approach to synthesizing cobalt oxide (Co_3O_4) nanoparticles (NPs) using an ethanolic extract of clove (Syzygium aromaticum). The natural compounds present in clove extract act as reducing agents, facilitating the formation of Co_3O_4 nanoparticles and being used to enhance their photocatalytic activity. The synthesis method employs a hydrothermal process to maximize the efficiency and performance of Co_3O_4 NPs for environmental remediation applications. Incorporating clove extract in the synthesis process significantly alters the surface properties and structure of Co_3O_4 NPs. This research highlights the potential of clove extract-mediated Co_3O_4 nanoparticles as a promising solution for removing MB dye from polluted water sources. These nanoparticles are preferred for their rapid synthesis, cost-effectiveness, and excellent dye degradation capability through photocatalysis. The Co_3O_4 NPs were synthesized via the hydrothermal method and thoroughly characterized using UV-visible absorption spectroscopy, FTIR spectroscopy, XRD, TEM, and SEM techniques. The synthesized Co_3O_4 NPs demonstrated favorable properties, including a crystallite size of 1.79 nm. Remarkably, these NPs achieved a photocatalytic degradation efficiency of 98% at a concentration of 12 mg/L over a 120 minutes exposure period. This achievement highlights the effectiveness of clove extract-mediated Co_3O_4 NPs in degrading the target dye under specific conditions. The novelty of this research lies in the synergistic combination of clove extract with Co_3O_4 NPs, showcasing their potential for addressing water pollution issues. With their enhanced synthesis process and exceptional photocatalytic performance, these NPs hold promise for treating wastewater contaminated with industrial dyes. The use of clove extract as a green reducing agent highlights the potential of natural resources in nanomaterial synthesis. Overall, this study contributes to developing eco-friendly methods for producing functional nanomaterials with diverse applications.

Keywords: Sustainable synthesis, Cobalt oxide nanoparticles, Clove extract, Photocatalytic degradation, Dye removal, Environmental remediation.

Green synthesis of piper nigrum-mediated CuO nanoparticles for enhanced photocatalytic degradation of contaminants

Diksha Rani, Sanjeev Kumar, Sanjeev Kumar
Department of Physics, Chandigarh University, Mohali, India

Abstract

In response to the escalating challenges of contemporary aquatic pollution and the associated surge in infectious diseases, our research addresses the urgent need for innovative materials serving as effective remedies. We suggest a beneficial way to make copper oxide (CuO) nanoparticles that is also beneficial for the environment. It uses green synthesis techniques and Piper nigrum plant extract as a key reducing agent. This complex process transfers electrons from Piper nigrum compounds to copper ions, simplifying the reduction process to CuO nanoparticles. We used scanning electron microscopy (SEM), high-resolution transmission electron microscopy (HRTEM), X-ray diffraction (XRD), UV spectroscopy, Raman spectroscopy, and photoluminescence spectroscopy to fully characterize the synthesized nanoparticles. We employed these techniques for conducting chemical, optical, and topographical analyses. To evaluate the practical implications of the CuO nanoparticles, extensive testing of their photocatalytic activity was performed. This investigation aimed to assess their efficacy in degrading contaminants, establishing their potential as a sustainable solution for mitigating aquatic pollution. Our findings contribute to the expanding knowledge base in nanomaterial synthesis, holding promise for the development of environmentally conscious technologies with tangible applications in pollution remediation. This research serves as a significant stride toward a future where innovative materials play a pivotal role in ameliorating the profound challenges posed by modernity's impact on aquatic ecosystems and public health.

Keywords: Copper oxide (CuO) nanoparticles; green synthesis; piper nigrum; photocatalytic degradation.

Sustainable and environmental-benign coatings for wood and wood-based substrates

Tulika Sharma[1], Gaurav Manik[2]
[1]Department of Polymer & Process Engineering, Indian Institute of Technology, Roorkee 247667, India (Research Associate)
[2]Department of Polymer & Process Engineering, Indian Institute of Technology, Roorkee 247667, India (Head of Department)

Abstract

In recent years, there has been a significant increase in the enthusiasm for cellulose nanocrystals (CNCs) as a potential nanomaterial, mostly because of their exceptional biological and mechanical properties. The present research focuses on a composite coating made of CNCs, polyvinyl alcohol (PVA), and a methanolic extract obtained from dried leaves and fruit of the fig tree (Ficus auriculata). The process of obtaining CNCs involved a sequential approach that included alkaline and acid hydrolysis, followed by sonication and suitable purification methods. Analytical techniques, including scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD), were used to evaluate the films containing CNC. The thermogravimetric analysis (TGA) of composites revealed that the films reinforced with CNC had superior thermal stability compared to the control group, as evidenced by higher degradation temperatures. These findings indicate that the suggested coatings for wooden surfaces would possess environmental resistance, which is a highly desirable characteristic. By combining CNCs, PVA, and FAE, all of which possess well-documented insecticidal characteristics. The researchers examined the mortality rate of termites and the ability of the composite material to resist termites. They discovered that combining CNCs, PVA, and FAE significantly enhanced the material's ability to create a more robust barrier against termites. According to the findings of this study, the composite that was developed has significant promise for use in producing reliable and efficient methods for controlling termites. The produced composites also demonstrated noteworthy antibacterial activity. Among all the evaluated films, the film containing a 0.7% extract in PVA demonstrated the most favourable outcomes. It exhibited a growth inhibition zone of 26 mm and 28 mm for Gram-positive bacteria, and 26 mm for both strains of Gram-negative bacteria. Based on the findings, this composite has the potential to serve as an environmentally benign and durable solution for managing termites and preventing the growth of bacteria in various construction materials and wood preservation applications. Additionally, it exhibits resistance to environmental influences.

Keywords: Wood Coating; Cellulose Nanocrystals; Ficus auriculata; Anti-bacterial; Anti-termite.

The multifaceted potential of nanomaterials: synthesis, characterization, and emerging applications

Nishtha Chandel[1], Sanjeev Kumar[2]
[1]University Institute of Teachers Training and Research, Chandigarh University, Gharuan Mohali 140413, India
[2]Department of Physics, Chandigarh University, Gharuan Mohali 140413, India

Abstract

Nanomaterials, characterized by their nanoscale dimensions and unique physicochemical properties, have revolutionized multiple domains of science and engineering. This work provides a comprehensive analysis of the synthesis, characterization, and multifaceted applications of nanomaterials, emphasizing recent advancements and prospective developments. We investigate various synthesis methodologies, including chemical vapor deposition, sol-gel processes, hydrothermal synthesis, and biogenic approaches, each offering distinct advantages in tailoring nanoparticle size, morphology, and functionalization. Advanced characterization techniques, such as transmission electron microscopy (TEM), scanning electron microscopy (SEM), X-ray diffraction (XRD), and various spectroscopic methods, are critically reviewed to elucidate the structural, optical, and electronic properties of nanomaterials. These techniques provide vital insights into the crystallinity, phase composition, surface chemistry, and quantum effects inherent to nanostructures. The applications segment highlights the pivotal role of nanomaterials in biomedicine, including targeted drug delivery systems, diagnostic imaging, and novel therapeutic agents. In the energy sector, we examine their integration into high-efficiency photovoltaic cells, next-generation batteries, and supercapacitors, showcasing their potential to enhance energy conversion and storage capabilities. Environmental applications are explored, focusing on the use of nanomaterials in advanced water purification systems and pollutant remediation technologies, leveraging their high surface area and reactivity. The paper concludes with a discussion on the challenges and future trajectories in nanomaterial research, underscoring the necessity for standardized protocols to assess their safety, biocompatibility, and environmental impact. By synthesizing recent developments and adopting an interdisciplinary perspective, this paper aims to provide a detailed overview of the current landscape and prospects of nanomaterials, highlighting their transformative potential across diverse scientific and industrial sectors.

Keywords: Nanomaterial synthesis, characterization, drug delivery, energy, environment, future-prospects.

A Click-Chemistry Based Strategy for Synthesizing Coumarin Piperazine Analogues: Assessment of Anti-tubercular, Anti cancer, Anti-inflammatory and Antioxidant Potentials

Ashwini Jaggal[1], Kariyappa S. Katagi[2], Mahesh Akki[1], Vardhaman Babagond[1], Vinuta Kamat[2], Shrinivas Joshi[3]

[1]Research Centre, Department of Chemistry, Karnatak University's Karnatak Science College, Dharwad-580001, Karnataka, India

[2]Department of Chemistry, Mangalore University, Mangalagangothri-574199, Mangalore, Karnataka, India

[3]Novel Drug Design and Discovery Laboratory, Department of Pharmaceutical Chemistry, S.E.T's College of Pharmacy, Sangolli Rayanna Nagar, Dharwad-580002, Karnataka, India

Abstract

Using a click chemistry strategy, a novel series of coumarin piperazine analogues were made to determine their pharmacological potential. These analogues were evaluated in vitro for anti-tubercular activity against Mycobacterium tuberculosis H37Rv, revealing compound 8d as the most promising with a MIC of 1.04 µM. The compound 8d emerged as a promising candidate for % inhibition of acetyl-CoA synthetase activity. The anti-inflammatory potential was also observed in analogues 8c, 8d, 8e and 8j with marked activity in the 62.18 - 66.43 µM concentration range. Moreover, compounds 8c, 8d, 8i and 8j demonstrated strong antioxidant effects, as reflected by their low IC_{50} values between 61.85 to 78.22 µM. Molecular docking provided insight into the binding affinity and interactions of these compounds with a target protein, and in silico ADME profiles supported their pharmacokinetic viability. These findings identify compound 8d as a lead compound and highlights the therapeutic prospect of coumarin piperazine analogues.

Keywords: Coumarin; Piperazine; Click chemistry; Anti-tubercular activity; Molecular docking.

Colorimetric and Fluorimetric Detection of Fe(III) Using a Rhodamine-Imidazole Hydrazone Based Chemosensor: Photophysical Properties, DFT, TGA, and DSC Studies

Vardhaman Babagond, Kariyappa Katagi, Mahesh Akki, Ashwini Jaggal
Research Center, Department of Chemistry, Karnatak University's Karnatak Science College Dharwad, Karnataka, India

Abstract

In this research work, rhodamine-imidazole hydrazones(RIH), a chemosensor has been synthesized and characterised by FT-IR spectroscopy, ^{1}H-NMR, ^{13}C NMR, LCMS and absorption and fluorescence spectra. This chemosensor exhibits enhanced sensitivity and selectivity in detecting the biologically significant metal ion Fe^{3+} through both colorimetric and fluorescence changes. The optical properties have been investigated using binary acetonitrile-water (7:3 v/v) solution. The probe RIH-1 can be deployed as a fluorescent and colorimetric probe for detection of Fe^{3+} ion. It shows absorption band at 559nm and intensity band at 589 increases up to 37 times with increase in the concentration of Fe^{+3} with the detection limit as low as 25µM. In the visible light RIH-1 exhibited the detection of Fe^{+3} ion through naked eye. The addition of Fe^{3+} to the probe RIH-1 results in a colour change from colourless to pink. This is the result is due to the opening of lactone ring in RIH-1. Notably, RIH-1 probe displays a high quantum yield of 0.81, after binding with Fe^{3+} ions. Indeed, it has been found that sensor RIH-1 is very effective in sensing Fe^{+3} ions through both fluorescence based and visual detection methods. Additionally, DFT studies of these chemosensors have been conducted. The TGA and DSC analysis showed good thermal stability.

Keywords: Chemosensors, Rhodamine B, Cations.

Heat transfer performance of ZnO- ethylene glycol- water nanofluid using thermal lens technique

Ramya M[1], Ashik Wilson[2], Swathy Satheesh[3], Anita Mary Peter[1], Syammohan V[1], Kailasnath M[1]
[1]International School of Photonics, CUSAT, Kochi, Kerala, India
[2]Sree Vyasa N S S College, Wadakkanchery, Thrissur, Kerala, India
[3]Ansar Womens College, Perumpilavu, Thrissur, Kerala, India

Abstract

Nanofluids are engineered fluids used in advanced electronic systems for thermal management. Fluids with dispersed nanoparticles have exhibited remarkable thermal properties. Ethylene glycol (EG) and water mixtures are widely used in many industrial areas. This study investigates the synthesis and heat transfer performance of ZnO-EG, ZnO-water, and ZnO-EG-water nanofluids using a dual-beam thermal lens technique. ZnO is a widely used inorganic, UV-absorbing, multifunctional semiconducting material with applications in various fields due to its electrical, optical, and mechanical properties. Good transparency, high electron mobility, a wide band gap, and strong room-temperature luminescence are the favorable properties of ZnO, which have led to its application in numerous scientific fields. ZnO nanoparticles were synthesized using a simple solution method followed by ultrasonication, where ethylene glycol dispersed in zinc acetate dihydrate and NaOH were used as percursors. ZnO nanopowder was obtained and dispersed in water, ethylene glycol, and ethylene glycol water to prepare a 0.1 mg/ml concentrated stable ZnO nanofluid. The morphology of the synthesized nanoparticle was found using HRTEM, which concluded the spherical shape of the nanoparticles. The thermal diffusivity of the solvent and solvent-ZnO nanofluids was investigated using the dual-beam thermal lens technique. Significant enhancement in thermal diffusivity is observed when ZnO nanoparticles disperse in EG-water fluid. This enhancement in thermal diffusivity was observed due to the phonon scattering at the liquid-solid interface and the excellent stability of nanofluid. The superior heat transfer performance of ZnO-EG water nanofluid could be used as a coolant in optoelectronic devices instead of EG and water.

Keywords: ZnO; Ethylene glycol; Nanofluids; Thermal diffusivity.

Degradation of Methylene blue Dye using biosynthesized Silver Graphene oxide (Ag-GO) nanocomposite

Madhura S. Walujkar, Shobha A. Waghmode, Sharda R. Gadale
Department of Chemistry, Yashwantrao Mohite College of Arts, Science and Commerce, Pune, India 411038

Abstract

Dye Wastewater coming from numerous industries such as cosmetics, paper, food and textiles has been improperly treated and then released, is extremely dangerous to the environment and all living creatures. This work aims to determine the dye degradation potential of biosynthesized Ag-GO (Silver-Graphene oxide) nanocomposite. A Green, economical and environmentally safe method is used for the synthesis of Silver nanoparticles (AgNPs) using aqueous extracts of Withania somenifera medicinal plant as bioreducing agent. Synthesis of nanoparticles was confirmed by ultraviolet-visible (UV-Vis) spectrophotometry showing absorption peak at 415 nm. Further Ag-GO (Silver-Graphene oxide) nanocomposite was synthesized and characterized by X-Ray Diffraction(XRD), Field Emission Scanning electron microscopy (FESEM), EDX analysis and Fourier transform infrared (FTIR) spectroscopy. The XRD spectra obtained from the AgNPs synthesized, showed the crystalline nature of nanoparticles and confirmed the nano size of the particles. FESEM analysis showed the particles size between 35-45 nm and spherical morphology in nature and matching well with the XRD results. The present study was undertaken to investigate the effect of Silver – Graphene oxide (Ag-GO) nanocomposite for the degradation of Methylene blue dye from water sample. Further the effects of various experimental parameters such as dose of catalyst, initial substrate concentration were studied to achieve optimum conditions for the maximum degradation of pollutant. Withania somenifera plant extracts are suitable for the green synthesis of AgNPs and Ag-GO showed better catalytic activity for degradation of methylene blue dye and successfully removed 94.76 % dye from water sample.

Keywords: Withania Somenifera, Silver nanoparticles(AgNPs), Graphene oxide, Nanocomposite, Methylene blue.

A green approach: Pinus Patula-mediated synthesis of CuO nanoparticles with potential for wastewater treatment

Parneet Kaur, Sanjeev Kumar
Department of Physics, Chandigarh University, Gharuan Mohali-140413, India

Abstract

Green nanotechnology is advancing due to the growing demand for economically and environmentally sustainable techniques of producing nanoparticles. In this work, an extract from Pinus Patula (PP) is used to create copper oxide nanoparticles (CuO NPs) in a novel way. The successful synthesis of CuO, which has a crystallite size of 8.98 nm and is characterized by the presence of the monoclinic phase, is confirmed by X-ray diffraction (XRD) investigation. The functionalization of CuO with SA phytochemicals is demonstrated by Fourier-transform infrared (FTIR) spectroscopy, and the complex nanostructure of the nanoparticles is shown in high-resolution transmission electron microscopy (HR-TEM) and field emission scanning electron microscopy (FE-SEM) pictures. Their crystalline structure is further confirmed by selected area electron diffraction (SAED) patterns. The clear cut absorption peak at 259 nm and the energy band gap of 3.21 eV confirm that the fabrication of CuO nanoparticles was effective. Moreover, the produced nanoparticles demonstrate exceptional effectiveness in breaking down the hardy contaminant Congo red (CR) dye. According to pseudo-first-order kinetics, a 200 mg L^{-1} treatment removes 97% of the dye (100 mg L^{-1}) in just 100 minutes. This accomplishment exemplifies the benefits of green synthesis, which guarantees environmentally friendly manufacturing while exhibiting superior catalytic performance.

Keywords: green nanotechnology, biogenic CuO NPs, CR degradation, Pinus Patula extract, sustainable nanotechnology, photocatalysis.

Alcohol-assisted synthesis and photothermal studies of ZnO nanostructures

RamyaM[1], Najma P P[2], Kashmeera K B[2], Kailasnath M[1]
[1]International School of Photonics, CUSAT, Kochi, Kerala, India
[2]AnsarWomens College, Perumpilavu, Thrissur, Kerala, India

Abstract

Metal oxide nanoparticles are widely used in various thermoelectric applications. Among the various metal oxide nanoparticles, ZnO is one of the most stable and nontoxic materials and is used as a coolant material in optoelectronic devices. Recent research efforts have been dedicated to achieving a controlled synthesis of zinc oxide nanostructures with diverse morphologies. The choice of solvent is a prime factor in the nanoparticle growth mechanism. Alcohols are organic solvents used in the ZnO nanoparticle synthesis process that can help to control size and morphology properly. Accurate determination of thermal diffusivity is very important in thermal applications. The dual beam mode matched thermal lens technique is a well-known non-destructive technique to determine the thermal diffusivity of the nanofluid. In this paper, we experimentally investigated the thermal diffusivity of ZnO nanostructures synthesized by solution method using methanol, 1-butanol, 1-hexanol, and 1-decanol as solvents. The morphology of synthesized nanoparticles is determined using HRTEM analysis. Spherical nanoparticles are formed in methanol and 1-decanol is used as a solvent. In 1-butanol and 1-hexanol ZnO nanorods are formed. The result revealed that the solvent properties such as dielectric constant, viscosity, dipole moment, polarity, coordination ability, and solubility are the dependent parameters for the growth kinetics of nanoparticles. Also, we noted the morphology-dependent thermal properties of ZnO nanoparticles. Thermal diffusivity variations depend on the ZnO emission mechanism.

Keywords: ZnO nanostructures; Alcohols; Photothermal studies; Emission mechanism.

A study on solvent interaction and thermal transport of β carotene

Ramya M[1], Bhavya Pramod[2], Navya Pramod[2], Akshaya Muralidharan[2], Anita Mary Peter[1], Kailasnath M[1]

[1]International School of Photonics, CUSAT, Kochi, Kerala, India

[2]Sree Vyasa NSS College, Wadakanchery, Thrissur, Kerala, India

Abstract

β-carotene is one of the most prominent compounds of carotenoid compounds having a non-polar nature consisting of conjugated double bonds. It plays an important role in human health as a biological antioxidant and a precursor of vitamin A. In addition, it is also responsible for being a multicolored agent in various plant species and extensively employed in food colorants. This has centered attention on β-carotene nowadays. For the extraction of β carotene, we used the most popular source of raw carrots. The solubility of β-carotene depends upon the polarity nature of the solvents. In this study, the extraction and solubility of β-carotene in nine different solvents namely isopropanol, methanol, toluene, ethylene glycol, dimethyl flutamide (DMF), dimethyl sulfoxide (DMSO), water, butanol, hydrogen peroxide were investigated. The samples where the β-carotene was extracted and dye was formed exhibited a pale yellowish to orange color whereas few solvents remained colorless. The solubility of β carotene is not uniform, it is the highest isopropanol. The absorption and photoluminescence characteristics were studied to further understand the concentration, efficiency of extraction, and emission properties. According to our knowledge, this paper addresses a novel study presenting the thermal-optic properties of the β-carotene dye in different solvents using a dual beam thermal lens setup and it was compared to the thermal diffusivity of solvents. The enhancement in the thermal diffusivity of solvents was also observed. The enhancement in heat-transferring properties of β-carotene dye may be explored for non-linear optical applications in optoelectronic devices also.

Keywords: β-carotene, carotenoid, solvents, thermal diffusivity.

Understanding the Corrosion Behavior of Graphite in Peat Environment for Environmental and SustainabilityApplications

Nurettin ÇEK[1], Ayhan ORHAN[2]

[1]Firat University, Graduate School of Natural and Applied Sciences, Department of Metallurgical and Materials Engineering Technology, Elazig 23119, Turkey

[2]Firat University, Faculty of Technology, Department of Metallurgical and Materials Engineering, Elazig 23119, Turkey

Abstract

Natural environments that have a corrosive effect on materials are generally classified as water, air and soil. Corrosion products resulting from the corrosion caused by these natural environments emit pollutants in the environment and pollute the soil, water and atmosphere. Determining the necessary strategies to monitor and control this pollution creates the need to understand corrosion behavior in real-world conditions. Peat, which is in acidic form and contains high amounts of organic material, reflecting real world conditions, has not been examined in detail in terms of its corrosion properties as a type of natural environment. Additionally, corrosion, an issue of primary importance for the long-term stability of carbon materials used in various areas of industry, has unfortunately not been adequately addressed. Moreover, the literature on the corrosion behavior of graphite, a carbon material, in natural environments reflecting real-world conditions is quite poor. In this context, understanding and addressing the environmental impact of corrosion caused by the peat environment on graphite is very important for sustainable development and the environment. Considering this importance, in this study, the corrosion behavior of graphite in aqueous peat environment was investigated by creating a three-electrode electrochemical cell connected to a potentiostat/galvanostat device. Although the results of the study showed that the corrosion resistance of graphite material in the aqueous peat environment was quite high, they also clearly demonstrated that corrosion processes were present here. This study presented successful sustainable engineering evaluation of the use of graphite material in sustainable development and environmental applications.

Keywords: Corrosion; Peat; Carbon materials; Graphite; Electrochemical cell.

Amino Acid (L-alanine) Capped CuS Nanoparticles: Synthesis and Characterization

Y. S. Tamgadge[1], P. P. Gedam[2], R. P. Ganorkar[3], P. M. Wankhade[4], N. B. Thakre[5], G. G. Muley[6]
[1] Department of Physics, Mahatma Fule Mahavidyalaya, Warud, Dist. Amravati (MS), India
[2]Department of Physics, Shri. R. L. T. Science College, Akola (MS), India
[3]Department of Chemistry, Mahatma Fule Mahavidyalaya, Warud, Dist. Amravati (MS), India
[4]Department of Physics, Late RB AC and Smt SB Science College, Arni, Dist. Yavatmal (MS), India
[5]Department of Physics, Shri Shivaji College, Akola (MS), India
[6]Department of Physics, Sant Gadge Baba Amravati University, Amravati (MS), India 444602

Abstract

We report synthesis and characterization of CuS nanoparticles (NPs) capped using l-alanine amino acid by simple co-precipitation method. The samples in powder form were characterized by X-ray diffractometry (XRD), Energy dispersive X-ray spectroscopy (EDS), ultra-violet visible (UV-vis) spectroscopy and fourier transform infrared (FT-IR) spectroscopy. Formation of desired phase was confirmed by XRD data and purity of the sample was confirmed by EDS spectrum. The diffraction peaks in the XRD spectra are found to be broadened indicating narrow crystallite size which was found to be -----. UV-vis spectra show blue shift in the maximum absorption peaks and the shift is more prominent for the CuS sample prepared using highest concentration of l-alanine justifying its role in the efficient capping agent. FT-IR spectrum confirms the presence of amino-acid group.

Keywords: CuS nanoparticles, XRD, L-alanine, FT-IR, EDS, etc.

Transformation at the atomic level: redefining materials science

Deeksha Sharma, Sanjeev Kumar
Department ofPhysics, Chandigarh University, Gharuan Mohali-140413 India

Abstract

The field of material science is undergoing a radical transformation fuelled by groundbreaking advancements in material synthesis and processing. This paper explores the innovative techniques pushing the boundaries of what is possible. We delve into pioneering methods like atomically-precise nanofabrication (both bottom-up approaches like chemical vapor deposition and top-down methods like electron beam lithography) that allow for the creation of nanostructured materials with exceptional, finely controlled properties. Additionally, the advent of 3D printing and additive manufacturing, with techniques like selective laser sintering and stereolithography, revolutionizes the creation of complex structures, offering unparalleled customization and rapid prototyping capabilities.Furthermore, high-throughput experimentation and computational materials science, powered by artificial intelligence and machine learning, are accelerating the discovery and optimization of novel materials. These AI driven methods, including generative adversarial networks and reinforcement learning, significantly reduce traditional trial-and-error processes by predicting and synthesizing materials with precisely tailored properties.The integration of these advanced techniques unlocks the development of materials with superior mechanical, thermal, and electrical characteristics. These advancements hold immense potential for applications in aerospace, biomedical engineering, renewable energy, and beyond. This paper aims to inspire further research and development, fostering the next generation of materials that will shape the future of technology and industry.

Keywords: Atomic nanofabrication, high-throughput, additive manufacturingrevolution, tailored material properties, synergistic material design, next-gen technology.

Opening the future - A glimpse into advanced materials science and technology

Harshita Shrivastav, Sanjeev Kumar
Department of Physics, Chandigarh University, Gharuan Mohali-140413, India

Abstract

The field of advanced materials science and technology is now experiencing a rapid and significant change driven by innovative research and state-of-the-art breakthroughs. The present work explores the core of this ever-changing discipline, highlighting significant advancements in the creation, analysis, and practical uses of materials. The focus is on innovative materials such as graphene, metamaterials, and nanocomposites. These materials have exceptional characteristics, presenting intriguing opportunities in several industries, such as electronics, energy storage, healthcare, and aerospace. In addition, advanced manufacturing methods such as additive printing and bottom-up assembly are transforming the production of complex materials with precisely customised features. The significance of multidisciplinary cooperation is also emphasised, underscoring how the use of computer modelling and simulation may greatly expedite the processes of material discovery and optimisation. This work offers an intriguing insight into the exciting progressions that are influencing the future of advanced materials science and technology, highlighting their enormous capacity to transform several facets of our life.

Keywords: Advanced materials: graphene, metamaterials, nanocomposites.

Nanomaterials: The Impact of High Surface-to-Volume Ratios on Nanomaterial Properties and Applications

Sahiban Singh, Sanjeev Kumar
Department of Physics, Chandigarh University, Gharuan Mohali-140413, India

Abstract

Nanomaterial, defined as materials with at least one dimension less than 100 nanometers, have garnered immense interest across various scientific and industrial fields due to their unique properties and vast potential applications. These materials exhibit distinctive physical, chemical, and biological characteristics that differ significantly from their bulk counterparts, primarily due to quantum effects and high surface-to-volume ratios. The scope of nanomaterials encompasses nanoparticles, nanowires, nanotubes, and thin films, each offering specific advantages for diverse applications. Nanomaterials, characterized by their dimensions in the nanometer scale (1-100 nm), exhibit a high surface-to-volume ratio (SVR), a fundamental property that distinguishes them from their bulk counterparts. In the biomedical field, the high SVR of nanomaterials enables the development of advanced drug delivery systems. Nanoparticles can be engineered to carry therapeutic agents and release them at targeted sites within the body, improving drug efficacy and reducing side effects. Additionally, nanomaterials' surfaces can be functionalized with biomolecules for use in diagnostic imaging and biosensing, providing high sensitivity and specificity. Environmental applications benefit from the high SVR as well. Nanomaterials are employed in water and air purification systems, where their large surface areas allow for the efficient adsorption and degradation of pollutants. This property is also harnessed in the design of nanomaterial-based sensors that detect environmental toxins at very low concentrations. However, the increased SVR also presents challenges, particularly concerning the environmental and health implications of nanomaterials. Their high reactivity and potential for easy dispersion raise concerns about toxicity and environmental impact, necessitating thorough risk assessments and the establishment of safety guidelines. In conclusion, the high surface-to-volume ratio is a defining and advantageous characteristic of nanomaterials, underpinning their diverse applications and contributions to technological advancements. Continued research is essential to optimize the benefits of this property while addressing the associated risks, ensuring the safe and effective integration of nanomaterials into various sectors.

Electrocatalytic and photocatalytic green hydrogen generation via economical Zn substituted Cobalt ferrite

Jyoti Prakash[1], Rohit Jasrotia[2]
[1]School of Physics and Materials science, Shoolini university, solan, Himachal Pradesh, India
[2]School of Physics and Materials science, Shoolini university, solan, Himachal Pradesh, India

Abstract

The depleting fossil fuel reserves have become a major concern for human society. This has given rise to increase in research and development of the sustainable energy sources. Among the numerous sustainable sources, the hydrogen as fuel has a good appeal for sustainable development. Hydrogen has high calorific values, no secondary pollution and can be produced sustainably. Also, the hydrogen fuel is decentralized and can be produced anywhere making it more cost efficient. The reason that hydrogen still haven't become primary source of energy is because of its inefficient production methods. Currently, hydrogen is mostly made using gas reforming which requires fossil fuels. This defeats the purpose of using hydrogen as green sustainable fuel. To counter these drawbacks, methods like electrocatalysis and photocatalysis are being utilized for producing hydrogen sustainably. But these methods are not cost efficient and their yield is also low. To counter these drawbacks, we have tried to produce catalysts which shows potential for both the photocatalysis and electrocatalysis and produces high yield. Our study focuses on developing Ni doped Cobalt ferrite nanocatalysts (Co1-xZnxFe2O4; x = 0.02, 0.04, 0.06) using sol-gel approach, for green hydrogen generation through photocatalytic and electrocatalytic water splitting. The catalysts demonstrate promising catalytic behavior. Photocatalytic evaluation under ambient conditions reveals the catalyst as photoactive, producing maximum of 21.51 mmol $gcat^{-1}$ of hydrogen in 8 hours. Electrochemical assessment in 0.5 M H2SO4 electrolyte shows superior performance of the Co0.94Zn0.06Fe2O4 nanocatalysts for hydrogen evolution reaction, showing Tafel slope of 141.88 mV/dec. These findings highlight the efficiency of the developed nanocatalysts for clean and sustainable hydrogen production.

Keywords: Green Hydrogen; Electrocatalysis; Photocatalysis; Cobalt ferrite; Sol-gel.

Development of a rechargeable proton energy storage device utilizing a gel electrolyte

Konica Roy
Tezpur University, Assam, India

Abstract

The exceptionally small size of protons or hydrated protons, compared to other metallic ions such as Li^{+}, Na^{+}, Mg^{2+}, Al^{3+}, and Zn^{2+}, has made them crucial for various grid systems. Their small size and lower molecular mass allow for efficient accommodation in host electrodes, minimizing the pulverization of electrode materials during repeated cycling and thereby enhancing cycling stability. Moreover, the proton transport process, which operates via the Grotthuss mechanism, is faster than that of metallic ions. This results in improved proton insertion kinetics in electrode materials, potentially boosting energy storage and power capability. In this study, we explore the phenomenon of electrochemical proton storage in layered vanadium oxide ($V_{10}O_{24}$•$12H_2O$). Our experiments were conducted in a particular type of gel electrolyte consisting of polyvinyl alcohol in various ratios. We illustrate the electrochemical performance of a proton storage full cell with WO_3 and $V_{10}O_{24}$•$12H_2O$ as electrodes in PVA-based gel and hybrid gel electrolytes. As the concentration of the electrolyte increases, an enhancement in the specific capacitance of the cell is observed. However, the performance of the cell further improves when using the hybrid electrolyte. Additionally, an important finding of our study is the substantial reduction in the self discharge rate of the full cell when using the gel electrolyte compared to the pristine aqueous medium electrolyte.

Keywords: Gel electrolyte, $V_{10}O_{24}$•$12H_2O$, long cycle stability, proton storage, full cell.

Synthesis and Characterisation of Carbon Quantum Dots using Multiple Fruit Extract

V. Lakshmy[1], T. Somanathan[2]

[1]Department of Chemistry, School of Basic Sciences, Vels Institute of Science Technology and Advanced Studies, Chennai, Tamil Nadu, India – 600 117

[2]Department of Chemistry, School of Basic Sciences, Vels Institute of Science Technology and Advanced Studies, Chennai, Tamil Nadu, India – 600117

Abstract

Carbon quantum dots (CQDs) have garnered significant attention in recent years owing to their unique optical, electronic, and chemical properties, making them promising candidates for a wide range of applications. In this study, we present a novel approach for the synthesis and characterization of CQDs using multiple fruit extract as the carbon precursor. The choice of multiple fruits offers a diverse pool of carbon sources and natural antioxidants, which may impart distinct properties to the resulting CQDs. The synthesis process involves the carbonization of fruit extract followed by optional surface functionalization to tailor the properties of the CQDs. The synthesized CQDs are systematically characterized using various techniques including UV-Vis absorption spectroscopy, transmission electron microscopy (TEM), X-ray diffraction (XRD) and Raman Spectroscopy, Through these characterizations, we elucidate the optical, structural, and chemical properties of the CQDs, shedding light on their potential applications in optoelectronics, bioimaging, and sensing. This study demonstrates the feasibility of utilizing multiple fruit extract as a sustainable and cost-effective precursor for the synthesis of CQDs with tailored properties, thereby contributing to the advancement of carbon-based nanomaterials for various technological applications.

Keywords: Multiple Fruit Extract; Carbon Quantum Dots; Transmission Electron Microscopy; Carbon sources; X-ray diffraction.

Catalytic Synthesis of Carbon Nanotubes Using CeFeMgO: Efficiency and Structural Insights

D. Manikandan[1], T. Somanathan[2]

[1] Department of Chemistry, School of Basic Sciences, Vels Institute of Science Technology and Advanced Studies, Chennai, Tamil Nadu, India – 600 117

[2] Department of Chemistry, School of Basic Sciences, Vels Institute of Science Technology and Advanced Studies, Chennai, Tamil Nadu, India – 600117

Abstract

The catalytic synthesis of carbon nanotubes (CNTs) using CeFeMgO catalysts represents a promising avenue for achieving efficient and controlled nanotube growth. This study investigates the synthesis process and provides structural insights into the CNTs produced. CeFeMgO catalysts were prepared via solution combustion techniques and growth of CNTs were obtained from chemical vapour deposition (CVD) method. Characterization techniques such as X-ray diffraction (XRD), Field Emission Scanning Electron Microscopy (FESEM), Transmission Electron Microscopy (TEM), Thermogravimetric Analyzer (TGA), Particle Size Analyzer (PSA) and Raman Spectroscopy were employed to analyze the morphology, crystallinity, and composition of the synthesized CNTs. Results indicate that the study reveals robust catalytic activity that facilitates the formation of high-quality carbon nanotubes (CNTs), highlighting the efficiency of CeFeMgO catalysts in promoting CNT growth and elucidating the structural aspects crucial for optimizing nanotube production. Characterization results demonstrate uniform nanotube dimensions, excellent crystallinity, and minimal defects, underscoring the catalyst's efficacy in achieving controlled and efficient nanotube synthesis. This work contributes to advancing the understanding and application of CeFeMgO catalysts in nanomaterial synthesis.

Keywords: Multiwalled Carbon Nanotubes; CVD; CeFeMgO catalyst; Solution Combustion Techniques; TEM.

ICCMEPR-2024/ST/113

Exploring the Electrochemical Potential of $CuCo_2O_4$@Co_3O_4 Nanocomposite on Different Substrates for Supercapacitor Application

Bhakti G. Thali, Rajesh M. Kamble
Electro–Analytical Research Laboratory, Department of Chemistry, University of Mumbai, Santacruz (E), Mumbai 400 098, India

Abstract

Copper cobaltite nanomaterials have attracted more research focus due to their multiple oxidation states in comparison to other transition metals. Spinel structures of metal oxides are of tremendous interest for energy storage applications. Mixed valence metal cations in spinel cobaltites (MCo_2O_4) offer more electronic conductivity and electrochemical activity than single–component oxides. Natural abundance, good electrical and thermal stability, environment–friendly nature, and low cost motivates researchers for carrying out an extensive study of such materials. In this study, binary composite $CuCo_2O_4$@Co_3O_4 was synthesized by facile hydrothermal method. FT–IR, XRD, FEG–SEM and XPS studies have established the successful formation of all the nanocomposites were used to primarily characterize the sample. Cyclic voltammetry (CV), Galvanostatic Charge–Discharge (GCD) and Electrochemical Impedance (EIS) measurements were recorded to examine the electrochemical characteristics. The comparative specific capacitance of the synthesized CuCo2O4@Co3O4 nanocomposite displayed 542.77 Fg^{-1} using Glassy Carbon (GCE) as the working electrode whereas it exhibited 683.72 Fg^{-1} at the same current density of 1 Ag^{-1}using Nickel foam as the electrode substrate. The composite electrode exhibited excellent pseudocapacitive behavior using 1 M Na_2SO_4 and 1 M KOH as electrolytes respectively for electrochemical measurements. Impedance analysis reveals the capacitive nature of the synthesized materials. Furthermore, cyclic stability for $CuCo_2O_4$@Co_3O_4 nanocomposite was found to be 76% (GCE) upto 1000 cycles at 5 $Ag^{-1}$and 78% (Nickel foam) upto 3000 cycles at 5 Ag^{-1}. Based on the study of the electrochemical performance, the synthesized transition metal oxide nanocomposite holds potency as an efficient electrode material for energy storage applications.

Keywords: CuCo2O4@Co3O4 nanocomposite, Electrode Material, Supercapacitor.

A green approach: Nature's blueprint: transformative NiO nanoparticle synthesis via Dracaena Reflexafor (Song of india) next-generation MG dye remediation

Shivam kumar, Sanjeev Kumar
Department of Physics, Chandigarh University, Gharuan Mohali-140413, India

Abstract

This study explores a novel method for producing nickel oxide (NiO) nanoparticles using an extract from Dracaena reflexa, known as the "Song of India." By harnessing the natural phytochemicals of Dracaena reflexa, this green synthesis technique offers an economical and environmentally safe approach to nanoparticle production. The NiO nanoparticles synthesized through this method exhibit exceptional effectiveness in removing Malachite Green (MG) dye, a common pollutant found in water bodies. Techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), and UV-Vis spectroscopy confirm the successful synthesis and demonstrate the nanoparticles' capability to degrade MG dye efficiently.The focus of this application lies in addressing environmental challenges posed by MG dye contamination. The NiO nanoparticles demonstrate high surface area and catalytic activity, which are key factors in their efficiency for MG dye degradation. This study highlights the potential of utilizing plant-based extracts for nanoparticle synthesis, offering a promising approach for advancing next-generation water purification technologies. The results pave the way for environmentally friendly technological advancements by emphasizing the benefits of enhanced environmental cleanup and sustainable nanoparticle production.XRD analysis confirms the successful synthesis of NiO nanoparticles with a crystallite size of 7.89 nm and a face-centered cubic (FCC) structure. Fourier-transform infrared (FTIR) spectroscopy reveals the surface chemistry and interactions with environmental pollutants, showcasing the functionalization of NiO with Dracaena reflexa phytochemicals. Selected area electron diffraction (SAED) results further verify the nanoparticles' crystalline structure, ensuring their purity and crystallinity.

The optical properties of the synthesized NiO nanoparticles are highlighted by well-defined absorption peaks ranging from 290 nm to 350 nm and energy band gaps of 3.54 - 3.6 eV. These properties are crucial for applications such as photocatalysis. High-resolution transmission electron microscopy (HRTEM) confirms the heterogeneous nature of the nanoparticles, providing detailed insights into their morphology.FESEM imaging reveals various nanoparticle morphologies including spherical, flower-like, rod-like, or sheet-like structures, influenced by the phytochemicals and synthesis conditions of Dracaena reflexa extract. These morphologies underscore the versatility and tailored synthesis capabilities of the green synthesis approach.The demonstrated capability of the synthesized NiO nanoparticles to degrade MG dye, achieving a remarkable 97% removal within a short 100-minute timeframe using a concentration of 200 mg L^{-1}, underscores the transformative potential of green synthesis techniques. This achievement not only ensures environmentally benign manufacturing but also establishes superior catalytic performance in NiO nanoparticles for effective environmental cleanup.

Keywords: Green synthesis, Nickel oxide (NiO) nanoparticles, Dracaena reflexa, Song of India, Phytochemical functionalization, Malachite Green (MG) dye remediation, Environmental contaminants, Water purification technology, X-ray diffraction (XRD), Fourier-transform infrared (FTIR) spectroscopy, Selected area electron diffraction (SAED), High-resolution transmission electron microscopy (HRTEM), Field emission scanning electron microscopy (FESEM), Optical properties, Energy band gaps, Pseudo-first order kinetics, Sustainable nanotechnology, Environmental remediation,Surface chemistry, Photocatalysis.

Innovative Sustainable Structural Materials for the Future

Tannu puri, Sanjeev Kumar
Department of Physics, Chandigarh University, Gharuan, Mohali -140413, India

Abstract

The urgent need for sustainable development has forced the building industry to create materials that provide an ideal combination of performance, cost-effectiveness, and environmental advantages. This article explores the innovative field of sustainable structural materials, assessing its potential to revolutionise the construction industry. Conventional building materials such as concrete and steel are thoroughly evaluated for their environmental consequences, prompting the search for more environmentally friendly alternatives. This study investigates a range of cutting-edge materials, such as bio-based composites, recycled content goods, and sophisticated nanomaterials. Materials derived from renewable resources, such as bamboo, hemp, and mycelium, show great potential owing to their little impact on carbon emissions and capacity to naturally break down over time. Recycled materials, such as recycled steel and concrete aggregates, show promise in reducing waste and conserving resources. Nanomaterials, due to their exceptional characteristics, have the potential to fabricate structures that are stronger, lighter, and more resilient, while simultaneously reducing the consumption of raw materials. An essential element of this research is doing a life cycle analysis (LCA) of these materials, which assesses their environmental effect across their whole life cycle, from manufacture to disposal. The article examines energy consumption, greenhouse gas emissions, and resource efficiency of both conventional and new materials in order to determine the most viable choices for sustainable building. Furthermore, this analysis focuses on the integration of these materials into construction methods, with a particular emphasis on factors related to design, structural effectiveness, and regulatory challenges. This study provides a comprehensive examination of the most recent developments in sustainable structural materials and urges academics, industry experts, and policymakers to accelerate the transition towards building methods that are more ecologically sound.

Keywords: Life cycle analysis (LCA); Sustainable construction & Recycled materials.

Bio-based structural materials: opportunities and challenges

Ankita Thakur, Sanjeev Kumar
Department of Physics, Chandigarh University, Gharuan, Mohali -140413, India

Abstract

The growing need for sustainable construction solutions has spurred the development of bio based structural materials sourced from renewable resources. This paper examines the potential of materials like bamboo, hemp, and mycelium as viable alternatives to conventional construction materials such as concrete and steel. These bio-based materials present notable environmental advantages, including reduced carbon footprints, biodegradability, and decreased dependence on non-renewable resources. This study examines the mechanical properties, durability, and performance of bio-based materials across diverse structural applications. Employing life cycle analysis (LCA), it evaluates their environmental impact from raw material extraction through disposal at end-of-life. The findings underscore the benefits of bio-based materials in lowering greenhouse gas emissions and energy consumption relative to conventional alternatives. The integration of bio-based structural materials faces significant challenges. These include variability in material properties, susceptibility to moisture and pests, and the necessity for standardised testing and certification. Additionally, the economic feasibility of bio-based materials, encompassing production costs and market acceptance, undergoes thorough analysis. This research aims to provide a thorough understanding of both the opportunities and challenges linked to bio-based structural materials. It seeks to educate and motivate stakeholders within the construction industry to further the adoption of sustainable, renewable materials in building practices.

Keywords: Biodegradability; material properties, durability.

Nanomaterials in renewable energy: innovations and future prospects

Munisha Mahajan[1], Sanjeev Kumar[2]
[1]Department of Physics, Chandigarh University, Gharuan Mohali 140413, India
[2]Department of Physics, Chandigarh University, Gharuan Mohali 140413, India

Abstract

Nanomaterials have been a focal point of renewable energy research due to the increasing need for sustainable energy solutions. This study investigates the novel uses of nanomaterials in the renewable energy industry, with a specific emphasis on how they improve the effectiveness and functionality of solar cells, fuel cells, and energy storage devices. The distinct characteristics of nanomaterials, including their expansive surface area, adjustable electrical properties, and exceptional catalytic activity, are analyzed for energy conversion and storage. The research emphasizes progress in the fabrication of nanostructured materials for solar cells, such as quantum dots, perovskite nanocrystals, and graphene-based composites. These materials have shown significant improvements in their ability to absorb light and transport charge carriers. The catalytic characteristics and endurance of fuel cell systems may be enhanced by including nanomaterials such as platinum nanoparticles and carbon nanotubes, which also help in decreasing costs. The research examines the use of nanomaterials in lithium-ion batteries and supercapacitors for energy storage. It highlights how these materials improve capacity, charge/discharge rates, and cycle stability. Furthermore, the study discusses the difficulties and possible ecological consequences of using nanomaterials in renewable energy applications. It supports the idea of conducting thorough evaluations across the whole lifespan and promoting the creation of environmentally friendly synthesis techniques. This study emphasizes the crucial role of nanomaterials in improving renewable energy technology and reaching global sustainability objectives by offering a comprehensive overview of existing advances and future potential.

Keywords: nanomaterials, renewable energy, solar cells, fuel cells, energy storage, quantum dots, perovskite nanocrystals, graphene, catalysis, environmental impact.

Synthesis of MoO_3-Fe_2O_3 as a potential electrode for high performance supercapacitor applications

Sandhiya Sundaresan, Gobi Raju
PG and Research Department of Physics, Arignar Anna Government Arts College, Namakkal-02, Tamilnadu, India

Abstract

The fabrication of high-performance supercapacitor electrodes for upcoming energy storage applications has involved a thorough investigation of two-dimensional materials possessing exceptional electrochemical properties. In this study, 2D MoO3 nanoplates were created, and Fe2O3 NPs were added to improve their electrochemical performance. The cyclic voltammetry (CV) analysis further revealed that the MoO3-Fe2O3 NC had a high specific capacitance of 908 F/g at 10mV/s. In the MoO3-Fe2O3 NC electrochemical impedance spectra (EIS), the solution resistance (Rs) and charge transfer resistance (Rct) are 0.48Ω and 0.01Ω, respectively. The Galvanostatic charge-discharge (GCD) experiment demonstrated the long charge-discharge and high rate capabilities of the MoO3-Fe2O3 NC. The exceptional capacitive retention of 88.8 percent is provided by the cyclic stability of MoO3-Fe2O3 NC, even after 3000 cycles. The MoO3-Fe2O3//AC asymmetric supercapacitor (ASC) device yielded a power density of 600 W/kg and an energy density of 43.3 Wh/kg. Moreover, even after 2000 cycles of charge and discharge, the ASC retains 81.17 percent cyclic stability.

Keywords: Specific capacitance, Assymmetric device, Energy density, Two-dimensional materials, and Supercapacitor.

ICCMEPR-2024/ST/121

Transformative pathways in material synthesis: from theory to real-world impact

Neetu Kaur, Sanjeev Kumar
Department of Physics, Chandigarh University, Gharuan, Mohali-140413, India

Abstract

Progress in science and technology hinges on the synthesis and processing of materials, which form the foundation for breakthroughs in many other fields. This paper conducts a comprehensive analysis of modern approaches to material synthesis and processing, examining methods like mechanical alloying, sol-gel processing, and chemical vapor deposition. This research goes beyond traditional boundaries by revealing the complex links between synthesis methods and material properties. It achieves this through an in-depth analysis of theoretical frameworks and practical studies. This work paves the way for the creation of customized materials with improved qualities and functionalities. It achieves this by examining the influence of synthesis parameters and by elucidating the principles that govern material behaviour. Furthermore, sophisticated characterization methods illuminate the evolution of the synthesized materials' microstructure, providing valuable information about their performance in real-world settings. This research has broad implications, with potential applications in electronics, medical devices, renewable energy, and beyond. This study creates the groundwork for groundbreaking inventions that could significantly alter industries and advance society. It achieves this by bridging the gap between theory and practice. By engaging with this study, readers will gain a deeper understanding of the pivotal role that material synthesis and processing play in advancing scientific knowledge and shaping interdisciplinary research. This research invites researchers to delve into the intricate properties and potential applications of synthesized materials, contributing to the ongoing discourse in materials science and paving the way for novel discoveries and breakthroughs.

Keywords: Material science revolution; advanced synthesis & processing for next-gen technology.

Enhancing Corrosion Resistance of Epoxy Coatings Using Different Nano-Fillers

Nikhil Sharma[1], Shruti Sharma[2], Sandeep Kumar Sharma[3], and Rajeev Mehta[4]
[1]Research Scholar, Civil Engineering Department, TIET, Patiala, India
[2]Professor, Civil Engineering Department, TIET, Patiala, India
[3]Associate Professor, Mechanical Engineering Department, TIET, Patiala, India
[4]Professor, Chemical Engineering Department, TIET, Patiala, India

Abstract

Among the broad spectrum of approaches aimed at mitigating steel corrosion, the application of epoxy coatings has exhibited significant effectiveness. Our investigation centres on advancing the corrosion resistance attributes of epoxy coating through the integration of different nano-clay based and carbon based fillers in epoxy. This encompasses different nano clays like montmorillonite (MMT) and halloysite nano-tubes (HNT), and different carbon based fillers like graphene oxide, reduced graphene oxide and carbon nano-tubes. High concentration of natural occurring nano-clays (2 wt%) were used and low-concentration of carbon-based fillers one-fifth of nano-clay (0.4 wt%) were investigated and compared among all. Coatings matrix were prepared using three-step mixing procedure, includes high shear homogenizing, probe-ultrasonication and mechanical stirring. Samples were coated and subjected to accelerated impressed current corrosion and their performance was evaluated by non-destructive testing of visual inspection, impressed corrosion current and ultrasonic guided wave measurements. Non-destructive testing results were supported by destructive testing of residual tensile strength and mass loss of corroded samples.

The results indicate that all type of nano-modification of epoxy successfully delays the initiation of corrosion in comparison to plain epoxy. The nano dispersion of fillers in epoxy enhances toughness, tensile, and flexural properties while creating tortuous paths for moisture diffusion as evidenced by minimal corrosion current rise and drop in ultrasonic guided wave signal indicative of deterioration due to pitting corrosion. After 90 days of accelerated corrosion exposure, low concentration of carbon-based nano-fillers performs better in terms of corrosion protection in comparison to five times more nano-clay based modification. Overall, among all coatings graphene oxide based modified coating perform superior in terms of corrosion protection. Since graphene oxide not only diffuses the path of aggressive ions but also entraps the aggressive ions due to its functional groups presence. Suggested modification leads to increase the life of infrastructure by several factors and required less maintenance which pointing towards the goal of sustainable construction.

Keywords: Nano-clay; Graphene derivatives; Carbon-nanotubes; Accelerated corrosion; Non destructive monitoring.

Evolution of H_2 and O_2 through overall Efficient Electrochemical Water splitting using $ZnTiO_3$ Perovskite deposited Electrode

Suhriday Barman, Partha Pratim Sahu
Department of Electronics & Communication Engineering, Tezpur University, Tezpur, India, 784028

Abstract

This study investigates the evolution of hydrogen (H_2) and oxygen (O_2) through water splitting using $ZnTiO_3$ perovskite deposited on Fe screw pitch electrodes (SPCE). The growth of hydrogen generation as a clean energy source relies heavily on the development of stable and effective catalysts for water splitting. Recently, perovskite oxide-based materials have been extensively investigated for hydrogen and oxygen production due to their favorable physical and chemical properties. Titanate-based perovskites, in particular, have shown great potential in this field. In this study, ZnTiO3 perovskite was synthesized using a low-cost sol gel method and subsequently deposited onto Fe screw pitch cylindrical electrodes (SPCE) at varying concentrations to achieve efficient overall water splitting at a low voltage of 1.3 V in a NaOH electrolyte solution of different pH solutions. The structural and morphological characteristics of the ZnTiO3 perovskite were analyzed using X-ray diffraction (XRD) and scanning electron microscopy (SEM) as well as Energy Dispersive X-ray spectroscopy. Experimental results revealed a high evolution rate of 2.46×10^{19} molecules/sec for hydrogen generation and 1.23×10^{19} molecules/sec for oxygen generation. The results indicated that increasing the amount of deposited perovskite material enhanced the evolution rates of both gases. Furthermore, the study examined the impact of different pH electrolyte solutions on hydrogen and oxygen evolution, finding that a higher pH of 13.5 gives the best results. Durability tests of the Fe SPCE electrodes were conducted through continuous electrochemical water splitting experiments over 500 hours, showing less than a 5% variation in performance. A remarkable hydrogen conversion efficiency of 63.24% was achieved through overall water splitting. These findings shows the potential of ZnTiO3 perovskite as a cost-effective and durable catalyst for water splitting applications, contributing significantly to sustainable hydrogen production.

Keywords: Perovskite; Electrochemical water splitting; hydrogen evolution rate; oxygen evolution rate; clean energy; Fe SPCE; sol-gel method.

Mesua assamica (king & prain) seed shell derived recyclable Bronsted acid nanocatalyst for biodiesel production from different oil feedstocks

Gobinda Prasad Chutia, Kandarpa Phukan
Department of Chemistry, Handique Girls' College, Guwahati-781001, Assam, India

Abstract

Waste seed shells from mesua assamica (King & Prain) were used to create a novel magnetically separable Fe_3O_4@biochar@SO_3H catalyst for the economically viable generation of biodiesel using mesua assamica seed oil, jatropha oil, and soybean oil. Fe_3O_4 magnetic nanoparticle impregnation was done after the sulfonation methods. The successful sulfonation and presence of -SO3H groups on the catalyst surface were indicated by Fourier transform infrared (FT-IR) and X-ray photoelectron spectroscopy (XPS). 1.9 mmol $g^{-1}$of total acidity and 1.8 mmol g-1 of –SO3H density are found in the produced magnetic acidic catalyst. The catalyst particle with a core-shell configuration was observed having a mean size of 87.4 nm and a surface area of 71.47 m^2g^{-1}. The maximum production of 96.8% mesua assamica biodiesel, 95.3% jatropha biodiesel, and 95.8% soybean biodiesel under optimal reaction parameters were easily achieved by the acidic catalyst. A pseudo first order kinetics with an activation energy of 32.42 kJ mol^{-1} was suggested by the kinetic analysis. Additionally, the magnetically separable catalyst showed encouraging stability and activity up to the third cycle, yielding more than 75% biodiesel.

Keywords: Biodiesel; Biochar; Heterogeneous acid catalyst; Magnetic nanocatalyst; Transesterification.

ZnO Nanostructure Shape Effects in Photocatalysis of Methylene Blue

M Ramya[1], Jitha P Marydasan[2], Swathy Satheesh[2], V P N Nampoori[1], M Kailasnath[1]
[1]International School of Photonics, CUSAT, Kochi, Kerala, India
[2]Ansar Women's College, Perumpilavu, Thrissur, Kerala, India

Abstract

Nowadays, dyes are used in the food industry, textile industry, paper industry, hair coloring, light-harvesting arrays, photoelectrochemical cells, etc. Most of the dyes are nonbiodegradable, toxic, carcinogenic, and consist of organic compounds. These dye wastages are discharged into water bodies and the environment causing serious hazards to the marine ecosystem as well as the humans extensively. To treat toxic dyes traditional methods such as adsorption, activated carbon, ultrafiltration, and reverse osmosis are used for dye removal. But, in these processes pollution from one form transfers to another form causing secondary pollution. In the present study, efficient ZnO nanostructure (nanodot, nanorod, nanoplate, and nanoflower) photocatalysts were prepared by ultrasonication-assisted solution method using ethylene glycol, 1-butanol, acetic acid, and water as solvent. ZnO has a wide band gap and it can be excited using UV light. For excellent photocatalysis, electron-hole recombination is suppressed by trapping charge carriers at defect states. Thus, the photocatalytic activity of ZnO is modified by changing its shape, size, and doping with transition metal ions. Here, we discussed the degradation of methylene blue (MB) using different dimensional ZnO nanostructures as a potential photocatalyst. The morphology and surface area of the synthesized samples were analyzed using TEM and BET analysis. Solvent physicochemical properties affect the growth kinetics and morphological evolution. ZnO nanoflower exhibits excellent photocatalytic performance than the other structures towards methylene blue degradation due to their larger surface area. Higher surface area enhances the dye adsorption and photodegradation efficiency to 85% under exposure to visible light after 20 minutes.

Keywords: ZnO; Methylene Blue; Photocatalysis; Degradation.

Synthesis and Characterization of Cu-Al-O based Delafossite by Ball Milling process

Apurba Sarkar[1], Soumya Mukherjee[2], Jamil Akhtar[3], Shibayan Roy[3], Nandan Pakhira[1]
[1]Department of Physics, Kazi Nazrul University, Asansol-713340, India
[2]Department of Metallurgical Engineering. Kazi Nazrul University, Asansol-713340, India
[3]Material Science Centre. Indian Institute of Technology, Kharagpur-721302, India

Abstract

Delafossite are class of materials used for transparent electronics, solar cells , thermoelectric and others, In the present investigation, ball milling process was adopted to synthesize the Cu-Al-O based delafossite material having generalized formula ABO2. AR grade precursors of CuO, Alumina are taken with in the ball millng with ball: sample ratio being maintained at 5:1. Milling speed was maintained at 370 rpm for 70 hours duration with acetone as medium for grinding. Thermal analyses was carried (Inert atmosphere) to note the zone of crystallization of phase followed by annealing accordingly for phase development. Annealing was carried at 1200°C for 6 hours duration. XRD confirms delafossite structure with crystallite size estimation by Scherrers formula. Crystallite size estimated was noted to be about 48nm by Scherrers formula and 134 nm using William Son Hall method. Apparent porosity approx 41%, BD (2.79g/cc) was estimated using Archimedes principle followed by bonding analysis for M-O from FTIR. Both XRD, FTIR confirms delaffosite formation. Morphology of the sample was revealed by SEM which indicates agglomerates with some porosity and interlocking. Agglomerates were noted to be various polygonal in shape (cuboid,hexagonal) with dimensions close to about 4µ. Microhardness value was estimated to be about 0.91 GPa while dielectric constant was about 550.

Keywords: Delafossite; Thermal analysis; Phase analysis; Morphology; Microhardness; Dielectric constant.

Assessment of Ground Water of different taluks of Tumkur District, Karnataka

Bhavya N.S.[1], H.V. Jayaprakesh[2], H.S. Lalithamba[3], Prashanth G.K.[4]

[1]Sri Siddhartha Institute of Technology, Maraluru, Tumkuru, Sri Siddhartha Academy of Higher Education, Agalkote, Tumkur-572107, Karnataka, India

[2]Associate Professor, Department of Chemistry, Sri Siddhartha Institute of Technology, Maraluru, Tumkur-572105, Karnataka, India

[3]Professor and Head, Department of Chemistry, Siddaganga Institute of Technology, B.H.Road,Tumkur-572103, Karnataka, India

[4]Department of Chemistry, Sir M. Visvesvaraya Institute of Technology, Bengaluru 562157, India

Abstract

Human and industrial activities causes the subsurface water pollution leads to the serious situation almost everywhere. This activity involves evaluating the quality of ground water. The samples of ground water of two taluks of Karnataka were collected and their physico chemical parameters are analyzed. Study areas of present research work are Kurubarahalli village and town bore well of Chikkanayakanahalli taluk and Maridasanahalli village and Pavagada rural of Pavagada taluk. Determination and comparison of thirteen physico chemical parameters like electrical conductivity and pH, chloride, fluoride, sulfates, nitrates, COD, BOD, DO, total hardness, alkalinity, acidity of these two taluk's water samples are done using water quality standards. In some regions, people are making extensive use of groundwater for irrigation. Analysis results show that fluoride and chloride concentrations are excessive and deficiency in the study areas. Due to this, people are suffering with serious health effects in these areas. So, steps should be taken to avoid ground water pollution and usage of ground water to a large extent.

Keywords: Ground water pollution; physico-chemical parameters; fluoride; chloride; water quality standard measures.

Novel dischiff's base esters with 2-Aminobenzothiazole containing liquid crystalline derivatives: Studying for new antimicrobial agents

Keval bambharoliya[1], Sanskruti H. Patel[2], Chetan B. Sangani[3], H. N. Patel[1]

[1]Shree Maneklal M. Patel Institute of Sciences & Research Sector 15/23, Gandhinagar. Kadi Sarva Vishwavidhyalaya, Gandhinagar, India

[2]Department of Chemistry, School of Sciences, Gujarat University, Ahmedabad 380009, India

[3]Department of Chemistry, Government Science College Gandhinagar-382016, Gujarat University. Gujarat, India

Abstract

The benzothiazole and dischiff's base esters are pivotal practicality due to their extensive variety of biological multifariousness and have an extensive range of therapeutic distinctive as well as liquid crystalline demeanor. Keeping in view the significance of these organic heterocyclic compounds, a new series of 2-Aminobenzothiazole consisting novel dischiff's base esters derivatives were integrated by organic reactions. The integrated compounds were characterized by amalgamation of elemental evaluations and standard spectroscopic methods. Then studying of liquid crystalline demeanor by utilizing polarized optical microscope with differential scanning calorimeter which displayed liquid crystal phase in our compounds. The integrated organic heterocyclic derivatives were evaluated for them in vitro antibacterial activity against gram positive and gram negative bacteria. The homologues of lower members revealed enantiotropic nematic mesophase whereas higher members displayed smectic A mesophase. The phase transition of the present series is compared with other structurally similar compounds to evaluate the consequence of central Schiff's base linkage and lateral 2-aminobenzothiazole substitution on their mesophase behavior.

Keywords: 2-Aminobenzothiazole, liquid crystalline, novel dischiff's base esters, antibacterial activity, DSC.

ICCMEPR-2024/ST/137

Optimizing Gallium Nitride (GaN) Based SOI-TF-FinFETs for Enhanced Linearity and Low Distortion in High-Frequency Applications

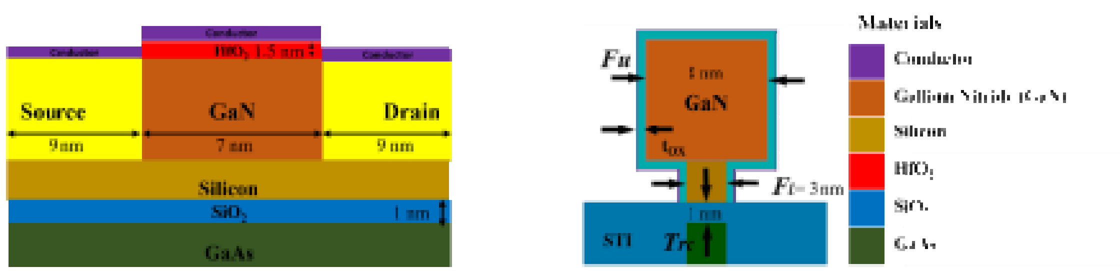
Praween Kumar Srivastava, Atul Kumar, Ajay Kumar
Jaypee Institute of Information Technology, Noida

Abstract

Gallium Nitride (GaN) based Fin Field-Effect Transistors (FinFETs) represent a breakthrough in semiconductor technology, particularly for applications requiring high power, high frequency, and high efficiency. GaN is a wide bandgap semiconductor material known for its excellent electrical properties, including high electron mobility, high breakdown voltage, and thermal stability. These characteristics make GaN an ideal candidate for next-generation electronic devices, especially in the fields of RF and microwave communication, power amplification, and high-speed digital circuits. This paper investigates GaN-SOI truncated Fin FinFET (GaN-SOI-TF-FinFET) designed for high-performance linearity and low distortion, focusing on key metrics such as voltage and current third-order intercept points (VIP3 and IIP3), second and third harmonic distortion (HD2 and HD3), third-order intermodulation distortion (IMD3), and the 1-dB compression point (1dB CP). Leveraging the high electron mobility and wide bandgap of GaN, we have optimized the fin dimensions and gate structures to enhance device performance. Our results demonstrate that GaN-SOI-TF-FinFET achieve a VIP3 and IIP3 significantly higher than those of traditional silicon-based transistors, indicating superior linearity. Additionally, the devices exhibit reduced HD2 and HD3, highlighting their low distortion characteristics. Measurements show that the IMD3 is minimized, and the 1dB CP is improved, confirming the high power-handling capability and robustness of GaN-SOI TF-FinFET. These findings underscore the potential of GaN-SOI-TF-FinFET for advanced RF and communication applications requiring high linearity and low distortion.

The following sections of this paper will discuss the fabrication process of GaN-SOI-TF FinFET, present detailed experimental results, analyze the performance based on the aforementioned key metrics, and conclude with the potential applications and future directions for GaN-SOI-TF-FinFET technology. The proposed dvice structure of GaN-SOI-TF-FinFET is shown in Fig. 1.

Keywords: GaN-SOI-TF-FinFET; Linearity; Distortion; Reliability; Materials.



(a) (b)

Fig. 1: (a) Three-dimensional structure of GaN-TF-FinFET.
(b) Lateral cross-sectional view of GaN-SOI-TF-FinFET at 7 nm node.

The enhanced charge isolation over dual Z-scheme CeO_2/BiOCl/Ag_2WO_4 photocatalyst for cationic dyes degradation: mechanistic insights and pathway

Kusum Sharma, Pardeep Singh, Pankaj Raizada
School of Advanced Chemical Sciences, Faculty of Basic Sciences, Shoolini University, Solan (HP), India-173229

Abstract

The fabrication of a multi-component heterojunction system with enhanced charge isolation efficacy still remains challenging. Herein, a photoactive CeO2/BiOCl/Ag2WO4 heterojunction was successfully constructed using co-precipitation technique for the degradation of CV and MB dyes. It was found through a combination of characterization and experiments that the dual Z-scheme system not only augmented the charge isolation and migration efficiency but also maintains superior redox ability with extended visible light absorption capacity. In CeO2/BiOCl/Ag2WO4 system, 97% of MB and 98% of CV was degraded in 75 min using 50 mg/L of ternary photocatalyst. The rate of reaction of CeO2/BiOCl/Ag2WO4 for MB (0.0445 min^{-1}) and CV (0.05053 min^{-1}) exhibited multi-fold increase in comparison to the bare photocatalysts. The electron spin resonance (ESR) analysis have remarkably identified hydroxyl and superoxide radicals (•OH, $•O_2^-$) as the primary reactive species in the degradation process. Liquid chromatography-mass spectrometry (LC MS) analysis was utilized in order to obtain potential degradation pathway for MB and CV, respectively. The dual charge transferal mechanism by the ternary photocatalyst resulted in significant increase in the photocatalytic activity and provided new perspectives on the principles guiding the rational development of multicomponent system for environmental remediation.

Keywords: CeO_2/ BiOCl/Ag_2WO_4, Dual Z-scheme, Enhanced electron-hole separation, cationic dyes mitigation: degradation pathways.

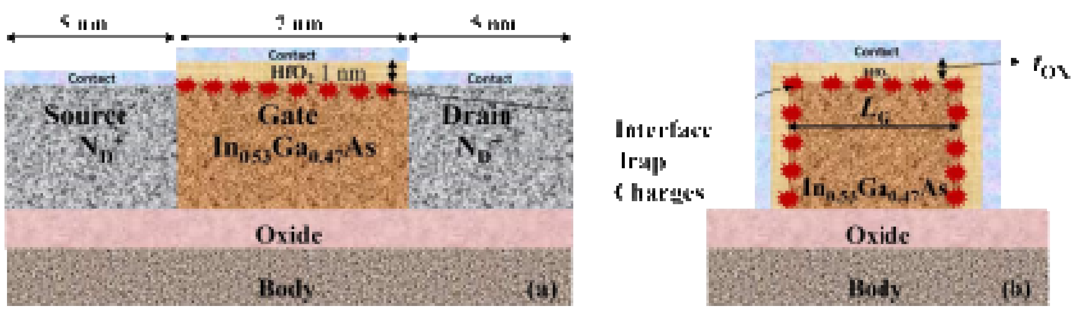
Reliability Investigation of Interfacial Defects in $In_{0.53}Ga_{0.47}As$ SOI-FinFET for High-Performance Applications

Priyanka Agrwal, Ajay Kumar
Jaypee Institute of Information Technology, Noida

Abstract

Indium Gallium Arsenide (InGaAs) based FinFETs)have emerged as promising candidates for next-generation high-performance semiconductor devices. The relentless pursuit of improved speed, power efficiency, and miniaturization in electronic devices has driven the exploration of materials beyond traditional silicon. In0.53Ga0.47As, with its superior electron mobility and high saturation velocity, offers significant advantages for high-speed and high-frequency applications, making it an attractive alternative to silicon. This study investigates the reliability of interfacial defects in Indium Gallium Arsenide (In0.53Ga0.47As) Silicon-On-Insulator (SOI) Fin Field-Effect Transistors (FinFETs) for high-performance applications. In0.53Ga0.47As is a promising material for next-generation transistors due to its high electron mobility, which is essential for high-speed and high-frequency applications. However, the presence of interface trap charges (ITCs) can significantly impact device performance and reliability. We conducted a comprehensive analysis of ITCs in In0.53Ga0.47As SOI-FinFETs, examining their effects on key performance parameters such as threshold voltage, subthreshold slope, and mobility. Through advanced characterization techniques and stress tests, we identified the dominant interfacial defects and their impact on device degradation over time. Our results indicate that optimizing the interface quality is crucial for enhancing the reliability and performance of In0.53Ga0.47As SOI-FinFETs. This work provides valuable insights into the defect mechanisms and offers guidelines for improving the fabrication processes to achieve more reliable high performance In0.53Ga0.47As SOI-FinFETs. The proposed device structure of In0.53Ga0.47As SOI FinFETs is shown in Fig. 1.

Keywords: In0.53Ga0.47As SOI-FinFETs; Interface Trap Charges (ITCs); Reliability; Materials.



(a) (b)

Fig. 1: (a) Three-dimensional structure of In0.53Ga0.47As SOI-FinFET.
(b) Lateral cross sectional view of In0.53Ga0.47As SOI-FinFET.

High temperature dielectric and hopping mechanism of thin flexible mats of PU/PMMA- $(PrFeO_3)_{0.24}$-$(PbTiO_3)_{0.76}$

Sajan Masih[1], Anupinder Singh[2]

[1]Multifunctional Materials Laboratory, Department of Physics, Guru Nanak Dev University, Amritsar, Punjab, India-143005

[2]Multifunctional Materials Laboratory, Department of Physics, Guru Nanak Dev University, Amritsar, Punjab, India-143005

Abstract

The development of high-performance dielectric materials has been a significant focus in the field of flexible electronics and energy storage devices [1-3]. Flexible electronic materials are increasingly important for a wide range of advanced technological applications, including wearable electronics, flexible sensors, and high-performance capacitors [4]. These materials are crucial for the development of advanced devices in modern technology. In this work, Polyurethane (PU) and polymethyl methacrylate (PMMA) composites used for their flexibility and $(PrFeO_3)_{0.24}$-$PbTiO_3)_{0.76}$ have energy storage and magnetoelectric properties [5]. The incorporation of $(PrFeO_3)_{0.24}$-$PbTiO_3)_{0.76}$ in of PU/PMMA can potentially enhance flexibility, dielectric and magnetic properties. Traditional materials often struggle due to theirs low flexibility, making the development of flexible with dielectric and magnetic properties a priority [6]. This study investigates the high-temperature dielectric properties and hopping conduction mechanism of thin flexible mats composed of a PU/PMMA-($(PrFeO_3)_{0.24}$- $PbTiO_3)_{0.76}$. Thin flexible mats of PU/PMMA were prepared with varying concentrations of $(PrFeO_3)_{0.24}$-$PbTiO_3)_{0.76}$. The impedance and dielectric properties were measured using an impedance analyzer over a temperature range from room temperature to 250°C. AC conductivity was analyzed to understand the hopping conduction mechanism. Understanding the hopping mechanism is crucial for optimizing the electrical performance of the composite, particularly in high-temperature environments. By tailoring the material composition and processing conditions, it is possible to enhance the dielectric properties and control the charge transport behavior to meet specific application requirements [7]. Micro-structural analysis performed using the field effect scanning electron microscope (Carl Zeiss Supra 55).

Keywords: Dielectric, Hopping conduction, Multiferroic.

References:

1. Zhi-Min Dang, Jin-Kai Yuan , Sheng-Hong Yao , and Rui-Jin Liao, Flexible Nanodielectric Materials with High Permittivity for Power Energy Storage, Adv. Mater. 2013, 25, 6334–6365
2. Haribabu Palneedi, Mahesh Peddigari, Geon-Tae Hwang, Dae-Yong Jeong, and Jungho Ryu, High-Performance Dielectric Ceramic Films for Energy Storage Capacitors: Progress and Outlook, Adv. Funct. Mater. 2018, 28, 180366
3. Qi Li, Fang-Zhou Yao, Yang Liu, Guangzu Zhang, Hong Wang, and Qing Wang,High Temperature Dielectric Materials for Electrical Energy Storage, Annual Review of Materials Research, Volume 48, 2018
4. Chunya Wang, Kailun Xia, Huimin Wang, Xiaoping Liang, Zhe Yin, and Yingying Zhang, Advanced Carbon for Flexible and Wearable Electronics, Adv. Mater. 2019, 31, 1801072
5. Mehak Arora, Shubhpreet Kaur, Sunil Kumar, Parambir Singh Malhi, Mandeep Singh and Anupinder Singh, Evaluation of dielectric, energy storage and multiferroic properties of PrFeO3–PbTiO3 solid solutions, J. Adv. Dielect. 12, 2250012 (2022)
6. Yifei Luo et. al, Technological roadmap for flexible sensors, ACS Nano 2023, 17, 6, 5211–5295
7. Rui Wang, YuJie Zhu, Jing Fu, Mingcong Yang, Zhaoyu Ran, Junluo Li, Manxi Li, Jun Hu, Jinliang He, and Qi Li, Designing tailored combinations of structural units in polymer dielectrics for high-temperature capacitive energy storage, Nat Commun. 2023; 14: 2406.

Metal nanoparticles via green approaches and their applications

V. K. Linima, R. Ragunathan, Jesteena Johney
Department of Biotechnology (Bionanotechnology), Centre for Bioscience and Nanoscience Research, Eachanari, Coimbatore – 641021, Tamilnadu, India

Abstract

Nanoparticle production from natural substances represents a rapidly advancing field within nanotechnology research. These nanoparticles hold immense promise for transforming drug delivery, enhancing therapeutic effectiveness, and reducing adverse effects. Their minute size and expansive surface area facilitate intricate interactions with biological systems, paving the way for targeted therapies and diagnostic advancements. Characterized by biocompatibility and stability, they are particularly valuable in medical sciences, given the prevalence of plant derived drugs. Nanotechnology's capability to synthesize antimicrobial nanoparticles is pivotal in healthcare, notably in biomedicine. In a recent study, iron and silver nanoparticles were biologically synthesized using Desmodium triflorum leaf extract, renowned for its diverse phytochemical composition rich in bioactive compounds. Comprehensive analysis of the leaf extract encompassed phytochemical profiling, thin-layer chromatography (TLC), antioxidant assays, and GC-MS analysis, revealing significant concentrations of antioxidants. These phytoconstituents play a crucial role in the extract's antimicrobial properties. Morphological characterization of the synthesized iron and silver nanoparticles was conducted using UV-Vis absorption spectroscopy, Fourier transform infrared (FT-IR) spectroscopy, X-Ray Diffraction (XRD), and Scanning Electron Microscopy (SEM) coupled with Energy Dispersive Spectroscopy (EDS). Evaluation of the iron nanoparticles highlighted their potent antibacterial and antifungal efficacy, with Minimum Inhibitory Concentration (MIC) studies confirming their strength. Notably, both types of nanoparticles exhibited strong bactericidal effects against Staphylococcus aureus. These findings underscore the potential of utilizing biologically synthesized nanoparticles derived from Desmodium triflorum for therapeutic applications. The integration of nanotechnology with natural resources promises innovative and sustainable approaches in medicine, potentially yielding safer and more efficient therapeutic solutions.

Keywords: Green synthesis, FeNPs and AgNPs, SEM, TEM, Antimicrobial activity.

Experimental and Theoretical Insights into the Bi-based Halide Double Perovskites for Optoelectronic Applications

S. N. Rahane[1] S. R. Rondiya[2], S. R. Jadkar[1]
[1]Department of Physics, Savitribai Phule Pune University, Pune 411007, India
[2]Department of Materials Engineering, Indian Institute of Science (IISc), Bangalore 560012, India

Abstract

Inorganic lead-free halide double perovskites with the formula $A_2BB'X_6$ (X = Cl, Br), have garnered significant attention as substitutes for lead halide perovskites in optoelectronic applications due to their non-toxicity and improved stability. However, our current understanding of their intrinsic defect properties and their impact on carrier transport remains limited. Defects such as vacancies, anti-site substitutions, and interstitials are common in these quaternary halide double perovskites, influencing carrier density and transport characteristics. The optical properties, particularly the dynamics of self-trapped excitons (STEs), are crucial for their application in optoelectronics. Our research focuses on investigating how Fe doping affects the structural and optical features of $Cs_2AgBiCl_6$ double perovskites. We have successfully synthesized $Cs_2AgBiCl_6$ as the host material and doped them with Fe^{3+}. The synthesized materials are characterized by X-ray diffraction (XRD), Raman spectroscopy, Xray Photoelectron Spectroscopy (XPS) and electrochemical measurements. Photoluminescence (PL), time-resolved PL (TRPL) measurements further explore the absorption, excitation, and recombination processes. Using a combined experimental-computational approach, we investigate the optoelectronic properties of both undoped and Fe-doped $Cs_2AgBiCl_6$ perovskites. Density functional theory (DFT) calculations affirm the retention of the cubic crystalline structure upon Fe doping and predict the introduction of shallow defect energy levels within the band gap due to partial Bi substitution by Fe. This results in indirect band gaps for both undoped and Fe-doped $Cs_2AgBiCl_6$. Fe-doped $Cs_2AgBiCl_6$ exhibits strong absorption from below 400 nm up to 700 nm, suggesting sub-band gap state transitions originating from surface defects. The PL analysis reveals a significant enhancement in PL intensity with Fe doping, attributed to increased radiative recombination rates and higher densities of free excitons. Photoluminescence Quantum Yield (PLQY) measurements further support these findings, indicating enhanced PL intensity with increasing Fe dopant concentration up to 3%, and a subsequent decrease at 6% doping. The radiative kinetics and average lifetime are investigated by TRPL measurements. Overall, these results underline the potential of Fe-doped $Cs_2AgBiCl_6$ as phosphors in white light-emitting diodes (WLEDs), as well as their promise as p-type solar absorbers with efficient carrier transport characteristics, offering novel avenues for the development of lead-free double perovskites in the field of optoelectronic applications.

Keywords: Double perovskites, doping, optoelectronics, recombination, self-trapped excitons.

Efficient photocatalytic degradation of 4-nitrophenol in wastewater using novel activated carbon-based nanocomposites

Shisak Sharma, Dipak Sinha
Department of Chemistry, Nagaland University, Lumami-798627, Nagaland, India

Abstract

This paper describes the photocatalytic degradation of the 4-nitrophenol in aqueous suspensions using croton caudatus activated carbon/ZrO_2-ZnO (CCAC/ZrO_2-ZnO) nanocomposite in UV light. Analytical techniques such as XRD, FT-IR, TEM-SEAD, XPS, PL, and BET analyzer were used to characterize the CCAC/ZrO_2-ZnO nanocomposite. The BET surface area of the photocatalyst was found to be 223.387 m^2g^{-1}, having a total pore volume of 0.1845 cm^3g^{-1}. The mechanism of composite formation was explained using DFT investigations, which demonstrated a favorable immobilization of ZrO_2- ZnO on CCAC. Chemical descriptors gained from DFT investigations, such as HOMO-LUMO energy, ionization energy, dipole moment, chemical softness, and chemical hardness, supported an understanding of the relative efficiency and reactivity of ZrO_2-ZnO and CCAC/ZrO_2-ZnO towards 4-nitrophenol degradation.

Keywords: Activated carbon; Nanocomposites; Photocatalytic degradation; UV light irradiation; Density functional theory.

Photoelectrocatalyatic Degradation of Methylene Blue using Nanocrystalline Al-doped CdSe/TiO2 Thin Film under Visible light

Lata Shete, Rakesh Shedam, Shivanand Masti
Shivaji University, Kolhapur, India

Abstract

Aluminium-doped CdSe/TiO2 nanocrystalline thin film was synthesized using spray pyrolysis technique at the optimized temperature on fluorine-doped tin oxide (F.T.O.) glass substrate. The synthesized thin film was characterized by Atomic Force microscopy(AFM), scanning electron microscopy (SEM), energy-dispersive X-ray (EDX), and UV-visible spectroscopy techniques. The thin film's photoelectrocatalysis(PEC) performance was investigated via methylene blue (MB) dye degradation from an aqueous solution under visible light. AFM investigation confirms that Al-doped CdSe/TiO2 thin film has a non-uniform grain size. The grain size and surface roughness increase with the doping concentration. SEM analysis confirmed uniform film deposition with regularly arrayed crystal grains and indicated a flower-type crystal structure presence of TiO2 on the thin film. The particle size was determined by using SEM and found to be 119.3 nm, and due to the doping, the size was increased. The EDAX analysis confirms the elements Cd, Se, Al, Ti, and O present on the thin film. The direct band gap was determined by UV-VIS spectroscopy and by Tauc's relation is found to be 2.1eV. The direct band gap of TiO2 is 3.2 ev and due to Al doping in CdSe is reduced to activate in the Visible region. The maximum photodegradation percentage was obtained for 5 % Al-doped CdSe/TiO2 thin film for a Xenon lamp (500W) is 75.48% and in visible light (sunlight) is 94.42% for 300 min.

Keywords: Cadmium selenide, Al-doping, Thin films, Spray pyrolysis, Optoelectronic properties, Photoelectrocatalysis, Photodegradation.

Integrating BiOI/g-C_3N_4/Bi_2WO_6 Derived Dual S-Scheme Photocatalyst with Biochar for Emerging Adsorption for Photocatalysis: Multicharge Migration and Mechanistic Insights

Anchal Rana, Pardeep Singh
Affiliation-School of Advanced Chemical Sciences, Shoolini University, Solan, India

Abstract

Photocatalysis for environmental cleanup applications has seen an enormous increase in interest recently. This study aimed to examine the in situ photoactivity of the photocatalyst BiOI/g-C_3N_4/Bi_2WO_6/Biochar for the photocatalytic decomposition of the target pollutant methylene blue (MB). During photocatalysis, biochar is utilized as a support material by using light harvesting and electron-conductive qualities to hinder the quick recombination of e– /h+pairs. The BiOI/g-C_3N_4/Bi_2WO_6/Biochar composite showed improved photoactivity and stability after adding biochar. For MB degradation, the attained rate constant K was found to be 0.04102 > 0.02446 > 0.01818 > 0.0119 > 0.00933 > 0.00705 min^{-1} for g C_3N_4/Bi_2WO_6/BIOI/Biochar > g-C_3N_4/Bi_2WO_6/BIOI > g-C_3N_4/Bi_2WO_6 > BiOI > Bi_2WO_6 > g-C_3N_4, respectively. The degradation efficiencies of BiOI/g-C_3N_4/Bi_2WO_6/Biochar photocatalysts for MB were 97.56% within 70 min. Scavenger and electron spin resonance (ESR) studies further demonstrated that h+,•O^{2-}, and •OH are significant reactive species that aid in the photodegradation of dyes. Additionally, the structural analyses of MB using DFT calculations and the examination of the degraded products using GC-MS (gas chromatography–mass spectrometry) allowed for a more insightful deduction of the photodegradation pathways. Results showed that the degradation efficiencies of BiOI/g C_3N_4/Bi_2WO_6 significantly improved the degradation rate with the addition of biochar. The quaternary composite improved light harvesting, absorption capacity, porosity, and pore structure of the photocatalyst. This work suggests possible applications and a novel technique for large-scale photocatalytic degradation. It also suggests a straightforward and inexpensive strategy for creating a stable semiconductor-based photocatalytic system.

Keywords: S-scheme, Biochar, Methylene Blue.

An overview of magnesium matrix composites reinforced with waste materials

NikhilGupta[1], Subodh Barthwal[1], Praveen pachauri[2]
[1]Research Scholar, Mechanical Engineering, Amity School of Engineering and Technology, Greater Noida, Uttar Pradesh, India
[2]Professor, Government Polytechnic Siwan, Bihar, India

Abstract

The requirement of light weight materials with high specific strength is becoming more and more necessary in the numerous of sectors like aerospace sectors, automobile sectors, electronic sector and medical sector etc. Materials based on magnesium (Mg) have gained appeal across a wide range of industries due to their high density, excellent vibration damping capabilities, and recyclability. However, magnesium faces major challenges in its extensive industrial application due to its poor strength and wear resistance. Researchers are creating magnesium matrix composites (MMC) with a variety of reinforcements to increase the use based on requirements. Al_2O_3, SiC, B_4C, TiB_2, CNTs, and GNPs are common reinforcements used in the fabrication of magnesium matrix composites. In recent years, many of researchers have attempted to minimize the price of magnesium matrix composites by utilizing the ecologically friendly reinforcements. These reinforcements are rice husk, granite, egg shell, seashell, fly ash, red mud and CNT etc. This review paper studied on magnesium matrix composites reinforced with waste materials to enhance the various properties like wear, corrosion, and other thermal properties by adding the these reinforcements.

Keywords: Magnesium matrix composite (MMC), Waste Reinforced material, strength, Wear, corrosion.

Green BZF Nanocomposite for Electrochemical Sensor Applications

D. M. Tejashwini[1], H. P. Nagaswarupa[1], Ramachandra Naik[2], A S Manjunatha[3]
[1]Department of Studies in Chemistry, Shivagangotri, Davangere University, Davangere 577007, Karnataka, India
[2]Department of Physics, New Horizon College of Engineering, Bangalore-560103, Karnataka, India
[3]Department of Chemistry, Don Bosco Institute of Technology, Bengaluru-560074, Karnataka, India

Abstract

Bismuth zinc ferrite (BZF - $ZnFe_2O_4/Bi_2O_3$) nanocomposite was synthesized in the current study by solution combustion technique using aloe-vera extract as a green fuel. X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), UV diffuse reflectance spectroscopy (UV-DRS), scanning electron microscopy (SEM), energy dispersion X-ray diffraction analysis (EDAX), and transmission electron microscopy (TEM) analysis are used to validate the synthesized nanocomposite. The crystallite size of BZF nanocomposite is found to be ~32 nm computed by using Debye-Scherrer equation. The measured band gap for BZF nanocomposite was found to be 2.73 eV, confirmed by the UV-DRS technique. The findings of the investigations have been validated by applications in electrochemical studies. The electrochemical tests of modified BZF nanocomposite-based carbon paste electrode demonstrate outstanding redox-potentials determined by cyclic voltammetry (CV), electrochemical impedance spectroscopic (EIS) techniques, which are supported by the presence of the Nyquist plot followed by the sensing of the biomolecule like urea.

Keywords: BZF nanocomposite, green synthesis, aloe-vera, combustion synthesis, electrochemical sensing.

Effect of Sb addition on physical and optical properties of ternary Ge-Se-Te glasses

Anila Thomas, Sheenu Thomas
International School of Photonics, Cochin University of Science And Technology, Kalamassery, India, Kochi-682022

Abstract

Chalcogenide glasses are amorphous solids that include at least one of the chalcogen elements (S/Se/Te). Our work investigates the changes in physical and optical properties of the GeSeTe glass matrix when Te is substituted with Sb. The bulk chalcogenide glass is prepared by the conventional melt quench method. X-ray diffraction is employed to determine the amorphous nature of bulk samples. The ratio of compositional elements is verified using energy-dispersive X-ray spectroscopy. Diffuse reflectance spectroscopy is employed to assess the optical bandgap arising from indirect electronic transitions. Its value changes with the incorporation of Sb as the fourth element. Differential scanning calorimetry studies demonstrate that the addition of Sb leads to a higher transition temperature, enhancing the cross-linking and consequently the rigidity of the glass. IR transparency of these glasses is observable in the FTIR spectrum except for some impurity absorption. These glasses prove to be good optoelectronic materials for the fabrication of waveguide structures.

Keywords: Chalcogenide glass, optical band gap, transition temperature.

Nanoparticles as Potential Antimicrobials: A Novel Approach to Combatting Drug-Resistant Pathogens

Pooja Kumari
Department of Chemistry, Mahatma Gandhi Kashi Vidyapith University, Varanasi India

Abstract

The escalating challenge of antimicrobial resistance (AMR) necessitates innovative strategies to develop new antimicrobial agents. This study aims to investigate the potential of nanoparticles (NPs), including metal-based, carbon-based, and polymeric nanoparticles, as novel antimicrobial agents. The scope of the research involves the synthesis, characterization, and evaluation of the antimicrobial efficacy of these nanoparticles against a broad spectrum of pathogenic microorganisms, including bacteria, fungi, and viruses. The study delves into the underlying mechanisms of nanoparticle action, such as membrane disruption, reactive oxygen species generation, and interaction with microbial DNA and proteins. Furthermore, the research explores the synergistic effects of combining nanoparticles with existing antimicrobial drugs to enhance their effectiveness and counteract resistance. The results demonstrate that nanoparticles exhibit significant antimicrobial activity, attributed to their unique physicochemical properties and multiple mechanisms of action. Conclusively, nanoparticles present a promising avenue for developing new antimicrobial agents capable of overcoming the limitations of conventional therapies. Future research should focus on optimizing nanoparticle design, understanding their interactions with biological systems, and ensuring their safety and efficacy for potential clinical applications. This study underscores the critical role of nanoparticles in addressing the global AMR crisis and paves the way for their integration into next-generation antimicrobial therapies.

Keywords: Bacteria, Fungi, Viruses, Nanoparticles, Resistance.

Sensitivity Analysis of a GaAs/GaSb Heterojunction Polarity Control TFET-Based Biosensor

Mukesh Kumar Bind[1], Sajai Vir singh[1], Kaushal Kumar Nigam[2]
[1]Jaypee Institute of Information Technology, Noida, India-201304
[2]National Institute of Technology, Raipur, Chhatisgarh - 492010

Abstract

Dielectrically modulated heterostructure TFET-based biosensors are emerging as low-power and ultra-high-sensitivity bioanalyte detectors. This paper presents a GaAs/GaSb heterojunction polarity control TFET (GaAs/GaSb HJ-PC-TFET) biosensor, which employs a dielectrically modulated label-free detection approach to enhance sensitivity. To create a p^+ source region in the proposed device, the polarity control approach is utilized to avoid concerns such as ultra-sharp doping concentration gradients, high thermal requirements, and manufacturing complexity. To enhance the performance of heterojunction TFET devices, GaAs is used as the drain/channel material and GaSb as the source material. The sensing performance of the proposed biosensor is analyzed in terms of drain current (I_{DS}), threshold voltage (V_{Th}), and subthreshold swing (SS) variations with different biomolecules. Various biomolecules with dielectric constants ranging from 1 to 24 were incorporated to assess the sensor's performance. The proposed GaAs/GaSb HJ-PC-TFET biosensor offers I_{DS}, V_{Th}, and SS sensitivities of 1.63×10^{13}, 0.48, and 0.91, respectively, for neutral biomolecules (dielectric constant of 24). The sensitivity evaluations demonstrate that the proposed GaAs/GaSb HJ PC-TFET biosensor is a promising device for sensing applications.

Keywords: TFET; Heterojunction; Polarity control; Biosensor; Sensitivity; Biomolecules.

Nanoparticles for defluoridation of ground water - A review

Bhavya N.S.[1], H.V. Jayaprakash[2], H.S. Lalithamba[3], Prashanth G.K.[4]
[1]Sri Siddhartha Institute of Technology, Maraluru, Tumkuru, Sri Siddhartha Academy of Higher Education, Agalkote, Tumkur-572107, Karnataka, India
[2]Associate Professor, Department of Chemistry, Sri Siddhartha Institute of Technology, Maraluru, Tumkur-572105, Karnataka, India
[3]Professor and Head, Department of Chemistry, Siddaganga Institute pof Technologyu, B.H. Road, Tumkur-572103, Karnataka, India
[4]Department of Chemistry, Sir M. Visvesvaraya Institute of Technology, Bengaluru-562157, India

Abstract

Because of industrial waste water and the leaching of dangerous metals from nearby rocks and strata, numerous hazardous contaminants are being added to ground and surface water sources, causing pollution. The effectiveness of water filtration and decontamination can be greatly enhanced using nanotechnology. When it comes to eliminating bacteria, heavy metals, organic and inorganic contaminants from wastewater, nanoparticles are highly effective. Due to adsorption's numerous benefits, it has demonstrated itself to be the most effective method of treating water compared to other methods like coagulation, membrane processes, ion exchange, precipitation and electrolytic treatment. Because of its dangerous effects on people, plants, and animals, fluoride is one of the contaminants found in ground water that is being concentrated globally. Fluoride concentrations in water exceeding 1.5 mg/L are harmful to human health and the environment, causing dental and skeletal fluorosis. Fluoride pollution affects the ground water in about 19 states in India. Hence, ground water treatment is very essential to be treated to remove various pollutants by various low cost materials. The present paper deals with the short review on defluoridation of water by adsorption using various methods and adsorbents.

Keywords: Ground and surface water; fluoride; nanoparticle; defluoridation methods; adsorbents.

Modeling of ZnO based Nano Sensor Device for Evaluating Electronic Interaction with NO2 Pollutant: Combining Multiphysics Approach and DFT Study

Indranil Maity[1], Aman Kumar Jha[2], Yash Shaw[2]

[1]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM-K), University of Engineering and Management (UEM-K), Kolkata, West Bengal, India

[2]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM-K), Kolkata, West Bengal, India

Abstract

This study focuses on the designing of a ZnO nanowire (NW) based sensor device model, and the evaluation of the chemical response of the same nanomaterial in the presence of nitrogen dioxide (NO_2), a pollutant that poses significant threats to human health and the environment. Experimentally grown ZnO nanostructures were used as the basis for modeling/designing of the ZnO NWs based sensor device along with a single ZnO NW, utilizing COMSOL Multiphysics (version 4.3). The considered device structure was modelled using ZnO NWs array as the central element having two tungsten electrodes. The model was designed on a silicon substrate and ZnO seed layer. Variations in electrical potential and current density were investigated under different voltage inputs. Additionally, Gaussian 09W and GaussView 6.0 were employed to derive the optimized structure of the single ZnO NW, and the computations of the electronic properties and electronic interactions based on first principles density functional theory (DFT). A detailed investigation was conducted to examine the interaction between NO_2 gas and a single ZnO NW. The highest occupied molecular orbital (HOMO), lowest unoccupied molecular orbital (LUMO), and their energy gap were analyzed to assess chemical reactivity and stability. Electrostatic potential (ESP) plots were generated to reveal charge density distribution, and to identify the electron-rich and electron-deficient areas/surfaces into the structure. The results indicate a significant change in the electronic properties of ZnO NW upon the interaction with NO_2. This research identifies that ZnO based one dimensional (1D) nanowires structure (sensor model) can be effectively used as a suitable candidates for NO_2 sensing. The present work not only enhances the understanding of the electronic characteristics and the behaviour of single ZnO NW in addition to the array of ZnO NWs based nano device, but also lays a foundation for diverse applications in chemical/gas sensing, materials science, and nanotechnology.

Keywords: ZnO nanowire, COMSOL Multiphysics, Gaussian tool, NO_2 gas, HOMO-LUMO.

Development of $In_{0.51}Ga_{0.49}P$/GaAs Dual Junction based Solar Cell Devices to Calculate and Analyse Key Solar Cell Parameters utilising Silvaco TCAD Simulation

Indranil Maity[1], Arighna Bhattacharjee[2], Arijit Mondol[2]

[1]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM), Kolkata, University of Engineering & Management(UEM), Kolkata

[2]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM), Kolkata

Abstract

In the present work, a multi-junction solar cell was designed and developed to obtain better performance over the single-junction solar cells. The proposed structure is composed of different layers of diverse semiconductor materials stacked on each other. Here, an $In_{0.51}Ga_{0.49}P$/GaAs double-junction solar cell was outlined and designed having a distinctive material i.e., GaAs as the tunnelling junction. To optimize the solar cell's effectiveness, the window layer and presented back-surface field (BSF) layers were modified via $In_{0.47}Ga_{0.15}Al_{0.37}P$ composite material. All the optimizations and computations were performed utilizing the Silvaco TCAD software (version: 5.26.1.R), under 1 sun (1370 W/m^2) of the standard AM1.5G solar spectrum at 300 K. With the help of two basic cells (i.e., top cell and bottom cell), and by fine-tuning of the layer parameters (viz. materials property and material thickness), notable operational parameters were accomplished for the multi-junction solar cells. Our examination centred on the photogeneration rate, energy band diagrams, and the current voltage (I-V) characteristics of the proposed structure in standard test conditions (STC). By interfacing the top cell and the bottom cell with the intermediate GaAs tunnel junctions, and by utilizing $In_{0.47}Ga_{0.15}Al_{0.37}P$ for both the BSF and window layers, an efficiency of 25.65% was achieved. The results showed an open-circuit voltage (Voc) of 1.74 V, a short-circuit current density (Jsc) of 16.71 mA/cm², and a fill factor (FF) of 88.05%. All the considered layers were lattice-matched, guaranteeing compatibility with the current manufacturing innovations. This study illustrates that through key layer optimization and progressed re-enactment methods, high-efficiency multi-junction solar cells can be created for their viable usage in the progressed photovoltaic applications. The obtained result also provides better output efficiency compared to that of primitive $In_{0.51}Ga_{0.49}P$/GaAs dual-junction solar cells. Thus, by tuning the distinctive semiconductor materials with different band gap energies, multi-junction solar cells have the potential to revolutionize the field of solar energy.

Keywords: Multi-junction solar cells, In0.51Ga0.49P/GaAs double-junction, TCAD simulation, Fill factor, Photovoltaic efficiency.

A Comparative Analysis of Structural and Electronic Properties in 2D Transition Metal Dichalcogenides (MoS_2 and $MoSe_2$) based on DFT Calculations

Indranil Maity[1], **Saurabhi Biswas**[2]

[1]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM-K), University of Engineering and Management (UEM-K), Kolkata, West Bengal, India

[2]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM-K), Kolkata, West Bengal, India

Abstract

The 2D transition metal dichalcogenides (TMDs) are of huge interest and they can be utilised as the potential materials for gas sensor applications due to their unique properties. The present report is based on the comparative analysis of structural and electronic properties of two novel TMDs viz. molybdenum disulfide (MoS_2) and molybdenum diselenide ($MoSe_2$) towards sensing applications. The studies were carried out using the density functional theory (DFT) as implemented in the Gaussian 09W and GaussView 6.0 suits. The structural properties reported here, includes the 2x2 optimised lattice structure of MoS_2 and $MoSe_2$ along with their calculated corresponding bond lengths. The Mo-S bond length was found to be 2.42 Å, and Mo-Se as 2.60 Å, which is almost equal to the experimental reported values. Various crucial electronic parameters were computed such as the highest occupied molecular orbital (HOMO), and the lowest unoccupied molecular orbital (LUMO) with their corresponding energy values, which further gives the HOMO-LUMO gap, which in turn is a very important parameter that greatly influences the performance of sensor devices. The HOMO-LUMO gap was found to be 0.024 eV in the case of MoS_2, and 0.029 eV for $MoSe_2$. The electrostatic potential (ESP) plot gives an overview of the reactive sites present into the molecule for electrophilic or nucleophilic attacks. The DOS spectrum obtained using the GaussSum software provides an idea about the number of available states at a particular energy level of the molecule. A detailed study of the structural and electronic properties of MoS_2 and $MoSe_2$ is essential for understanding, and further optimising their performance as the sensing materials.

Keywords: TMDs, MoS_2, $MoSe_2$, DFT study, HOMO-LUMO.

Deep eutectic solvent assisted electrodeposition of NiCu alloy on the surface of stainless-steel mesh: Unveiling Its potential for water splitting reactions

Philominrajan Maria Viyanni, Mathur Gopalakrishnan Sethuraman
Department of Chemistry, The Gandhigram Rural Institute – Deemed to be University, Gandhigram, Tamil Nadu, India

Abstract

Deep eutectic solvents (DES), similar to ionic liquids, have been garnering significant attention from scientists as a new class of eco-friendly, nontoxic solvents. By combining choline chloride and crystalline urea in a 1:2 ratio, a DES has been synthesized and employed for the electrodeposition of NiCu on a stainless-steel substrate using the chronopotentiometric method. The synthesized DES was characterized using FTIR and the fabricated NiCu@SS alloy was characterized using various techniques, including X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDAX), and X ray photoelectron spectroscopy (XPS). The produced NiCu@SS nanoparticles (NPs) display a loose porous structure, which can remarkably facilitate mass transfer and bubble diffusion during electrocatalysis. The catalytic performance of the NiCu@SS alloy in the Water splitting reaction was then evaluated using a three-electrode system in a 1 M KOH medium. The synthesized NiCu@SS alloy demonstrated desirable properties, including low overpotential, low charge transfer resistance, high current density, and a large surface area. Among all the deposited electrocatalysts, NiCu@SS demonstrated the highest catalytic activity and excellent stability for the hydrogen evolution reactions (HER), achieving an overpotential of 257 mV at a current density of 100 mA/cm^2. For oxygen evolution reaction it shows a low overpotential of 175 mV for obtaining a current density of 100 mA/cm^2 and a small Tafel slope of 87 mV dec^{-1}. Consequently, the NiCu@SS catalyst used in the two electrodes 1 M KOH electrolyzer for water splitting a current density of 50 mA/cm^2 achieved at a low cell voltage of 1.54 V. The results of the study highlighted the robustness and efficiency of the fabricated catalyst in the water-splitting reaction.

Keywords: Deep eutectic solvent, Water splitting reaction, NiCu deposition, Green solvent, Alkaline medium.

Machine Learning Application in Vapor Compressor Refrigeration Cycle in Real-Time Applications and Renewable Energy - A Review

Harishchandra Patel[1], Dwesh K. Singh[2], O. P. Verma[3]

[1,2]Department of Mechanical Engineering, Dr B R Ambedkar National Institute of Technology, Jalandhar 144 011, India

[3]Department of Instrumentation and Control Engineering, Dr B R Ambedkar National Institute of Technology, Jalandhar 144 011, India

Abstract

Machine learning techniques have found various applications in mechanical engineering. Technologies like big data and artificial intelligence play a significant role here. By acquiring large volumes of data in real-time, refrigeration systems can be measured comprehensively. Vapor compression refrigeration is a widely used technology for cooling and food preservation in domestic and commercial settings. However, conventional control methods often need more adaptability and optimization capabilities, leading to energy wastage and suboptimal cooling performance. Challenges and considerations for implementing machine learning in refrigeration systems include data availability, model complexity, and algorithm robustness. By incorporating machine learning algorithms, such as neural networks, decision trees, and reinforcement learning, into the control and optimization processes, refrigeration systems can adaptively adjust cooling parameters based on real time data inputs and user preferences. This paper explores integrating machine learning tools into vapor compression refrigeration and solar systems to enhance performance and efficiency, along with discussing the potential benefits of using machine learning in vapor compression refrigeration, including improved energy efficiency, predictive maintenance, adaptive cooling control, and enhanced user experience. Further, the present study deliberated on improving renewable energy systems based on ML research. Also, the superiority and drawbacks of various methods are discussed. Integrating machine learning tools can revolutionize the operation and management of vapor compression refrigeration systems and renewable energy, making them more innovative, efficient, and environmentally friendly.

Keywords: Machine Learning; VCRS Nano refrigerant; Nanofluid; Nano lubricant; Renewable Energy.

Fabrication and characterization of eugenol-loaded eudragit (RS100) nanofibrous mats

K. Shreevani[1], B. Narayana[1, 2*], B. K. Sarojini[3]
[1] Department of Studies in Chemistry, Mangalore University, Mangalagangothri 574199, Karnataka, India
[2] School of Applied Sciences, K. K. University, Bihar Sharif, Beraunti, Bihar 803115, India
[3] Department of Studies in Industrial Chemistry, Mangalore University, Mangalagangothri 574199, India

Abstract

This study aims at fabricating eugenol loaded eudragit (RS 100) nanofibers by electrospinning technique. The effect of eugenol loading on morphology, hydrophobicity and mechanical properties of polymer nanofiber was analysed by various tools. The results revealed significant enlargement of fibers from 261 nm to 412 nm upon increasing the eugenol concentration from 0% to 3%. The secondary interaction between the drug and the polymer were analysed by FTIR spectroscopy with the shift of the absorption band to lower wavenumbers. Furthermore, the enhanced swelling capacity of the membranes (359%) was found favourable for the increased cell attachment of nanofibrous scaffolds, cell proliferation and tissue recovery. The good compatibility between the drug and the matrix was established by increased modulus and tensile strength values. Taking together all these characteristics, the fabricated nanofibrous membrane found as an efficient system for various biomedical and environmental applications.

Keywords: Electrospinning, Nanofiber, Eudragit (RS 100).

Cobalt and Dysprosium doped Barium hexaferrite for waste water treatment

Himanshi, Rohit Jasrotia
School of Physics and Materials Science, Shoolini University, Solan, India

Abstract

Research on advanced materials for environmental remediation and pollutant degradation is rapidly progressing due to their diverse applications. Recently, barium hexaferrite nanoparticles have garnered significant attention from researchers due to their potential applications in water treatment. BaFe12O19 nanoparticles are cost-effective magnetic materials that demonstrate stability across various environmental conditions. BaFe12O19 nanomaterial, as a photocatalyst, exhibits enhanced performance through doping, excellent magnetic trait, strong photoabsorption, and crystal structure. In this study, we synthesized co doped $Ba_{1-x}Co_xDy_yFe_{12-y}O_{19}$ (x = y = 0.0 – 0.06) via the sol-gel auto-combustion method for the degradation of malachite green dye. This material has demonstrated significant efficacy in the degradation of dyes under visible light irradiation, outperforming other photocatalysts. Its exceptional non-toxicity, suitability, low cost, and long-term stability make it an efficient photocatalyst for degrading effluents from textile and pharmaceutical industries, which have become a major environmental concern in the modern world. Photocatalytic water splitting involves three vital steps: (i) absorption of photon and generation of charge carriers ($e^-$and h^+) by a semiconductor photocatalyst upon irradiation, (ii) separation and migration of electrons to the conduction band (CB) leaving holes in the valence band (VB), and (iii) redox reaction to split water molecule into hydrogen and oxygen on the surface of the photocatalyst. The structures, morphology, optical, magnetic, and photocatalytic properties of the composites were analyzed using X-ray diffraction (XRD), infrared (IR) spectroscopy, X-ray photoelectron spectroscopy (XPS), and a vibrating sample magnetometer (VSM). The photocatalytic efficacy of $Ba_{1-x}Co_xDy_yFe_{12-y}O_{19}$ was evaluated through the degradation of malachite green dye in the presence of H_2O_2 under natural sunlight. Additionally, the $Ba_{1-x}Co_xDy_yFe_{12-y}O_{19}$ exhibit favorable magnetic properties, enabling easy recovery and recycling of the photocatalyst post process.

Keywords: M-type hexaferrite; Malachite green; Waste water treatment; Photocatalysis.

Polymer doped NiO blend composite for electrochemical performance

Ganesha H[1,2,3], Vijaykumar S P[1], Sapna S[1], Abdullaha Ba shbil[1], Suresh D S[1], Devendrappa H[1], Sutasinee Kityakarn[2], Sirikanjana Thongmee[3]

[1]Department of Physics, Faculty of Science, Kasetsart University, Bangkok 10900, Thailand

[2]Department of Chemistry, Faculty of Science, Kasetsart University, Bangkok 10900, Thailand

[3]Department of Physics, Mangalore University, Manglagngothri 574199, India

Abstract

Solution casting technique was used to prepare of Polymer and polymer/NiO blends films. The surface morphology displayed homogeneous dispersion of NiO on the Polymer matrix, the formation of the NiO phase in the polymer, displaying a sphere nature that could potentially enhance the materials, Additionally, Atomic Force Microscopy (AFM) was utilized to analyze the chemical interactions and variations in surface roughness present in the Polymer blend film, along with different weight percentages (wt%) of NiO-loaded composites. while the LSV curve exhibited a linear shape across different scan rates from 10 mV/s to 50 mV/s. The Polymer /NiO loaded polymer blend films showcased synergistic properties contributing to enhanced electrochemical performance.

Keywords: Polymer; Nickel oxide; Electrochemical Performance; Morphology; Solution casting.

Analysis of green metrics for liquid fuel production from Feronia elephantum seed oil using waste egg shell derived heterogeneous catalyst

Surekha Kademani, Kariyappa S Katagi
Department of Chemistry, Karnatak Science College, Dharwad-580001, India

Abstract

The biodiesel synthesis from Feronia elephantum seed oil using waste eggshell derived heterogenous catalyst is the main focus of this present work. The comparative analysis of the transesterification of Feronia elephantum seed oil with methanol in the presence of KOH as homogenous and egg shell derived CaO as heterogenous catalyst is evaluated. The synthesised biodiesel is characterised by ^{1}H NMR, FTIR, TGA. The biodiesel fuel properties are assessed by using mathematical models and they agreed well with ASTM and EN standards. The fatty acid methyl esters or biodiesel yield obtained is 96 %. Green metrics such as E-factor, atom economy, atom efficiency, mass intensity and mass productivity, solvent and catalyst environmental impact factor are deployed for the assessment of the sustainability of biodiesel production. The results shows that heterogenous transesterification is cleaner and more sustainable method for biodiesel production.

Keywords: Feronia elephantum, heterogenous catalyst, green metrics, transesterification.

Microbial Immobilization Techniques for Enhanced Dye Degradation and Textile Wastewater Remediation

Shivanshi Tyagi, Rachana Singh, Riti Thapar Kapoor
Centre for Plant and Environmental Biotechnology
Amity Institute of Biotechnology, Amity University Uttar Pradesh,
Noida -201 313, Uttar Pradesh, India

Abstract

Textile effluent containing recalcitrant azo dyes poses an alarming challenge to the environment due to its complex chemical composition and persistent nature. The release of untreated dye contaminated wastewater into the ecosystem shows adverse impact on environment's aesthetics and aquatic life. Conventional treatment methods frequently fail to achieve suitable removal efficiency, demanding novel approaches for effective remediation. This paper emphasizes on recent developments in microbial immobilization techniques employing renewable carriers, with the objective for enhancing the efficiency for degradation of textile dyes. Microbial immobilization has significant advantages over free-cell approaches, such as ensuring higher cell density and stability, prolonged enzyme activity, and increased resistance to changing environments. Utilizing sustainable carriers, such as biopolymers, agricultural residues, and nanomaterials, have effectively enhanced the performance of microorganisms in dye degradation process. By facilitating the rapid separation and possible reuse of immobilized cells, these carriers not only establish an environment that is favourable for bacterial growth but also reduce operating costs and environmental impact. Results of our study clearly demonstrate that immobilization techniques have shown higher dye removal rate as compared to free-cell methods. Immobilized bacteria were more resistant to inhibitory substances present in textile effluents, enabling long-term performance. Thus, present paper highlights the exciting possibilities for microbial immobilization with renewable carriers for dye degradation and textile wastewater treatment. By explaining the mechanism and benefits of immobilization, this paper supports for its implementation as a promising solution for sustainable industrial wastewater management practices.

Keywords: Azo dyes, bioremediation, decolourisation, immobilisation, microbial degradation, effluent.

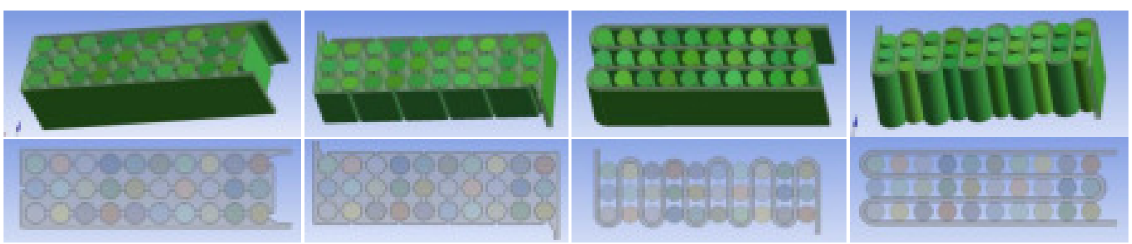
Efficient cooling system for lithium-ion battery Pack by using non-Newtonian nano-fluid in cooling channel under laminar flow A numerical analysis

Gajendra Kumar, Rajan Kumar, Rabinder Singh Bharj
Department of Mechanical Engineering, Dr B R Ambedkar National Institute of Technology, Jalandhar, Punjab 144008, India

Abstract

To enhance the efficiency and prolong the lifespan of the power battery module in electric vehicles, we propose a Battery Thermal Management System (BTMS) that incorporates liquid cooling. This study focuses on a numerical investigation aimed at assessing the effectiveness of a cooling channel in reducing thermal non-uniformity in the performance of lithium-ion battery packs. A specially designed wrapped cooling channel is employed to augment the heat transfer area, and its cooling performance under liquid cooling is examined. The chosen liquid coolant is a nano-fluid consisting of multi-wall carbon nanotubes (MWCNT) as nano-particles, mixed with a base fluid of distilled water and ethylene glycol. The analysis considers various parameters, including mass flow rate, discharge rate, and configuration, to evaluate cooling performance. The numerical solution employs the laminar flow regime and the SIMPLE method. The results indicate superior cooling performance achieved by the proposed wrapped cooling channel. This approach demonstrates promising results for mitigating thermal non-uniformities and improving the overall performance of lithium-ion battery packs in electric vehicles.

Keywords: Lithium-ion battery; Cooling channel; Nano-fluidCooling performance; Numerical analysis.



Advances in colorimetric detection; A short review of techniques for interdisciplinary applications

Sreedevi Paramparambath[1,2], Mithra Geetha[1], Anglet Chiramal Jacob[1], Maryam Al Ejji[1], John-John Cabibihan[2], Kishor Kumar Sadasivuni[1,2]

[1]Centre for Advanced Materials, Qatar University, PO Box 2713, Doha, Qatar

[2]Department of Mechanical and Industrial Engineering, Qatar University, PO Box 2713, Doha, Qatar

Abstract

It is evident that the colorimetric techniques, which have been developed and well established in routine analysis for more than 100 years and has been fully explored. However, over the last two decades, colorimetric methods have been explored widely due to the advancements and extensive utilization of imaging tools, as well as establishments of portable analytical devices; for example, paper-based sensor which relay on colorimetric experiments. The remarkable changes in the employment of these instruments, many color detecting models are developed and improved to meet the demands of providing qualitative, semi quantitative and complete quantitative analysis of various analytes. Here, we provide a short review of the latest advancements and challenges in colorimetric detection within modern analytical chemistry over the past five years. Additionally, we propose insights and ideas for future directions in this field aimed at enhancing the application of colorimetric detection across various approaches.

Keywords: Colorimetry, Sensor, Environmental monitoring, Detection, Internet of things (IoT), Biomedical.

Synthesis, Structural, Optical and Magnetic properties of Fe_3O_4@ ZnO nanocomposites for biomedical applications

Nishin C[1], Gopika M S[2], Savitha Pillai S[3]
[1]Department of Physics, University of Kerala, Karyavattom 695581 Kerala, India
[2]Department of Physics, University of Kerala, Karyavattom 695581 Kerala, India
[3]Department of Physics, University of Kerala, Karyavattom 695581 Kerala, India

Abstract

Composite materials are new emerging class of multifunctional materials to overcome the limitations of single-phase materials. These are made from two or more constituent materials with different physical and chemical properties, to produce materials with properties different from individual components to do multiple functions simultaneously[1,2]. Fe_3O_4 nanoparticles are highly demanding for biomedical applications such as magnetic hyperthermia and MRI due to its properties like least toxicity, biocompatibility, high magnetic moment, and chemical stability[3]. However, they lack luminescent properties, which limits their use in biomedical imaging applications. To address this limitation, efforts are underway to enhance their optical properties by coupling them with optically active system. This study presents the growth of ZnO over Fe_3O_4, potentially leading to the properties that incorporate both, such as magnetic and optical properties. ZnO is used in imaging applications due to its properties such as high electron mobility, low toxicity, biocompatibility, and photoluminescence properties. Fe_3O_4@ZnO nanoparticles were synthesized by simple two step process and characterized using various analytical techniques. Fe_3O_4 nanoparticles were synthesized by using a simple co-precipitation method. The growth of ZnO over Fe_3O_4 is done by hydrothermal method. The phase pure formation of Fe_3O_4@ZnO was confirmed using X ray diffraction. FTIR Spectra was used to study the vibrational bands of the composites. Optical Absorption spectra show the optical functionality of the nanocomposites with band gap in the range of 2.5eV. Photoluminescence spectra of the nanocomposites shows an emission in the range of 650nm. Field dependent magnetic studies reveal the superparamagnetic behaviour of Fe_3O_4@ZnO nanocomposites with saturation magnetization value of 27 emu/g . The synthesised Fe_3O_4@ZnO composites possess the ability to be used in biomedical applications clubbing together the magnetic and optical response.

Keywords: Zinc Oxide, Iron Oxide, Optical properties, Magnetic properties, Biomedical.

References:

1. Yiu, H.H., Niu, H.J., Biermans, E., Van Tendeloo, G. and Rosseinsky, M.J., 2010. Designed multifunctional nanocomposites for biomedical applications. Advanced Functional Materials, 20(10), pp.1599-1609.
2. Haam, S., Lee, K., Yang, J. and Huh, Y.M., 2007. Multifunctional Nanocomposites for Biomedical Applications. Nanotechnologies for the Life Sciences: Online.
3. Ganapathe, L.S., Mohamed, M.A., Mohamad Yunus, R. and Berhanuddin, D.D., 2020. Magnetite (Fe_3O_4) nanoparticles in biomedical application: From synthesis to surface functionalisation. Magnetochemistry, 6(4), p.68.

Synthesis and Photoluminescence Dynamics of Europium (III) and Terbium (III) Co-Doped of $GdSrAl_3O_7$ Color- Tunable Nanophosphors

Deepika Dhaterwal, Mahesh Matoria, Annu Dalal, Surender Kumar, Sonika Singh
Department of Chemistry, Chaudhary Bansi Lal University, Bhiwani, Haryana, India-127031

Abstract

A series of Europium (III) and Terbium (III) co- doped $GdSrAl_3O_7$ color- tunable nanophosphors were synthesized by a simplistic, streamlined and self- propagating, urea assisted solution combustion synthesis process. The structural, and luminescence characteristics of synthesized Eu^{3+}/ Tb^{3+} co- doped Gadolinium Strontium Aluminate nanocrystalline phosphors were validated using powder X- ray diffraction (PXRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), energy dispersive X ray analysis (EDAX), and photoluminescence spectra studies. The morphological studies revealed that the synthesized co- doped phosphor crystals seemed to be agglomerated spherical- shaped porous nanocrystalline particles with interconnected boundaries. Through diffuse reflectance (DR) spectroscopy, the optical band gap values for nanocrystalline phosphors were also studied. The simultaneous presence of these two rare earth ions may provide specific luminous assets, including efficient energy transfer along with controlled emissions. The detailed analysis of the photoluminescence excitation (PLE) and photoluminescence emission (PL) spectra of Europium (III) and Terbium (III) co- doped $GdSrAl_3O_7$ revealed that Tb^{3+} effectually sensitized Eu^{3+} ion and that the energy transfer could be precisely controlled to achieve color- tunable emission by varying the proportions of doped ions. The non- radiant energy loss i.e. concentration quenching phenomenon was also probed in detail. Additionally, by using their emission data, colorimetric traits including Commission International de I'Eclairage 1931 color coordinates, color purity (CP), and correlated color temperature (CCT) were also obtained. The photometric properties of developed nanocrystalline co- doped phosphor materials introduce new prospects and layout potentials for upgraded luminous materials that can be used in field emission displays, solid state technologies, multicolor display applications and a variety of illumination strategies.

Keywords: solution combustion, nanocrystalline, phosphors, photoluminescence, color coordinates.

Analysis of Groundwater Quality Parameters and its Remediation using Graphene-based Nanocomposites in Bisoi Block, Mayurbhanj District, Odisha

Sandhya Rani Mishra, Pramoda Kumar Satapathy, Rajesh Kumar Sing, Kallola Kumar Swain
P.G.Department of Chemistry, Maharaja Sriram Chandra Bhanjadeo University, Sriram Vihar, Takatpur, Baripada, Odisha- 757003, India

Abstract

"Water" being the most important component of mankind and the biosphere to survive has various forms of availability. Still, it is well known that this society's present requirements completely depend on groundwater available on the earth's crust. Groundwater is utilized for drinking and has wide importance in agriculture and industries. The present study has focused on the quality of groundwater in the Bisoi block of Mayurbhanj district, Odisha. Groundwater samples were assemblage from different Tube wells of the Bisoi block of Mayurbhanj district for determining its utility quality and for assessing the levels of varying contamination by analyzing different physical parameters like pH, electrical conductance (EC), Total dissolved solids (TDS), total hardness as $CaCO_3$ (TH), turbidity, Chloride (Cl^-), Fluoride (F^-), Nitrate (NO_3^-), Dissolved Iron, Free Chlorine, and Alkalinity using the Water-kit and compared with the standard values recommended by World Health Organisation (WHO, 1993) and Indian Standards Institution (ISI, 1991). These analyses will be Carried out for the Physico-chemical Parameters, in the presence of Heavy Metals (HM) in groundwater by both conventional and instrumental methods using Flame Atomic Absorption Spectroscopy (AAS) for cation analysis and Ion Chromatography (IC) for both cations and anions and Further Membrane Technology (Available at BARC) will be implemented to separate the contaminants. Contrarily, various GO-based oxides, rGO-based oxides, and mixed-oxides nanocomposites as adsorbents were planned to install contaminants by the adsorption-desorption method.

A short review on adsorptive removal of fluroquinolone antibiotics by plant-based biochar and their composites

Teeyasha Das, Ispita Biswas, Animesh Debnath
Department of Civil Engineering, National Institute of Technology Agartala, Jirania, West Tripura-799046

Abstract

Fluroquinolone antibiotics are a class of broad-spectrum antibiotics, with high efficiency in treating wide range of bacterial infections. These are synthetic derivatives of quinolone antibiotics with a fluorine atom at the C6 position enhancing their disinfecting capacity and pharmacokinetic parameters. Few common fluroquinolone antibiotics are ciprofloxacin, ofloxacin, levofloxacin, norfloxacin, moxifloxacin etc. They are present in the environment and can cause certain derogatory health issues. For preventing antibiotic resistance, it is mandatory to reduce the environmental level of these fluroquinolones for disseminating of bacteria that are resistant to antibiotics and mitigate the emergence. The removal of low concentration of fluroquinolones from water through adsorption is a task that challenges many other conventional and long-established methods. Numerous adsorbents have the capacity to be regenerated and reused there by reducing overall treatment, expenses, and environmental impact. The adsorption capacity and mechanism of fluroquinolone antibiotics removal using biochar materials have been researched extensively to understand environmental contamination. This study compares the effectiveness of plant-based biochar, nanomaterial enhanced biochar, and biochar composites in adsorbing fluoroquinolones. Plant based biochar sourced from agricultural waste explains adsorption capacity moderately due to their surface functional groups and porous structure. However few times their efficacy is constrained by heterogenous active sites and specific low surface areas. On the other hand, nanomaterial enhanced biochar which incorporates materials like carbon nanotubes and graphene oxide showcases significantly higher adsorption capacities. This enhancement accredits to the increased surface area, refined porosity and the presence of active sites that form strong interactions with fluroquinolone molecules. Biochar composites, which integrate biochar with substances such as metal oxides, produce a synergistic effect, further enhancing adsorption through mechanisms like electrostatic attraction, π-π interactions, and hydrogen bonding. In this review, the adsorption performance and mechanism of biochar on common fluroquinolone antibiotics removal are firstly summarized and then extensively reviewed after providing a summary of recent biochar made from plant waste, composites with biochar, and various modification methods used in biochar-assisted fluroquinolone antibiotic removal. Lastly, key research recommendations and trends are highlighted, accompanied by suggestions and ideas for further advancement.

Keywords: Fluroquinolone antibiotics, adsorption, plant based biochar, nanomaterials, biochar composites.

Advanced adsorption-assisted photocatalytic degradation of tetracycline hydrochloride using $Bi_4O_5Br_2$ and $Co_3(PO_4)_2$ immobilized on activated carbon-based photocatalyst

Komal Poonia, Pankaj Raizada
School of Advanced Chemical Sciences, Shoolini University, Solan, Himachal Pradesh, 173212, India

Abstract

In this research work, a co-precipitation approach is followed to fabricate oxygen-deficient $Bi_4O_5Br_2$ and $Co_3(PO_4)_2$ nanocomposite dispersed over activated carbon (AC) for degradation of tetracycline hydrochloride via the synergistic effect of adsorption and photocatalysis. For validation of compositional and optical properties, formed nanocomposite has been characterized by fourier transmission infrared spectroscopy, X-ray diffraction, transmission electron microscopy, scanning electron microscopy, and UV–Vis spectroscopy. $Bi_4O_5Br^{2-}$ Ov/$Co_3(PO_4)_2$@AC shows good photocatalytic activity owing to a higher specific area, porous structure, stability, wide solar spectrum response, and reduced charge carrier recombination. Among the synthesized bare ($Bi_4O_5Br_2$ and $Co_3(PO_4)_2$) and binary photocatalysts, the $Bi_4O_5Br_2/Co_3(PO_4)_2$@AC nanocomposite exhibited the highest tetracycline hydrochloride photodegradation efficiency (90.7%) at pH 6.5 within 90 min of light illumination. Further, analysis in terms of reaction kinetics confirmed that the system followed a pseudo-first order reaction. $Bi_4O_5Br_2/Co_3(PO_4)_2$@AC facilitates the degradation via high adsorption capability due to reduced recombination, better charge separation, and the presence of activated carbon as a mediator of electrons. This experimental work paves the way to design tuneable simple junctions for photocatalytic applications by utilizing various experimental protocols.

Keywords: Activated carbon, Adsorptional photocatalysis, Tetracycline degradation, Heterojunction.

Characteristic Study of NiCoP Thin Films Successively Deposited by Spray pyrolysis Technique Predicted for Water Splitting Activity

Deepti Amol Khedekar, Bhushan B.Dhale
Department of Physics, R.P.Gogate College of Arts and Science and R.V. Jogalekar college of Commerce, Mumbai University, Ratnagiri, Maharashtra, 415612 India

Abstract

In the presence work ternary NiCoP thin film were deposited on a glass substrate by spray pyrolysis method. The deposition of this thin films was carried out by depositing five different combinations of concentrations of Cobalt (Co^{2+}) and Nickel (Ni^{2+}) precursor solutions and constant concentration of phosphate ions. The composition and characteristics of deposited thin films were studied like XRD, SEM, UV-Visibility. The surface morphology of coated films has been analyzed by using SEM micrographs. The deposited thin films are smooth, uniform and adherent to the substrate. X-ray diffraction analysis of NiCoP thin films reveals the existence of nano crystalline phase with predominant diffraction peaks. The average crystalline size of each NiCoP thin film were calculated from XRD. The Bandgap, Reflectance, absorbance was calculated by UV-Visibility characteristic. Band Gap of each film was calculated separately. Generally NiCo based films have potential applications. The prepared CoNiP thin film can be used in electrochemical water splitting activities.

Keywords: NiCoP thin films, Spray Pyrolysis, nano crystalline, water splitting, Characterization.

Hydrothermal synthesis of 2D $Mo_{1-x}Co_xS_2$ (x = 0.2 – 0.10) nanostructures for decomposition of organic pollutants in water

Rajwinder Singh[1], Sushil Kumar[2], Ankita Taneja[2], Hardev Singh[3], J.S. Shahi[1], Sanjeev Kumar[2]
[1]Department of Physics, Panjab University Chandigarh, India
[2]Department of Physics, Goswami Ganesh Dutta Sanatan Dharama College, Sector 32, Chandigarh, India
[3]Department of Physics, Kurukshetra University, Kurukshetra, India

Abstract

Pure MoS_2 and $Mo_{1-x}Co_xS_2$ (x = 2, 4, 6, 8 and 10) 2D nanostructures were successfully synthesized by hydrothermal method. The synthesized materials were characterized using powder X-ray powder diffraction (XRD), high resolution transmission electron microscope (HRTEM), energy dispersive X-ray (EDX) mapping, Brunauer-Emmett-Teller (BET), zeta potential and Fourier Transform Infrared Spectroscopy (FTIR) measurements. XRD analysis confirmed the formation of hexagonal structure of the synthesized MoS_2 nanostructures. HRTEM images revealed the incorporation of Co dopant on 2D layered MoS_2 nanostructures. Information about the Co dopant content and functional groups attached with synthesized materials were obtained from EDX mapping and FTIR measurements. Information about specific surface areas and pore size of synthesized nanocomposites were obtained from BET analysis. The decomposition of organic pollutants by synthesized 2D MoS_2 nanosheets doped with different concentrations of Co impurities were evaluated from the adsorption and photocatalytic degradation of methylene blue (MB) organic dye solution in the present of visible light irradiations. The preliminary photocatalytic results clearly revealed that MB dye solution degraded to maximum extent by $Mo_{0.94}Co_{0.06}S_2$ nanostructures with optimum dopant concentration of Co^{3+} ions corresponding to x = 0.06, whereas it degraded to minimum extent by pure MoS_2 after 150 min visible light irradiation. Finally, possible mechanisms for photocatalytic degradation of MB are proposed. The detailed adsorption and photocatalytic mechanisms explains the enhancement in the degradation efficiency are proposed.

Keywords: Nano-composites; Functional materials; Photocatalytic; Adsorption capacity.

Intra-Particle Diffusion Method to Describe Adsorption Activity of Ammonium Vanadate Nanostructures

Jaspreet Kaur, Rajesh Kumar
Department of Physics, Panjab University, Chandigarh

Abstract

This study aims to investigate the influence of shaking and stirring for dye adsorption activity of ammonium vanadate nanostructures. As stirring and shaking play critical role in the dye adsorption activity of various nanostructures. These mechanical processes enhance the interaction between dye molecules and nanoparticles by promoting mass transfer and increasing the collision frequency, which well described by using intra particle diffusion model. Stirring, typically involving a magnetic stirrer or a mechanical agitator, ensures uniform dispersion of nanoparticles and prevents agglomeration, thus exposing a large surface area for dye adsorption. Shaking, on the other hand, offers a dynamic environment where nanoparticles continuously come into contact with dye molecules, facilitating efficient binding. The intra-particle diffusion model explains the rate of adsorption on adsorbent surface. The combined effect of stirring and shaking results in improved adsorption kinetics and a higher overall dye removal efficiency, making them important parameters to optimize in nanoparticles based dye removal system.

Evaluation of a new activated carbon/graphene oxide as an efficient composite adsorbent for the removal of herbicide 2,4- Dichlorophenoxyacetic acid: Composite synthesis, characterization, and adsorption

Imotila T Longchar, Dipak Sinha
Department of Chemistry, Nagaland University, Lumami-798627, Nagaland, India

Abstract

Thysanolaena maxima-derived activated carbon/graphene oxide (TMAC/GO) composite was synthesized through a one-step mixing process via ultrasonication and used as adsorbent of 2,4-Dichlorophenoxyacetic acid (2,4-D) herbicide from solution. Various analytical techniques including FT-IR, FESEM-EDX, XRD, BET, and TEM were employed to characterize the synthesized composite. Results showed that the TMAC/GO had a porous structure with a large surface area of 958.569 m^2/g. A series of batch experiments were conducted for different adsorption parameters which includes TMAC/GO dosage (0.05 - 0.25 g/L), initial concentration (50 - 300 mg/L), pH (2 - 12), contact time (20 - 140 mins), and temperature (298 - 398 K). Adsorption thermodynamics, isotherm models and kinetics were employed to understand the adsorption mechanism. The composite showed good adsorption ability whereby the Langmuir model indicated a maximum adsorption of 98.4695 mg/g. The experimental results were shown to be justified by the pseudo-second-order kinetics model with R^2value of 0.9975. Furthermore, the composite displayed good reusability performance up to 5 cycles. These findings, along with the cheapness of the material, and its selectivity towards the herbicide suggests its practical importance for water decontamination.

Keywords: Thysanolaena maxima; Activated carbon; Graphene Oxide; 2,4-Dichlorophenoxyacetic acid; Adsorption.

Adsorption of Ciprofloxacin antibiotic by highly efficient MgAl activated carbon composite: Kinetics, Isotherm and Thermodynamic study

Raplang Steven Umdor, Dipak Sinha
Department of Chemistry, Nagaland University, Lumami-798627, Nagaland, India

Abstract

In this work, magnesium aluminium layered double hydroxide was incorporated onto activated carbon surface (MgAl-AC) for the removal of Ciprofloxacin (CIP) by adsorption. XRD, SEM EDS, FTIR, TEM and XPS were used to characterize the MgAl-AC composites. Batch adsorption experiments demonstrated that the composite showed higher adsorption capacity of CIP than then pure MgAl LDH. Pseudo-second order model described the adsorption kinetic, while Redlich-Peterson model fit the adsorption isotherms. The thermodynamic studies suggested that the adsorption process was favourable, spontaneous, and exothermic. Overall, these results suggest that MgAl- AC is a promising material for the removal of CIP from waste water system.

Keywords: Layered double hydroxide; Activated carbon; Adsorption; Pharmaceutical

Identification of polycyclic aromatic hydrocarbons (PAHs) in air particulate samples using synchronus fluorescence spectroscopic technique

Meenal Garg, Homdutt Sharma
Department of Physics, Amity Institute of Applied Sciences, Amity University, Sec. 125, Noida 201 301, India

Abstract

We have designed a simple, rapid, and inexpensive method for identifying polycyclic aromatic hydrocarbons (PAHs) including benz(a)anthracene (BaA), benzo(a)pyrene (BaP), benzo(k)fluoranthene (BkF), pyrene (Pyr), and benz(ghi)perylene (BghiP) in suspended particulate matter (SPM) in urban environment of Delhi. Samples of urban suspended particulate matter were collected during 2018 at two locations (Okhla, Daryaganj) on glass fiber filter papers and extracted using dichloromethane (DCM) and hexane with ultrasonication. Comparison of the emission spectra with standards enabled the identification of PAHs. The degree of condensation of aromatic compounds was determined, and individual compounds were identified. The use of $\Delta\lambda$ (delta lambda) parameter values enhanced the identification efficiency. This technique offers a valuable tool for monitoring PAHs in urban environments, supporting air quality management and health risk assessment.

Keywords: Polycyclic Aromatic Hydrocarbons; Suspended Particulate Matter; Urban Environment; Air Quality Monitoring; Synchronous Spectrofluorimetry.

Recent Advances in fabrication, characterization, and wear behavior of aluminum matrix composites

Dhruv kumar[1], Subodh Barthwal[1], Praveen pachauri[2]
[1]Research Scholar, Mechanical Engineering, Amity School of Engineering and Technology, Greater Noida, Uttar Pradesh, India
[2]Professor, Government Polytechnic Siwan, Bihar, India

Abstract

Aluminum is valued for its corrosion resistance, machinability, formability, and favorable weight to-strength ratio, making it widely used in automotive, aerospace, and structural applications. However, its drawbacks such as lower strength, poor low-temperature resistance, and higher wear rate restrict its suitability for applications requiring enhanced strength, thermal stability, and wear resistance. Various reinforcements including carbides, oxides, carbon allotropes, industrial waste, and agricultural waste have been explored to augment its mechanical properties and tribological behavior. This review focuses on aluminum alloy 6061 fabricated using techniques like stir casting and powder metallurgy, investigating the effects of micro and Nano reinforcements. Studies consistently show that increasing reinforcement content enhances the mechanical and tribological properties of the composites. Hybrid composites, particularly, exhibit superior qualities compared to those with single reinforcements. Wear behavior studies indicate that as reinforcement weight percentage increases, wear rates decrease, and coefficients of friction also decrease correspondingly

Keywords: Aluminum alloy 6061, Metal matrix composites, Reinforcement, Tribological.

DFT Study of Molecular Interaction of Curcumin with Silver Nanocluster

Madhulata Shukla
Department of Chemistry, Gram Bharti College, Ramgarh, Kaimur, Veer Kunwar Singh University, Bihar, India-821110

Abstract

The molecular interaction between curcumin, a naturally occurring polyphenolic compound with numerous health benefits, and silver nanoclusters has been investigated using Density Functional Theory (DFT). Silver nanoclusters are of great interest due to their unique optical, electronic, and catalytic properties. Understanding the interaction between curcumin and silver nanoclusters at the molecular level is crucial for potential applications in drug delivery, bioimaging, and therapeutics. DFT calculations have been used to explain the experimental observation such as UV-visible and IR frequencies. A detailed elucidation on the density of state calculation has been reported explaining that curcumin not only serves as a reducing agent or stabilizing agent for silver nanoclusters but also activates the nanoparticle by reducing the band gap in silver nanoparticles.

Keywords: Silver nanoparticles, curcumin, molecular interaction, DFT calculation.

Unlocking Janus Particles: The Power of Post-Synthesis MOF Modification

Rashi Bhardwaj, Tinku Basu
Amity Centre for Nanomedicine, Amity University, Sector-125, Noida, UP

Abstract

Metal-Organic Frameworks (MOFs) hold immense potential, boasting well-defined structures and cavernous internal spaces. While traditional synthesis offers some control, post-synthetic metalation (PSMet) unlocks a treasure trove of possibilities. It allows for the precise manipulation of MOFs after their creation, akin to customizing a pre-built house. PSMet empowers scientists with a versatile toolbox. They can strategically introduce functional moieties, swap out charged components within the framework, or even encapsulate nanoparticles. This exquisite control over the MOF's architecture and pore chemistry, termed "reticular chemistry," paves the way for the creation of entirely new materials. One particularly intriguing application lies in the realm of Janus particles. PSMet offers a distinct advantages over traditional methods. Unlike their uniform counterparts, Janus particles boast two distinct faces, each with unique properties. PSMet allows for the precise manipulation of these faces, enabling the introduction of diverse functionalities on each side. Imagine a Janus particle with one side tailored for specific catalysis and the other designed for selective functioning. This level of control unlocks a new era of material design. PSMet paves the way for the development of MOF-based Janus particles with remarkable properties, opening doors for advancements in catalysis, separation science, and targeted drug delivery. The future of MOFs is brimming with possibilities, and PSMet stands as a key to unlocking their full potential. In our work we have meticulously crafted a Janus micromotor (MM) - a microscopic marvel with a dual identity. This bidentate wonder, built on a zirconium core, boasts two key players: a carboxylic ligand forming the MOF framework and a pyridine-based ligand serving as a handshake for a secondary metal. The result? An iron-zirconium MOF MM, where iron acts as the engine, fueled by a specific fuel source. This unique design propels the MM forward at an impressive 197 µm/s, a testament to its optimized performance. But this MM isn't just fast, it's functional too. Employed as a tool to tackle antibiotic resistance, it effectively degrades 60% of amoxicillin within an hour at ambient conditions. This Fe-Zr MOF MM is a promising step towards cleaner environments and targeted antibiotic degradation.

Keywords: Metal Organic Framework, Post synthesis metalation, Janus particles, antibiotic degradation, Antimicrobial resistance.

High-Efficiency Photocatalytic Degradation of Organic Contaminants Using $MnO_2/NiO@g\text{-}C_3N_4$ Under UV Light

Sakarapani Sarala, Velusamy Sasikala, Palani Karthik, Natarajan Prakash, Azhagurajan Mukkannan
Department of Chemistry, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai- 602 105, Tamil Nadu, India

Abstract

This study investigates the enhanced photocatalytic activity of a novel $MnO_2/NiO@g$ C_3N_4 composite photocatalyst for the degradation of organic pollutants under UV light irradiation. The $MnO_2/NiO@g\text{-}C_3N_4$ photocatalyst was synthesized using a facile hydrothermal method and characterized through XRD, SEM, TEM, and UV-Vis spectroscopy. The results demonstrate that the composite exhibits superior photocatalytic performance compared to individual MnO_2, NiO, and $g\text{-}C_3N_4$ components, attributable to the synergistic effects among the constituents. The enhanced photocatalytic activity is primarily due to the efficient charge separation and extended light absorption range facilitated by the integration of MnO_2 and NiO with $g\text{-}C_3N_4$. This composite photocatalyst achieved significant degradation rates of various organic pollutants, including dyes and pharmaceutical compounds, under UV light. The study also explores the stability and reusability of the $MnO_2/NiO@g\text{-}C_3N_4$ photocatalyst, confirming its potential for practical environmental remediation applications. These findings suggest that $MnO_2/NiO@g\text{-}C_3N_4$ is a promising candidate for efficient and sustainable photocatalytic degradation of organic contaminants in wastewater treatment.

Keywords: Photocatalyst, Dye degradation, $MnO_2/NiO@g\text{-}C_3N_4$

ICCMEPR-2024/ST/209

Superionic Phase in Na_2MoO_4

P.K. Pandey[1], , F.Z.Haque[2], Apra Tripathi[3], K.M. Mishra[4]
[1,3,4]Department of Physics, D.D.U. Gorakhpur University, Gorakhpur (U.P.), India
[2]Department of Physics, MANIT, Bhopal, (M.P) India

Abstract

The electrical conductivity (σ) and Thermoelectric Power (S) of Pressed Pellet of Na_2MoO_4 are Presented in the temperature range from 450K to the melting point of the solid. The ionic (σi) and electronic (σe) contribution to σ have been separated over the entire temperature range with the help of time dependence study of the dc electrical conductivity. Superionic phase in the solid have been observed well below their melting point in which the conductivity is almost purely ionic. It has been shown that in the normal phase the solid is mixed conductor. Data for the temperature variation of both σiand σeare also presented and discussed. The paddle wheel mechanism is applicable to explain the transport mechanism.

Keywords: Phase transition, Electrical conductivity, Thermoelectric power, Heat of transport, activation energy.

CuI/VO_2(M) Composites for Enhanced Thermoelectric Performance

Mohammedhamidraza A Mawazzan, M. K. Rabinal
Department of Physics, Karnataka University, Dharwad-580003, India

Abstract

The use of non-toxic, readily available materials is crucial for thermoelectric technology. The thermoelectric behavior of an environmentally friendly composite material made of different weight ratio of copper iodide (CuI) to VO_2(M) is reported here. Here, bulk VO_2(M) material is synthesized using a time-efficient hydrothermal process, while CuI is prepared in bulk using a simple synthetic methodology. A mechanical grinding tool, motar, is used to create a composite material from both constituents. CuI, when prepared, has a high Seebeck coefficient of approximately 223 μV K^{-1} and a conductivity of nearly 10.65 S/cm. This results in a room temperature thermoelectric power factor of ~ 52.9 μW$m^{-1}K^{-2}$. On the other hand, VO_2(M) would exhibit a low electrical conductivity of ~ 0.0308 S/cm and a Seebeck coefficient of 20 μV K^{-1}, leading to a power factor of ~ 0.0012 μW m^{-1} K^{-2}. An attempt has been made to modify the defect chemistry of the thermoelectric material by heat annealing it and combining the two materials in varying ratios to adjust the thermoelectric performance. The thermoelectric power factor of the composite is improved to around 256.3 μW $m^{-1}K^{-2}$ at room temperature by annealing it at moderate temperatures (~200 K). The produced samples exhibit diffraction peaks corresponding to both CuI and VO_2(M) with particle sizes ranging to microns, as revealed by X-ray diffraction tests. This is further supported by scanning electron microscopy.

Keywords: Thermoelectric , Composites , CuI , VO_2(M) , Seebeck coefficient.

Growth of Single Phase CZTS by Hydrothermal Method

Neha, Mohd Zubari Ansari
Department of Physics, National Institute of Technology Srinagar, Hazrabal, Srinagar, Jammu and Kashmir, 19006, India

Abstract

Cu_2ZnSnS_4 (CZTS) has emerged as a highly desirable material for use in thin-film solar cells. CZTS materials have exceptional absorber qualities along with the advantages of abundance in the Earth's crust, an ideal band gap that aligns well with the solar spectrum 1.40- 1.65eV, a high absorption coefficient $\sim 10^4 cm^{-1}$, nontoxicity, and low-cost components [1,2]. Because of these exceptional characteristics, CZTS is being considered a promising material for use in inorganic photovoltaic devices. This study successfully synthesized CZTS nanoparticles using the hydrothermal method. Phase-pure CZTS nanoparticles synthesized with Cu (II), Zn (II), Sn (II) / Sn (IV) inorganic metal salts and thiourea as a sulfur source in distilled water solution as a precursor are described. The presence of binary or ternary phases impurities at different concentration ratios of sulfur and copper and at different temperature are also explained. The XRD peaks are observed at 2θ values of 28.5°, 32.9°, 47.4°, and 56.3°, corresponding to (112), (200), (220), and (312) of the tetragonal crystal Kesterite CZTS phase, respectively. In addition, the less intense peak observed at 2θ =50° corresponds to (110) for the SnS2 phase along with the CZTS phase. The crystallite size of the Cu2ZnSnS4 nanoparticles was obtained as 37.25nm. Syntheized CZTS nanomaterial can be use for solar device fabrication.

Keywords: CZTS, Hydrothermal method, single phase CZTS and Crystallian size of CZTS.

References:

1. Mohd Zubair Ansari, N. Khare, Journal of Physics D: Applied Physics, 47 (2014) 185101.
2. Mohd Zubair Ansari, N. Khare, Journal of Applied Physics, 117 (2015) 025706.

Comparative analysis of the structural, magnetic, dielectric and electrical properties of Ba^{2+} doped PrFeO3 through solid-state and sol-gel auto- combustion routes

Shiffali Middha, Anupinder Singh
Department of Physics, Guru Nanak Dev University, Amritsar-143005, Punjab

Abstract

In the present study, we synthesized $Pr_{1-x}Ba_xFeO_3$ where x = 0.1, 0.2, 0.3 through solid-state and sol-gel auto-combustion routes. Firstly, we theoretically calculate the Goldschmidt tolerance factor (T) of perovskite compounds $Pr_{1-x}Ba_xFeO_3$ and found T lies between 0.71 - 0.9, so the already predicted structure from theoretical calculation is Orthorhombic. Further, the comparative structural, magnetic, and dielectric and electrical properties was studied using an X-ray Diffractometer (XRD), Vibrating Sample Magnetometer (VSM), and Impedance Analyzer and Two-probe set with oven respectively. XRD confirms the orthorhombic phase of $PrFeO_3$ with space group Pbnm and matches with PDF no.98-002- 0768. $PrFeO_3$ is an antiferromagnetic but there is some weak ferromagnetism arise in samples formed by sol-gel due to Dzya-loshinskii-Moriya (DM interaction). From ac conductivity fitting plot we found the fitting parameter n lies below 1 (i.e. n<1) that means translation hopping is assisted by small polaron hopping mechanism. The resistivity versus temperature plot indicates that as temperature increases, resistivity decreases from an initial value of 10^3 ohms, which is characteristic of semiconductors. Resistivity of samples formed by solid state has lower resistivity than samples formed by sol-gel route due to higher surface to volume ratio of nanoparticles.

Keywords: Perovskite; Semiconductors; Antiferromagnetic; Nanoparticles.

Synthesis of low cost CuO nanoparticles by Hydrothermal method using rice husk and ethanol

Pramendra Kumar Pandey, Bharat Kumar
Department of chemistry, M. V. College, Buxar (constituent college of V.K.S.U Ara) Bihar- 802101

Abstract

Nanoparticles are the very small particles of 1-100 nm in size and they are used in manufacture of various properties such as medical instruments, medicines, cosmetics, nanowires, nano-chip etc. It is interdisciplinary technology in physical science, chemical science and biological science. Among these nanomaterials CuO nanoparticles has been used as batteries, catalysts, gas sensors, high temperature super conductors and tools for solar energy conversion. We had synthesized CuO by hydrothermal method. I this method rice husk is used as supporting materials. 2g of rice husk was sonicated in 50 ml methanol and 50 ml water for 20 minutes. After the sonication the solution was filtered using lensman filter paper. In the filtrate different milli mole of CuSO4.5H2O crystal was added and stirred whole the solution for 15 min. The above solution was placed in autoclaves for 16 hours at 200^0C temperature. The X-rays confirm the crystalline nature of CuO nanoparticles. The morphology will be identified by using scanning electron microscopy (SEM) and transmission electron microscopy (TEM). This nanoparticle will be further used as photocatalyst in dye degradation and electrocatalysis water splitting.

Keywords: Hydrothermal, CuO nanoparticles, gas sensor, dye degradation, water splitting.

References:

[1] Siegel R L, Miller K D and Jemal A 2015 Cancer statistics, 2015 CA Cancer J Clin 65 5–29
[2] Zong A, H Cao and Wang F 2012 Anticancer polysaccharides from natural resources: a review of recent research Carbohydrate Polymer 90 1395–410
[3] Parkin D M 2001 Global cancer statistics in the year 2000 Lancet Oncol. 2 533–43

Investigatuion of Arrhenius Plot and Activation Energy In LPG Sensing Properties of Nickel Oxide Doped Polyaniline Composite (PnNiO)

Vaishali.N Birge[1], Manjunatha B[2], Shruti Gogi[3], Sangshetty Kalyane[4]
[1, 3,4]Department of Physics, Bheemanna Khandre Institute of Technology, Bhalki, Bidar, Karnataka, India
[2]Department of Physics Govt. Women first grade college, Jevergi Colony Kalaburagi, Karnataka, India

Abstract

PANI comosites were prepared by in-situ polymerisation method using ammonium persulphate as oxidising agent. Various composites have been prepared by varying the level of additive material Nickel oxide. The phase and morphology of all the synthesized samples were analyzed using basic characterization techniques such XRD and SEM. The AC electrical conductivity of the samples was measured using the impedance technique within a frequency range of 10KHz to 1MHz at room temperature. Additionally, the dc electrical transport property of the composites was investigated within a temperature range of 40- 180^{0}C. The PnNiO composites showed an enhanced dc electrical conductivity with increasing temperature and NiO concentration in polyaniline. The Activation energies were evaluated from Arrhenius plots for all compositions. The activation energy decreased with increasing NiO concentration in polyaniline matrix. The activation energy of the prepared PnNiO composites decreased in comparison with the activation energy of a Pn, while the electrical conductivity increased as the amount of NiO was increased. The change in electrical resistance of both Pn and PnNiO composites was measured when exposed to 1000 ppm and 2000 ppm concentration of LPG gas. Both samples exhibited a rapid resistance change upon exposure to LPG gas, with the PnNiO composite demonstrating higher sensitivity and suitability for LPG sensing compared to Pn.

Keywords: Polyaniline (Pn), LPG sensing, AC, DC, Activation energy, XRD, SEM.

Synthesis and Characterization of Magnesium Doped Mixed Metal Oxide

Swati D Wakade[1], Dr. V. T. Vader[2]
[1]Department of Chemistry, Walchand College of Arts and Science, Solapur
[2]Department of Chemistry, Walchand College of Arts and Science, Solapur

Abstract

Mixed metal oxides have garnered significant interest in the field of materials science due to their diverse morphologies and exceptional properties, including selective oxidation, dehydration, photocatalysis, and electrocatalysis. Additionally, magnesium nitrate is noted for its potential antibacterial activity. In this study, we report the synthesis of the mixed metal oxide system $ZnFeCr_{1-x}Mg_xO_4$ using the sol-gel route, which is known to enhance both physical and chemical properties of the materials.

The sol-gel method involves the dissolution of metal precursors (zinc, iron, chromium, and magnesium nitrates) in a suitable solvent, followed by hydrolysis and polycondensation reactions to form a homogeneous sol. Subsequent gelation and controlled drying result in a xerogel, which is then calcined at high temperatures to obtain the desired mixed metal oxide. This method allows for precise control over the stoichiometry and uniform distribution of metal ions, leading to improved material characteristics.

The synthesized $ZnFeCr_{1-x}Mg_xO_4$ was characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), and scanning electron microscopy (SEM). XRD analysis confirmed the crystalline structure and phase purity of the mixed metal oxide, revealing well-defined peaks corresponding to the expected crystalline phases. FT-IR spectroscopy provided insights into the functional groups and bonding interactions within the material, with specific absorption bands indicating the presence of metal-oxygen bonds. SEM imaging elucidated the surface morphology and particle size distribution, showcasing a homogeneous and uniform structure.

The combination of these characterization techniques demonstrated that the sol-gel synthesized $ZnFeCr_{1-x}Mg_xO_4$ possesses enhanced structural and functional properties. The improved characteristics of this mixed metal oxide system suggest potential applications in catalysis, sensor technology, and antibacterial treatments. This study underscores the importance of precise synthesis and thorough characterization in developing advanced materials with tailored properties for specific industrial and biomedical applications.

Keywords: Mixed metal oxide; Sol-gel; Anti bacterial.

Selective esterification of glycerol over ionic liquid functionalized cellulose (IMD-Si/HSO4@Cellulose) under energy-efficient microwave irradiation

Nida Khan, Mohd Umar Khan, Zeba N. Siddiqui
Green Chemistry Laboratory, Organic Chemistry Division, Department of Chemistry, Aligarh Muslim University, Aligarh 202002, Uttar Pradesh, India

Abstract

A green and sustainable route for selective esterification of glycerol has been developed. Selectivity towards triacetin was investigated in the esterification of glycerol using highly efficient silica-based imidazolium hydrogen sulphate supported on cellulose (IMD Si/HSO4@Cellulose) as a heterogeneous catalyst. The cellulose-supported acidic ionic liquid material, IMD-Si/HSO4@Cellulose, was synthesized with cellulose in acetone by simple stirring of the ionic liquid (IMD-Si/HSO4). The synthesized catalyst was characterized by various techniques such as scanning electron microscopy/energy dispersive X-ray (SEM/EDX), elemental mapping, powder X-ray diffraction (XRD), transmission electron microscopy (TEM), thermogravimetric analysis (TGA), and Fourier transform infrared (FTIR) spectroscopy analyses. IMD-Si/HSO4@Cellulose showed excellent activity (100% conversion) and greater selectivity (99%) for the esterification of glycerol leading to the formation of triacetin under microwave irradiation in the minimum time (8 min). The catalyst was reused in up to five runs with insignificant loss in catalytic activity.

Keywords: Heterogeneous catalysis, green synthesis, microwave, esterification, fuel.

A facile single-pot hydrothermal synthesis and characterization of MnO_2 nanostructures for supercapacitor applications

Sapna Sharanappa, Vijaykumar S P, Suresh D S, Abdullah Ba Shbil, Ganesha H, Devendrappa H
Department of Physics, Mangalore University, Mangalagangothri-574199, India

Abstract

We report a facile and novel synthesis of MnO_2 nanostructures (MnO_2-NS) by a single-step hydrothermal method and their application as an electrode material in supercapacitors. The synthesized MnO_2 nanostructures sample was characterized by various physicochemical characterization techniques such as X-ray diffractometry (XRD), Fourier Transform Infrared (FTIR), Field Emission Scanning Electron Microscope (FESEM), and Ultraviolet-Visible (UV-Vis) spectroscopy techniques to study their chemical changes, structural phase, morphology, and optical properties. The morphological consisting of nanorods and nanocrystals. The electrochemical behaviors were examined by cyclic voltammetry, charge discharge, and electrochemical impedance spectroscopy techniques through a two-electrode system. The electrochemical results demonstrate that the MnO^{2-}NS electrode exhibits highly reversible features and good rate abilities respectively. Significantly, it exhibits a specific capacitance (Csp) of 190.1 Fg^{-1}at a current density (CD) of 1 Ag^{-1}. Remarkably, the MnO^{2-} NS electrode exhibited excellent rate capability and maintained 84.03 % capacitance retention after 3000 cycles indicating its suitability as a cost-effective and durable electrode material for supercapacitors.

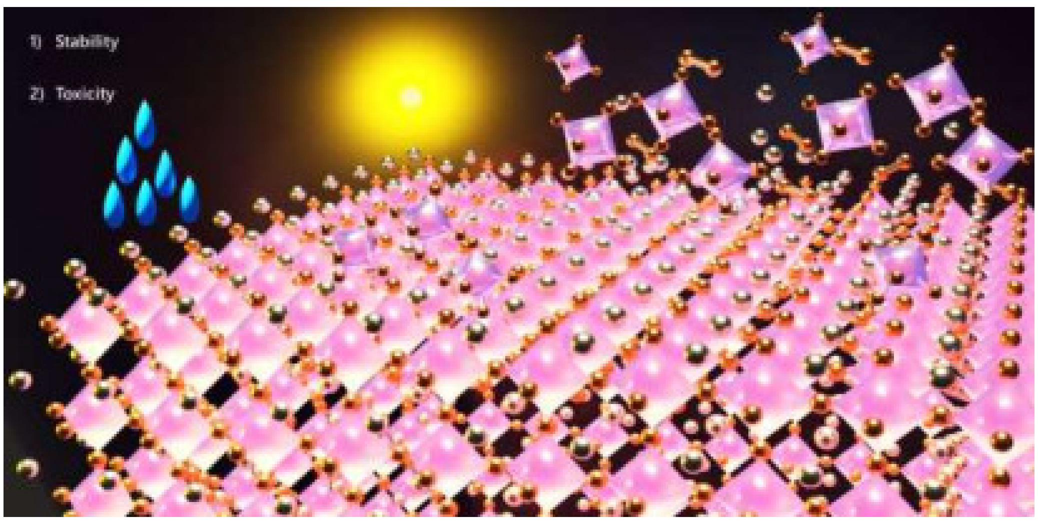
Keywords: Manganese oxide; Specific capacitance; Hydrothermal; Supercapacitors.

Designing Perovskite Single Crystals for Enhanced Photodetection

Sarvani Jowhar Khanam
Research Associate, University of Hyderabad, Hyderabad, India

Abstract

Metal Halide Perovskite (MHP) semiconductor materials have recently attracted significant attention from the scientific community towards efficient detection of high energy ionizing radiation (HEIR) detection due to their excellent optoelectronic properties in comparison to conventional. Many groups globally have reported a broad spectrum of perovskite applications ranging from solar cells to bright light-emitting diodes, along with electrically and optically pumped lasing, color imaging, PDs, and phototransistors. However, the scope of perovskite towards γ-ray detectors is least explored. This proposal provides a brief perspective on the consequentiality of optoelectronic properties MHP materials as HEIR detectors with various architectures involved. It discusses the directions for developing future lead halide perovskite materials, leading to high-energy resolution HER detectors.



Keywords: Metal Halide Perovskite, Ionizing Radiation, light-Emitting Diodes, Phototransistors, γ-Ray Detectors.

Dexterous green synthesis of Cu2O Nanoparticles: An amenable catalyst for aqueous Click reaction, Antiproliferative and Wound healing applications

Manojna R. Nayak, Ravindra R. Kamble
Department of Chemistry, Karnatak University, Dharwad, 580003, India

Abstract

The implementation of green chemistry principles to nanotechnology is one of the primary topics in the interdisciplinary area of nanoscience, which is a field of research that is perpetually expanding. A method for synthesizing Cu_2O nanoparticles from Copper (II) salts in an adroit and tactical way by employing solid jaggery as an economical and readily available source of reducing and stabilizing agent has been established. The explicitly synthesized nanoparticles were also discovered to be effective catalysts for the azide-alkyne Huisgen cycloaddition (Click reaction) in an aqueous media as green solvent. The substrate scope entails synthesis of 1,4-disubstituted 1,2,3-triazoles with good to excellent yields. The formation of Cu_2O NPs was corroborated by various physicochemical methods like UV–Vis, FTIR, DLS, Zeta potential, FESEM, EDX and XRD analyses. The Cu2O NPs were substantiated by evaluation using HeLa, MCF-7 and MDAMB-231 (IC50: 72.66 µg ¬mL^{-1}, 47.31, 63.44 µg mL^{-1}) cancer cell lines and unveiled eminent anticancer activities. This study also enabled us to elucidate the effects of Cu_2O NPs on wound healing and cell migration.

Keywords: Green synthesis, click chemistry, Cu2O NPs, Anticancer, Wound healing.

Green route synthesis, characterization, techniques of silver and vanadium nanoparticles using psidium guajava leaf extraction

Namrata Nagesh Mundargi, Sujatha K, Mohammed Juned Makandar, Muskan Karaneshi
Department of Chemistry, Karnatak University Dharwad 580003

Abstract

Nanotechnology is a relatively emerging field of science that involves the synthesis of different nanomaterials. The nanomaterials can be synthesized by various techniques such as chemical, physical and biological methods. Green synthesis is a safe, non-toxic, ecologically benign, and clean way to create nanoparticles. The synthesis of Silver, Vanadium nanoparticles by Psidium guajava (Guava) leaves extract which contains various compounds like Gallic acid and Flavonoids such as catechins, Kaempferol, Quercetin that act as reducing and stabilizing agents. The synthesized Silver-Vanadium nanoparticles were characterized by UV–Visible spectroscopy, Fourier transform-infrared spectroscopy (FTIR), X-ray diffraction (XRD) and scanning electron microscope (SEM).

Keywords: Green Synthesis, Psidium guajava leaves, Silver-Vanadium NPs, XRD, SEM.

Biosynthesis and Photocatalytic application of C – doped selective coinage metal oxides

Sivasankar T[1], Dr. B. Karthikeyan[2]
[1]Research scholar, Annamalai Universtiy, Annaimalainagar 608 002, India
[2]Assistant Professor, Department of Chemistry, Annamalai University, Annaimalainagar 608 002, India

Abstract

In this research, Nanoparticles of CuO and AgO are prepared by Co-precipatation method using Henna extract as reducing agent and photocatlylic application of C- doped Ago and CuO Nps and Graphite powder doped AgO and CuO Nps on blue dyes are to be done. Henna Charcoal C is obtained by drying its leaves for a week and kept for 2hrs at 200ºC in Muffle furnace by 0.3 M CuCl2.2H2O is doped with 0.15M Henna Charcoal carbon with constant magnetic stirring with rotation of 500rpm. Slowly in drops 0.6M NaOH is added to cause green precipitate of Cu(OH)2.Cu(CO3).x H2O and precipate is washed several times to come to pH nearly 10. C- doped precipitate is kept for 6 hrs at 350ºC in Muffle furnace. The same co-precipatation is carried out for preparation of C- doped AgO Nps by keeping its precipate for 5 hrs at 550ºC in Muffle furnace. The procedure is repeated for preparation of Graphite powder doped with CuO and AgO NPs. The spectral studies of FT-IR, XRD, SEM, UV-DRS, PL are taken and compared for each sample. The aborption peaks of blue dyes such as Methylene blue and Cobalt blue are studied by photocatalytic catalysis under UV emission and spectral studies are to be noted and compared for each one.

Comprehensive synthesis and characterisation of ZnO-Fe_2O_3 composites with the purpose of developing an effective U(VI) scavenger

Amandeep Kaur[1], Sangeeta Sharma[2]
[1]Department of Applied Sciences, Shaheed Bhagat Singh State University, Ferozepur, Punjab
[2]Department of Chemistry, Ch. Ishwar Singh Kanya Mahavidyala, Dhand, Kurukshetra, Haryana

Abstract

(1-x)ZnO- xFe2O3nanocomposites (where x = 0.05, 0.10, 0.15 & 0.20) have been successfully synthesized using a mechanical mixing approach. The X-ray diffraction technique was utilized in order to carry out the structural phase analysis, and the scanning electron microscope was utilized in order to analyze the morphological behavior of the material. EDX analysis was used to investigate the elemental composition of the prepared composites. The adsorption behavior of prepared nanocomposites was evaluated using systematic batch mode adsorption investigations.The Langmuir capacity of the prepared nanocomposite (0.80ZnO-0.20Fe2O3) was determined to be around 151.20 mg/g by isotherm models and kinetic investigations. These findings indicate that the0.80ZnO-0.20Fe2O3 nanocomposite effectively adsorbs U(VI) through chemisorption and has the potential to serve as a packing material for column units in water purifiers.

Keywords: Mechanical mixing; Adsorption; Isotherm; Chemisorptions.

Au nanocubes as Plasmonic refractive index sensor

Smitorshi Probho Roy, Jyoti Katyal
Amity Institute of Applied Science, Amity University, Noida, UP, India

Abstract

The finite-difference time-domain (FDTD) approach was used to investigate the localised surface plasmon resonance (LSPR) of Au nanocubes. For Au nanocube-based plasmonic nanosensors, the ideal dimensions of nanocubes for refractive index sensitivity (RIS), line shape broadening (FWHM), and figure-of-merit (FOM) are determined from the simulation results. Au nanocube is an effective plasmonic material for refractive index sensing from visible to near infrared wavelengths, according to our computed results. The LSPR range for nanocubes are dependent on factors such as its size, wavelength of light source, refractive index of medium and shape. Au nanocubes of the sizes ranging from 10-100 nanometers were taken and the wavelength of the light source was chosen to be between 450-1000 nm for the simulation. Simulation results showed increased sensitivity between the ranges of 60 nm to 100 nm.

Keywords: FDTD, Nanocube, Refractive index sensitivity, field enhancement.

.

Variation in LSPR and field enhancement of TiN nanosphere, nanoellipsoidal and nanoring structure

Ayushi, Jyoti Katyal
Amity Institute of Applied Science, Amity University, Noida, UP, India

Abstract

Using the finite-difference time-domain (FDTD) approach, the localised surface plasmon resonance (LSPR) of TiN nanospheres, nanoellipsoidal, and nanoring were investigated. The ideal sizes of nanospheres, nanoellipsodial, and nanorings for TiN-based plasmonic applications were studied. The LSPR peak was observed at 512 nm for nanosphere whereas for nanoellipsoidal the peak shifts to 740 nm. The local electric field enhancement at various regions of an individual nanostructure has been demonstrated numerically. The simulated electric field enhancement was in the order, corner > edge > surface, which is in complete agreement with the experimental results. This work provides direct theoretical evidence of localized enhancement of Raman signals for three different anostructure.

Keywords: Localised surface plasmon resonance, FDTD, TiN.

Synthesis of ZnO/Fe_2O_3 nanoparticles for photocatalytic degradation of dyes

Vaishnavi PU, Mahesh Bhat
Department of Chemistry, Poornaprajna College (Autonomous), Udupi-576101, Karnataka, India

Abstract

In this present study nano composites of ZnO /ferric oxide /starch was synthesized by the solution phase method. The synthesized nano composites was characterized by SEM and particle size is confirmed. Aqueous solution of dyes solution of dyes are prepared at 50 ppm. Batch experiments are carried out for the study of photocatalytic oxidation of dyes. The present nanocomposite shows superior photocatalytic activity on Methylene Blue of 81 % degradation and 73 % of food color yellow dye removal, as contact time increases, the photocatalytic oxidation of the dyes in aqueous solution also increases. In the graph, percentage removal of the dyes versus contact time by photo catalytic oxidation shows that moderate action of nanocomposite on Eriochrome Black-T.

Keywords: Nanocomposites, ZnO, Photocatalysis, Methylene blue.

Sustainable and Green Corrosion Inhibition of Mild Steel: Insights from Chemical and Electrochemical Approaches

Geeta.D. Pai, Manohar.R.Rathod, S.K. Rajappa
Department of Chemistry, Karnatak Science College, Dharwad-580001, India

Abstract

Green corrosion inhibitors have attracted great scientific attention because of their outstanding efficacy and affordable cost. In the current study, the chemical constituents of Putranjiva Roxburghii plant leaves extract (PRLE) were evaluated as corrosion inhibitors for mild steel (MS) in 1M HCl medium. Electrochemical impedance spectroscopy (EIS), potentiodynamic polarisation (PDP), and weight loss measurements were used to evaluate the PRLE's ability to protect the mild-steel surface against corrosion in 1M HCl medium. The maximum inhibition efficacy was reported as 95.45%, 93.99%, and 94.79% by weight loss measurements, EIS, and PDP methods, respectively. In the prolongation of the work, the entropy of adsorption (Δ), enthalpy of adsorption (Δ), Gibbs free energy of adsorption (Δ), and activation energy (E_a) of the reaction were calculated. The inhibition process proceeds through physiochemical adsorption on the mild steel and obeys the Langmuir isotherms model. In the absence of an inhibitor, the E_a value was found to be a minimum of 49.38 kJ/mol, whereas for the optimum concentration of PRLE, it was found to be 77.2 kJ/mol, implying that more energy is required to undergo corrosion. The surface morphological observations from the scanning electron microscope (SEM), atomic force microscopy (AFM), and contact angle explored the effective adsorption of PRLE. AFM values revealed that the average surface roughness (R_a) value of MS is high (188.08), whereas in the presence of PRLE, R_a values were significantly reduced to a minimum value of 37.226. Further, the chemical interactions between PRLE and the mild-steel surface as well as the inhibitory mechanisms were further elucidated by theoretical simulations.

Keywords: Mild-steel, Weight-loss, Putranjiva Roxburghii, PPD, EIS.

Adsorption of Congo Red from aqueous solution by Mango Bark Ash: Investigated by spectrophotometric and physicochemical analysis

Hina Desai, Malay Bhatt
HVHP Institute of Post Graduate Studies & Research, Kadi Sarva Vishwavidyalaya, Kadi, Gujarat

Abstract

To develop a cost-effective and highly efficient green adsorbent for removing Congo Red dye from wastewater, prioritizing the creation of a sustainable environment is essential. This study focuses on the adsorption of Congo Red dye onto the surface of dry mango bark ash prepared at 250°C. Both UV/Visible and physicochemical analyses were conducted, revealing interactions between Congo Red and the ash through observable data variations. X-ray diffraction results showed a decrease in the intensity of adsorbent counts post-adsorption, further validating the dye removal effectiveness. Remarkably, Congo Red exhibited adsorption capacities of up to 85-90% with the ash. Additionally, increased conductance, surface tension, and viscosity after interaction with dry mango bark ash compared to the initial dye solution confirmed the adsorption phenomenon.

Dye-doped polymer optical fiber luminescent solar concentrators: A comparison of the performance of step- index and graded-index fibers

Anugop B[1,3], Lakshmi Srinivasan[2], Kailasnath M[1]
[1]International School of Photonics, Cochin University of Science and Technology, Kochi, Kerala- 682022
[2]Inter University Centre for Nanomaterials and Devices, Cochin University of Science and Technology, Kochi, Kerala- 682022
[3]Department of Renewable Energy, St. Albert's College (Autonomous), Ernakulam, Kochi 682018

Abstract

Introduction of luminescent solar concentrators (LSC) help to improve the photovoltaic filed by reducing the cost of production and enhance the efficiency. An LSC contain a luminescent material embedded in a transparent waveguide so that they can absorb sunlight and re-emit and transport to the edges. These system can perform well without any light-tracking system and invariably under different lighting conditions. Here we analysed the performance of Rh640 perchlorate dye doped polymer optical fibers as an LSC. We compare the conversion efficiency of an uncladded step index (SI), cladded step index (CSI) and graded index (GI) fibers with four different diameters. All kind of fibers shows an enhancement in the efficiency with the fiber diameter. Also GI fibers shows better efficiency than other fibers. The performance of the fibers under different weather conditions were studied. It was found that fibers give better results under low pump powers.

Keywords: Luminescent solar concentrator, Dye doped polymer optical fiber, Rh640 perchlorate, Graded index fibers.

Remediation of Pb^{2+} from wastewater and eradication of cancer cell line using 3D Rod-like Fe-Ce BDC MOF synthesized via Solvothermal Route

Eshika Mahanty[†], Arnab Mukherjee[§], Debasis Dhak*

Nanomaterials Research Laboratory, Department of Chemistry, Sidho-Kanho-Birsha University, Purulia-723104, India

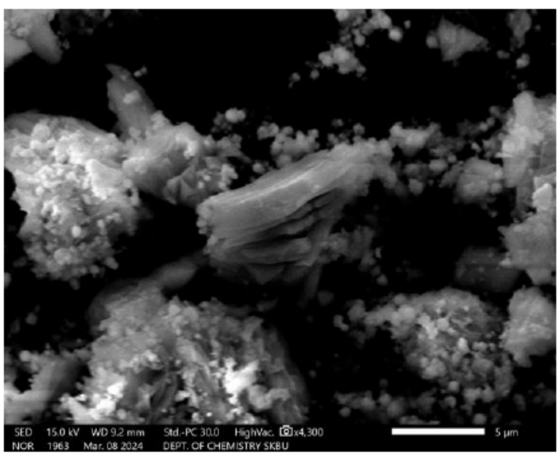
[†] Final year post-graduate student, Department of Chemistry, Sidho-Kanho-Birsha University, Purulia-723104, India

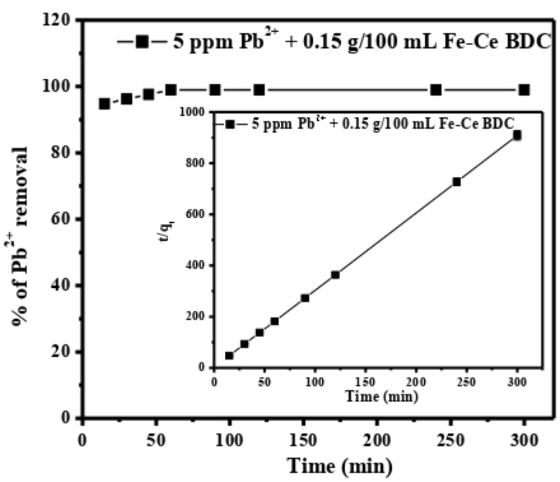
[§] Research Scholar, Department of Chemistry, Sidho-Kanho-Birsha University, Purulia 723104, India

[*] Professor, Department of Chemistry, Sidho-Kanho-Birsha University, Purulia-723104, India

Abstract

A pH-stable 3D-rod-like shaped Fe-Ce BDC MOF (1,4-benzene dicarboxylic acid abbreviated as BDC) has been synthesised via solvothermal route using a patented process (Patent Application No. 2022/09387). Fe-Ce BDC was characterized using thermogravimetric analysis (TGA), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, ξ-potential study, and Brunauer–Emmett–Teller (BET) surface area studies, etc. The 3D-rod shape was observed using the Scanning electron microscopy (SEM) analysis. Fe Ce BDC with 358.49 m^2/g surface area and average pore diameter 8.95 nm was able to remove Pb^{2+} from aqueous medium. The highest removal efficiency was 99±1% for 5 ppm initial Pb^{2+}solution at pH~7 with 0.15 g/100 mL adsorption dose. The chemisorption of Pb^{2+} onto the MOF was established by EDX and XPS analyses. The Pb^{2+} removal studies followed pseudo 2^{nd}-order kinetics and the material was found to be reuseable up to 5 cycles. Fe-Ce BDC MOF has potential to kill MCF-7 breast cancer cell line efficiently.





Keywords: pH-stable; 99±1%; MCF-7 breast cancer cell line.

Harnessing Mn-Doped V_2O_5 for Environmental Cleanup and Energy Crisis Solutions

Prashant, Vikas Dhiman, Raman Kumar, Abhishek Kumar, Neha Kondal
Department of Physics, Chandigarh University, Gharuan, Mohali, Punjab, India [2] Govt. College Dhaliara, Distt. Kangra, Himachal Pradesh, India

Abstract

The primary global issues of the 21st century is freshwater scarcity, pollution from industrial dyes, and the development of efficient energy storage devices. Over 700,000 tons of synthetic dyes are produced annually, with more than 15% ending up in water bodies. Additionally, advancements in energy storage devices are crucial for mitigating the environmental impact of energy consumption and transitioning towards sustainable energy sources. In this perspective, vanadium pentoxide (V_2O_5) has attracted considerable attention as a photocatalyst and a cathode material for energy storage devices due to its outstanding properties such as low cost, narrow bandgap (~2.3 eV), optical and chemical stability, and multiple oxidation states. Furthermore, in recent years, biological synthesis has emerged as an attractive alternative to traditional chemical and physical methods for producing nanomaterials. However, the narrow band gap of V_2O_5 also makes it easier for the photogenerated electrons and holes to recombine in the excited state, and the stored energy is instantly consumed by carrier recombination which affects the photocatalytic and cyclic stability for energy storage devices. Therefore, promoting the carrier separation of V_2O_5, improving the photocatalytic efficiency, and increasing the cyclic stability are the key problems to be solved. Several methods to improve the photocatalytic performance and electrochemical performance of V_2O_5 including metallic ion doping, non-metallic ion doping, semiconductor recombination, and noble metal deposition are reported to enhance its performance. In the present study, we have synthesized the Mn-doped V_2O_5 ($V_{2-x}Mn_xO_5$) with x = 0.01, 0.02, 0.03, and 0.04 using a solid state reaction method. The prepared V2-xMnxO5 samples were characterized by XRD, SEM, TEM, and EDS. Further, the effect of Mn doping on the solar-driven photocatalytic efficiency of the V_2O_5 was tested against the methylene blue dye under solar irradiation. The electrochemical performance of $V_{2-x}Mn_xO_5$ as a cathode material for Li-ion batteries was tested using three electrode system with LiPF6 as an electrolyte.

Keywords: Vanadium pentoxide; Solid-state reaction; Photocatalysis; Lithium-Ion Batteries.

Spectrophotometric studies of synthesized charge transfer complex of 2-ethylimidazole with 3,5-dinitrobenzoic acid: Exploring its interaction with Bovine Serum Albumin (BSA), antimicrobial activity, molecular docking and DFT/TD-DFT study

Farha Naaz, Ishaat M. Khan

Department of Chemistry, Faculty of Science, Aligarh Muslim University, Aligarh (U.P.) – India 202002

Abstract

The new charge transfer (CT) complex of 2 – Ethylimidazole (2 – EI) and 3,5 – dinitrobenzoic acid (3,5 – DNB) has been synthesized and FTIR and UV-Vis spectroscopy has been utilized, along with computational investigations such DFT/TD-DFT analysis and molecular docking to study it. The charge transfer complexes (CT complexes) are formed when an electron is transferred from one molecular entity (donor) to another (acceptor), resulting in the formation of an electronically excited state. These complexes are often utilized in various fields such as materials science, organic electronics, and analytical chemistry due to their unique properties. The FTIR spectra of the CT complex suggest the transfer of electron by displaying a new band in the CT spectra, it is further confirmed by SC – XRD analysis demonstrating $N^+ - H \cdots O^-$ bonding having a bond length of 2.648 Å. Moreover, the Benesi –Hildebrand plot and equation validate the 1:1 stoichiometry of the synthesized complex and various physical parameters such as Ionization potential (I_D), Energy of interaction (E_{CT}), Oscillator strength (f), Resonance energy (R_N), and Free energy (ΔG^o) have been determined by using UV-visible spectroscopy. The biological activity of the CT complex (anti-bacterial and anti-fungal) and its protein binding characteristics were also investigated. It has been observed that the CT complex can disrupt bacterial cell membranes or metabolic activities, which can result in bacteriostatic or bactericidal effects. Likewise, CT complex has the potential to demonstrate antifungal efficacy against a range of fungal species through the disruption of fungal cell membranes or interference with crucial cellular processes. Molecular docking studies were carried out to explore, how the synthesized CT complex bound to the BSA protein (PDB ID: 3V03). At the B3LYP/6-311G++ theoretical level, density functional theory (DFT) computations were performed. An analysis was conducted on the HOMO→LUMO electronic energy gap, the optimized geometry, and a molecular electrostatic potential map of the synthesized CT complex.

Keywords: Charge transfer complex, SC-XRD, DFT/TD-DFT, Bovine Serum Albumin, Antimicrobial study.

Three dimensional rotational flow of nanofluid over a stretching sheet with Newtonian heating/cooling

Puspanjali Mahapatra[1], Kharabela Swain[2], Tusar Parida[3]
[1]Department of Mathematics, Silicon University, Bhubaneswar, Odisha-751024, India
[2]Department of Mathematics, GIFT Autonomous, Bhubaneswar, Odisha-752054, India
[3]Department of Mathematics, Silicon University, Bhubaneswar, Odisha-751024, India

Abstract

The present study investigates the three dimensional (3D) rotational flow and heat transfer of nanofluid over a stretching sheet by considering thermal radiation and heat source with thermal convective boundary condition. The flow model includes rotation and translation which find applications in chemical and process industries. The nanofluid consists of water as base fluid, Cuas well asTiO_2as NPs. The boundary conditions on heat transfer involves Biot number(Bi)which is important because many problems reported in literature involves Nusselt number which is a relative measure of heat transfer coefficient and thermal conductivity, both related to flowing fluid. Using similarity transformation, the governing partial differential equations and corresponding boundary conditions reduce the system of ordinary differential equations and then solved by shooting techniques with the help of bvp4c code of MATLAB software. It is found that for metallic (Cu)nanofluid temperature remains positive and for metallic oxide nanofluid (TiO_2)the temperature remains negative, indicating thermal energy generation and absorption due to metal or metallic oxide as nanoparticles. This aspect warrants immense application in heating/cooling of the electronic devices as per the design requirement. This contributes to novelty and novel finding in augmentation as well as stability of thermal energy transport.

Keywords: Rotating flow; nanoparticles; stretching sheet; radiation; heat source; Newtonian heating/cooling.

A Smart Optimization of Fault Diagnosis in Electrical Grid Using Distributed Software defined IOT System

Maheswari K T[1], Bharanikumar R[2], Rithick S[3], Satya Priya N K[4]

Associate Professor, Department of Electrical and Electronics Engineering, Bannari amman Institute of Technology, Sathyamangalam, Tamilnadu-638401

[2]Professor, Department of Electrical and Electronics Engineering, Bannari amman Institute of Technology, Sathyamangalam, Tamilnadu-638401

[3]Student, Department of Electrical and Electronics Engineering, Bannari amman Institute of Technology, Sathyamangalam, Tamilnadu-638401

Abstract

Electrical power demands have increased significantly over the last years due to rapid increase in air conditioning units and home appliances per domestic. Having an uninterrupted power supply is essential for the continuity of power-generated home services and industrial platforms. Electrical power interruption has become a big concern to the utility suppliers. Despite successive attempts to put an end to this dilemma, the issue still prevails. One of the main factors in power outages in local zones is persistent faults in distribution transformers (DTs). DT is considered one of the main elements in the electrical network that is essential for the reliability of the grid supply. Due to the internal lack of monitoring system and periodic maintenance, DT is relentlessly subject to faults due to high overhead utilization. Therefore, in order to enhance the grid reliability, transformer health check, and maintenance practices, we propose a remote condition Internet of Things monitoring and fault prediction system that is based on a customized software-defined networking (SDN) technology. This approach is a transition to smart grid implementation by fusing the power grid with efficient and real-time wireless communication architecture. The SDN implementation is considered in two phases: one is a controller installed per local zone and the other is the main controller that is installed between zones and connected to the core network. The core network consists of redundant links to recover from any future fails. Furthermore, a prediction system based on an artificial neural network algorithm, called distribution transformer fault prediction has been proposed which is installed in the management plane for periodic prediction based on real-time sensor traffic to proposed cloud. Moreover, a communication protocol in the local zone called local SDN-sense has also been proposed which ensures a reliable communication and local node selection to relay DT sensor data to the main controller. An experimental verification has been done to validate thet that the proposed system is an efficient approach to handle future interruption and faults in power grid using cost-effective and reliable infrastructure that can predict and provide real-time health monitoring.

Performance of Combustion Synthesized ZnO & ZnO-ZrO_2 Nanocomposites for dye contaminated wastewater treatment

Abhijit S Landge[1], Abbas S Pathan[2], Yogesh V Hase[3], Sandesh R Jadkar[3*], Sandeep A Arote[2*], Shivaji V Bhosale[1, 4]

[1]Department of Physics, Fergusson College (Autonomous), Pune 411 004 (India)

[2]Departments of Physics, S. N. Arts, D.J. M. Commerce, and B. N. S. Science College (Autonomous), Sangamner 422605 (India)

[3]Department of Physics, Savitribai Phule Pune University, Pune 411 007 (India)

[4]Department of Physics, Sir Parashurambhau College (Autonomous), Pune 411 004 (India)

Abstract

In this study, zinc oxide (ZnO) and zinc oxide-zirconium dioxide nanocomposites (ZnO@ZrO_2) were different molar ratio of ZrO_2 synthesized by using an economical solution combustion method. This method strongly related to their structural, morphological, optical, and photocatalytic properties. The nanocomposites were characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), UV-vis absorption spectroscopy, scanning electron microscopy (SEM), and energy dispersive spectroscopy (EDS). XRD and EDS confirmed phase formation and purity. UV-vis absorption spectra showed that the addition of ZrO_2 significantly impacted optical absorption and increased the band gap energy from 3 to 3.16 eV. FTIR spectra verified the formation of ZnO and ZnO@ZrO_2. The morphology of the nanomaterials investigated by SEM the images revealed substantial changes with addition of ZrO_2 in ZnO. The photocatalytic performance of ZnO and ZnO@ZrO_2 was assessed by degrading methylene blue (MB) dye under solar light. The study detailed the influence of varying ZrO_2 content on degradation efficiency and time. The sample labeled P3 demonstrated the highest photodegradation efficiency of methylene blue dye is ~85% within 240 minutes.

Kewords: nanocomposites; solution combustion; ZnO@ZrO_2; MB dye; photodegradation efficiency.

Exploring the efficacy of Base-Modified Saccharum munja biomass for adsorptive removal of cationic dyes from single and binary systems

Aniket Singh, Nishita Sharma, Sarita Yadav, Surender Kumar
Department of Chemistry, Chaudhary Bansi Lal University, Bhiwani, Haryana, India 127031

Abstract

In the 21st century, anthropogenic activities, growing industrialization and unplanned urbanization have raised a serious concern about the deteriorating quality of water resources. The textile waste waters that contain high number of Synthetic dyes reduce light transmission and adversely affect the photosynthetic activity of aquatic life, causing a highly toxic effect on living communities. Various technologies are available for the remediation of wastewater, among which adsorption is regarded as a green, clean, and versatile method. Herein, Base modified Saccharum munja was used for the adsorptive removal of Fuchsin Basic and Methylene Blue dye from single and binary systems. Response surface methodology was used to optimize the effect of different parameters such as contact time, initial dye concentration, biosorbent dosage, and pH on the % removal of dye. Further the kinetic and isotherm of the adsorption process were evaluated with the help of different models. Pseudo-Second-order was found to be best fitted among all the kinetic models. The value of experimental qe = 87.92 mg/g was in good agreement with the calculated qe = 88.8 mg/g of FB dye; For MB dye qe experimental is 60.50 mg/g which is quite similar to calculated qe 61.46 mg/g. Langmuir Isotherm model suited the best with the experimental data. Further, the adsorption process was also favourable under Freundlich Isotherm model as the value of 1/n falls between 0 and 1 also showing a significant fit to the results that suggested the occurrence of multilayer adsorption. The maximum adsorption capacity (qmax) for Fuchsin Basic and Methylene Blue dye obtained from Langmuir model was 178.89mg/g and 87.26mg/g respectively. In conclusion, Saccharum munja can significantly reduce the environmental pollution associated with dye wastewaters and provide a sustainable solution for dye removal.

Keywords: Dyes, Saccharum munja; Wastewater; Adsorption; Biomass based composites.

DFT and Molecular Docking Studies of a Naturally Occurring Anticancer Drug: Ellipticine

Abhinav Mishra, Dipendra Sharma, S. N. Tiwari
Department of Physics, Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur, U.P. India-273009

Abstract

A member of the pyrido[4,3-b] carbazole family, ellipticine is one of the most basic naturally occurring alkaloids with a planar structure. It is utilized in the treatment of cancer. Its intercalative binding onto DNA helices consecutive base pairs is responsible for its pharmacological characteristics. This manuscript presents the physicochemical properties of the ellipticine drug obtained using the DFT-B3LYP/6-311G (d, p) and DFT-ωB97XD/6-311G (d, p) methods with the Gaussian 16 package. A comparative analysis of the calculated vibrational assignments of ellipticine vis-à-vis experimental data from literature has been performed. HOMO, LUMO, MEP surface and chemical reactivity descriptors have been computed. Further, employing molecular docking, inhibition activity and binding sites of ellipticine drug with three isomerase transcriptases (PDB Id: 1did, 2ypi and 1xig) have been unraveled.

Keywords: Ellipticine, DFT, MEP, HOMO, LUMO, Molecular Docking.

Structural, optical and morphological properties of Solvothermally synthesized CZTS nanomaterials

Roomul Mushtaq, Mohd Zubair Ansari
Department of Physics, National Institute of Technology Srinagar, Hazratbal, Srinagar, Jammu and Kashmir, 190006, India

Abstract

Cu_2ZnSnS_4 (CZTS) nanomaterials has seen substantial usage in solar cell research due to its significant absorption coefficient approximately$10^4 cm^{-1}$, appropriate band gap (1.5- 2.0 eV) in the visible spectrum, great potential as a p-type semiconductor material, good photo stability, the relative quantity of the component elements and their nontoxicity. This work presents the results of our investigation into the structural, morphological, and optical features of p-type kesterite Cu_2ZnSnS_4 nanocrystal powder, which was produced by solvothermal technique. The sharp XRD (X-ray diffractometer) peaks show that the material is highly crystalline, with crystallite size close to 10 nm. Because of the quantum confinement effect caused by the tiny size of the crystallites, the band gap of the produced nanomaterial is 1.75 eV, which is different from the usual 1.52 eV value. The morphology of CZTS nanostructures was examined using FESEM, or field emission scanning electron microscopy. The image clearly shows that the material is equally scattered with polygonal nanoparticles and agglomerated morphology.

Keywords: CZTS; kesterite; polygonal nanoparticles; quantum confinement; agglomeration.

Investation of the adsorptive efficiency of Base modified Saccharum munja biomass for Safranine O and crystal violet dyes in single and binary systems

Anisha Grewal, Nishita Sharma, Partiksha Panghal, Annu Dalal, Sonika Singh, Surender Kumar
Department of Chemistry, Chaudhary Bansi Lal University, Haryana, Bhiwani-127031, India

Abstract

With expanding populations, anthropogenic activities and climate change, water scarcity has become a significant issue that necessitates immediate efforts towards wastewater remediation. Textile wastewater loaded with organic dyes is harmful to aquatic life and disrupts photosynthetic activity. To address this issue, there are various technologies for treatment of wastewater. Among them, adsorption by using biomass-based composites is widely adopted technology due to its various characteristics such as eco-friendly, cost effectiveness, low operation time and no harmful secondary pollutants. Herein, we have utilized the base treated Saccharum munja for the removal of Safranine O dye and Crystal Violet dye from water. The as-synthesized composite was characterized by using various technologies to explore the associated physicochemical characteristics. Response surface methodology was used to optimize the effect of various parameters such as initial dye concentration, biosorbent dosage, and pH. Moreover, the kinetics and isotherm of the adsorption process were evaluated using various models. The best-fitted model was found to be the Pseudo-Second-Order model among all the kinetic models. The experimental value of qe, which is equal to 87 mg/g, was quite similar to the calculated value of qe, which is equal to 88.261mg/g for SO dye; For CV dye qe experimental is 92.66mg/g which is quite similar to calculated qe 93.37mg/g. The Langmuir Isotherm model was found to be the most suitable for SO dye and Freundlich isotherm model was found to be the most suitable for CV dye. Further, the adsorption process was also favorable under Freundlich isotherm model as the value of 1/n falls between 0 and 1 also showed a good fit with the results and suggested multilayer adsorption. The maximum adsorption capacity (qmax.) for Safranine O and Crystal Violet dye obtained from the Langmuir model was found to be 126.90 mg/g and 143.67 mg/g respectively. In conclusion, Saccharum munja can effectively reduce environmental pollution caused by dye wastewater and offer a sustainable solution for dye removal.

Keywords: Organic Dyes; Saccharum munja; Wastewater; Isotherm; Kinetics; Thermodynamics.

Insights into Adsorptive and efficient removal of Rose Bengal dye from wastewater by biomass-based adsorbent

Nishita Sharma, Sonika Singh, Surender Kumar
Department of Chemistry, Chaudhary Bansi Lal University, Bhiwani, Haryana, India 127031

Abstract

Water is a crucial part of our existence; nevertheless, the quality of water is deteriorating owing to industrialization and urbanization. Dyes are among the most common pollutants of water resources around the world. The carcinogenic and toxicological effects of dyes from industrial wastewater pose a serious hazard to ecosystem as well as human health. Various technologies are adopted by the researchers to remove these dyes from wastewater; among which adsorption is widely used technology because of its simple, cost-effective, eco-friendly and commercially viable nature. In this study, we have used the Raw Saccharum munja, as a potential low-cost and biodegradable biosorbent to remove the Rose Bengal dye from aqueous solution. The morphological and physicochemical properties of adsorbent were analyzed with different characterization techniques. Effect of different parameters on the adsorption efficiency of the as-prepared biosorbent was studied by carrying out batch adsorption studies. Further, the kinetics, equilibrium and thermodynamics of adsorption process was checked with various models. Moreover, the spent adsorbent was regenerated by using the mixture of acetone and hot water which makes the whole process economically viable for practical purpose.

Keywords: Dyes; Contaminants; Wastewater remediation; Adsorption; Saccharum munja.

Zinc Silicate Doped PDMS-PVA Nanofibers using Electrospinning Process

M. G. Veena, Usha Rani C M, Shalini M S, Anusha Narayan, Madhukar B S
JSS Science and Technology University (SJCE) Mysuru 570016, Karnataka, India

The present work carried out to develop nanofibers by combining hybrid polymers namely Polydimethylsiloxane (PDMS) and Polyvinyl alcohol (PVA) with hybrid nanoparticles namely Zinc oxide (ZnO) and silicon dioxide (SiO2) by synthesis of ZnO and SiO2 to form zinc silicate (ZnSiO3) nanoparticle by solution combustion method and to obtain the selected mixture of PDMS and PVA hybrid polymer by stirring the hybrid polymers and nanoparticles solution to produce viscous solution. The developed viscous solution of corresponding wt.% ratio namely 0.5wt.%, 1wt.% and 2wt.% is electro-spun by electrospinning technology in order to obtain ultrathin nanofibers. The investigation of surface morphology of the nanofibers is carried out by scanning electron microscopy (SEM). From the ImageJ software the developed nanofibers diameter ranges from 142 to 412 nm for 2wt.% loading of nanoparticles. The X-ray diffraction (XRD) analysis was used to study structure and crystallite size of nanofibers where the diffraction peak of 2wt.% is $2\theta=23.6^0$ and for 0.5wt.% it is $2\theta = 11.4^0$ and the intensity peak increases as increase in nanoparticles. It implies that the crystallinity is influenced by the surface properties of nanoparticles. The hydrophobicity of the nanofibers contact angle measurement was carried out. I was observed the contact angle of 2wt.% is 920 and for without nanoparticle is 430 so the 2wt.% sample is hydrophobic in nature. So, the hydrophobic nature increases with the increase in nanoparticles. The nanofiber is tested by air filter membrane test (AFM) which gives permeability, efficiency and porosity. The highest efficiency is obtained for the sample of 2wt.% compared to base 0.5wt.% and other nanoparticle loadings. Hence it was concluded that the 2wt.% nanofibers developed has shown improved performance which can be useful in the filtration media in hospitals, air conditioners and in industries.

Impact of Climate Change on Sone River Water Quality: A Study in Selected Blocks of Bihar and Uttar Pradesh

Sweta Kumari
Ph.D. Scholar, Départment of Chemistry V.K.S University Arrah, Bihar, India

Abstract

Climate change poses significant challenges to freshwater ecosystems worldwide, affecting water quality through altered hydrological patterns, temperature variations, and precipitation changes. This study focuses on assessing the impact of climate change on the physicochemical properties of Sone River water in selected blocks of Bihar and Uttar Pradesh. The research aims to understand how climate-related factors influence water quality parameters and identify potential implications for ecosystem health and human well-being.

Keywords: Sone River, climate change, water quality, physicochemical parameters.

Bio-inspired Carbon Dots as Potential Nanozymes for Combating Glioblastomal Hypoxia

Anjali Nisha[1,2], Amitabha Acharya[1,2]

[1]Biotechnology Division, CSIR-Institute of Himalayan Bioresource Technology, Palampur (H.P.) 176061, India

[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad – 201002, India

Abstract

Glioblastoma, the most aggressive brain cancer, remains a therapeutic challenge due to its relentless growth, treatment resistance, and ability to thrive in hypoxic (low-oxygen) environments. This hypoxia fuels tumor progression by promoting growth, metastasis, and resistance to conventional therapies. Tumor cells actively manipulate their environment by outpacing the blood supply and promoting dysfunctional blood vessel formation, further compromising oxygen delivery. The resulting hypoxic tumor microenvironment (TME) creates a vicious cycle: low oxygen activates pro-survival pathways in cancer cells, allowing them to evade therapy and hindering immune cell infiltration. Nanozymes, a new class of enzyme mimics, offer a promising strategy to combat hypoxia-mediated resistance. These nanomaterials possess the remarkable ability to mimic natural enzymes, with enhanced stability and tunability. By strategically designing nanozymes, the hypoxic TME can be targeted thus improving cancer treatment outcomes. Here we explore the potential of plant-derived carbon dots (pCDs) as novel nanozyme scavengers specifically designed to target glioblastoma's hypoxia. Similar to other nanozymes, pCDs can mimic the catalytic activity of natural enzymes while offering advantages in stability and tunability. We synthesized and characterized the pCDs using various techniques (UV-Vis, fluorescence, FTIR, TEM) to ensure their suitability for targeting the hypoxic and acidic TME. We hypothesize that pCDs can function as ROS scavengers, mimicking the activity of natural antioxidant enzymes. By neutralizing the detrimental effects of ROS generated under hypoxic conditions, these bio-inspired nanozymes could alleviate hypoxia, enhance glioblastoma cell susceptibility to conventional therapies, and ultimately improve the prognosis for glioblastoma patients.

Keywords: Glioblastoma, Hypoxia, Carbon Dots, Nanozymes, Cancer Therapy.

References:

1. W. Lv, M. Cao, J. Liu, Y. Hei, J. Bai, Acta Biomaterialia 2021, 135, 617–627.
2. P. Muhammad, S. Hanif, J. Li, A. Guller, F. U. Rehman, M. Ismail, D. Zhang, X. Yan, K. Fan, B. Shi, Nano Today 2022, 45, 101530.

Adsorptive removal of Eosin yellow dye from aqueous solutions using Pennisetum glaucum as a low-cost and green biosorbent

Partiksha, Surender Kumar
Department of Chemistry, Chaudhary Bansi Lal University, Bhiwani, Haryana, India 127031

Abstract

Clean water is essential to both human and environmental survival and has a major positive impact on a nation's rapidly expanding businesses. Nevertheless, the availability of pure water had decreased since contaminants like dyes had a detrimental effect on the primary water sources that were pure and clean. Biomass waste is widely available and has been researched as an inexpensive biosorbent for waste water dye sequestration in recent years. Adsorbents made from biomass waste are environmentally friendly, economically viable, and have a remarkable ability to remove colors. Despite its proven toxicity and carcinogenicity, eosin yellow is widely utilized as a coloring in many different applications. The plant waste Pennisetum glaucum were applied as potential adsorbent for the removal of Eosin yellow from aqueous solutions. Different characterization approaches were used to investigate the physicochemical properties of adsorbents. Using artificial aqueous solutions, batch adsorption studies were carried out to examine the effects of initial dye concentration, initial solution pH, initial adsorbent dose, and temperature. With the use of several models, the kinetics, equilibrium, and thermodynamics of the adsorption process were also analyzed.

Keywords: Eosin yellow; Pennisetum glaucum; Pollutants; Waste water; remediation.

Adsorption behavior of dyes onto Pennisetum glaucum in wastewater effluent

Sarita Yadav, Surender Kumar
Department of Chemistry, Chaudhary Bansi Lal University, Bhiwani, Haryana, India 127031

Abstract

In this research, Pennisetum glaucum agricultural waste was used for the waste water remediation. The prepared eco-friendly adsorbent was characterised and tested for the adsorption of Erythrosine B dye at natural pH. The impacts of adsorption parameters were examined. The kinetics of dye adsorption occurs with intra-particle diffusion and pseudo-2nd order kinetic models. The adsorption experimental data was fitted to Langmuir isotherm model. The dye sequestration in the prepared adsorbent was feasible and exothermic in nature. The study results showed that the prepared adsorbent was effective for wastewater treatment.

Keywords: Erythrosine B; Waste water; Pennisetum glaucum; Adsorbent.

Green Synthesis of Fluorescent Carbon Nanomaterial to Minimize the Cross-Interaction of Aß42 and Tau Hyperphosphorylation

Nandini[1,2], Amitabha Acharya[1,2]
[1]Biotechnology Division, CSIR-Institute of Himalayan Bioresource Technology, Palampur (H.P.) 176061, India
[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad – 201002, India

Abstract

Alzheimer disease, being the global baggage in the aging population is found to have extensive amyloid plaques in extraneuronal regions and tau fibrils deposition inside the neuronal cells. Amyloid and Tau are two ubiquitous hallmark proteins that have high aggregation propensity in pathological conditions leading to impairment of cellular functions. The dynamics of consecutive aggregation of amyloid and tau while combating their cross interaction that aggravates the pathology is under severe investigations. It is like a vicious cycle where Aβ42 and tau pathology exacerbate each other, accelerating neurodegeneration. Among therapeutic options, Himayalan bioresources have enormous potential phytomolecules that possess the promising therapeutic potency. The aromatic rings of these phytomolecules can intercalate itself within the peptide structure of amyloid and tau reducing its aggregation. Out of many current therapeutic approaches, use of nanomaterials in treating is superior due to its small size, large surface area, high bioavailability and high efficacy. The carbon nanomaterial has greater propensity to cross Blood Brain Barrier with less toxic effects. In order to target the pathological proteins, we have developed Himalayan plant based carbon nanomaterial that can target amyloid aggregation and tau hyperphosphorylation simultaneously. We have characterized the synthesized nanomaterial using spectroscopic and electron microscopy techniques such as Fluorescence spectrophotometer, UV-Vis Spectrophotometer, Fourier Transform Infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), X-ray diffraction spectroscopy (XRD) and Transmission electron microscopy (TEM). To increase its therapeutic potential, we will conjugate bioactive molecule on its surface for evaluating it in biological system by unraveling the intricate connection between Aβ aggregation and tau hyperphosphorylation for better understanding.

Keywords: Alzheimer, Amyloid plaques, Tau hyperphosphorylation, Green synthesis, Carbon nanomaterial.

References:

1. Hampel, Harald, et al. "The amyloid-β pathway in Alzheimer's disease." Molecular psychiatry 26.10 (2021): 5481-5503.
2. Wang, Bo, et al. "Modulating protein amyloid aggregation with nanomaterials." Environmental Science: Nano 4.9 (2017): 1772-1783.

Investigating Essential Oil-Based Nanoemulsions as a Potential Approach to Address the Growing Threat of Antibiotic Resistance

Rubina Dhiman[1], Amitabha Acharya[1,2]
[1]Biotechnology Division, CSIR-Institute of Himalayan Bioresource Technology, Palampur (H.P.) 176061, India
[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad – 201002, India

Abstract

The emergence of antibiotic resistance poses a critical and escalating threat to global public health. The indiscriminate use of antibiotics in human medicine, veterinary practices, and agriculture has fueled the rapid evolution of resistant bacterial strains. These "superbugs" are rendering existing antibiotics increasingly ineffective, jeopardizing our ability to treat even common bacterial infections. This situation necessitates the urgent development of novel antibacterial agents to combat this growing menace and preserve the efficacy of antibiotics in our clinical arsenal. This study delves into the potential of essential oil-based nanoemulsions as a promising strategy for combating bacterial growth. Our investigation employed a systematic approach to synthesize essential oil-based nanoemulsions. We explored various permutations and combinations of essential oils, surfactants, and cosurfactants to optimize the formulation for stable nanoemulsion. Following a rigorous screening process, we identified the most stable nanoemulsion formulation. To ensure long-term efficacy, we conducted comprehensive stability studies, evaluating the nanoemulsion's resistance to different storage conditions. This ensures consistent performance and prolonged shelf life, crucial for a practical therapeutic product. Finally, we evaluated the antibacterial activity of the optimized nanoemulsion against a gram-negative and gram-positive bacterial strain. This approach provides valuable insights into the potential of the nanoemulsion to combat a diverse range of bacterial pathogens. Further investigations will explore the mechanism of action of these nanoemulsions against bacteria.

Keywords: Essential oil, Nanoemulsion, Antibacterial, Antibiotic resistance, Therapeutics

References:

1. Garcia, C. R., Malik, M. H., Biswas, S., Tam, V. H., Rumbaugh, K. P., Li, W., & Liu, X. (2022). Nanoemulsion delivery systems for enhanced efficacy of antimicrobials and essential oils. Biomaterials Science, 10(3), 633-653.
2. Lu, W. C., Huang, D. W., Wang, C. C., Yeh, C. H., Tsai, J. C., Huang, Y. T., & Li, P. H. (2018). Preparation, characterization, and antimicrobial activity of nanoemulsions incorporating citral essential oil. Journal of food and drug analysis, 26(1), 82-89.

Increasing Bioavailability of an Antioxidant Through Nanotechnological Approach

Harpreet Kaur [1,2] , Amitabha Acharya [1,2], Sudesh Kumar Yadav [1,2]

[1]Biotechnology Division, CSIR-Institute of Himalayan Bioresource Technology, Palampur (H.P.) 176061, India

[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad – 201002, India

Abstract

Antioxidants are compounds that combat free radicals and reduce oxidative stress. These free radicals are unstable molecules capable of damaging cells, which may result in various health issues. Low bioavailability results in suboptimal concentrations of the active antioxidant molecules reaching their intended cellular targets, thus diminishing their potential to mitigate oxidative stress. High molecular weight, poor aqueous solubility and presence of efflux transporters are some of the factors contributing to low bioavailability of some molecules. Nanotechnology presents multiple cutting-edge strategies such as nanoencapsulation, nanoemulsions, nanostructured lipid carriers, self-emulsifying drug delivery systems, mesoporous silica nanoparticles to improve the bioavailability of biomolecules with low solubility. These advanced techniques leverage nanoscale structures and phenomena to overcome the limitations associated with poor bioavailability. We have carried out solubility analysis of a lipid soluble antioxidant using different solvents (DMSO, DMF, acetone, alcohol, ethyl acetate etc.) and developed HPLC method for its quantification. We have also characterised the pure molecule using spectroscopic techniques including UV-Visible spectroscopy, Fluorescence spectroscopy and Fourier transform infrared spectroscopy. We will employ a nanotechnological encapsulation method to incorporate this molecule into a nanocarrier system. Subsequently, we will conduct comprehensive characterization studies to evaluate and quantify the changes in its physicochemical properties, bioavailability and biological performance.

Keywords: Antioxidants, bioavailability, solubility, oxidative stress, nanoencapsulation.

References:

1. Williams, Hywel D., et al. "Strategies to address low drug solubility in discovery and development." Pharmacological reviews 65.1 (2013): 315-499.
2. Bhalani, Dixit V., et al. "Bioavailability enhancement techniques for poorly aqueous soluble drugs and therapeutics." Biomedicines 10.9 (2022): 2055.

Bio-conjugated functional fluorescent metal nanoparticles targeting glioblastoma

Rahul Bhardwaj[1,2], Amitabha Acharya[1,2]

[1]Biotechnology Division, CSIR-Institute of Himalayan Bioresource Technology, Palampur (H.P.) 176061, India

[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad – 201002, India

Abstract

Glioblastoma (GBM) is the most prevalent and aggressive primary cancer of the central nervous system (CNS), with a high mortality rate. Patients with this disease have a poor prognosis, with a median survival time of less than two years. Therapeutic efficacy in GBM has been restricted due to the cancer's heterogeneity, the presence of an immunosuppressive tumor microenvironment (TME), and the blood-brain barrier (BBB), which hinders therapeutic molecules from reaching the CNS. Nanoparticles (NPs) developed to treat GBM are an efficient method for improving current therapies by increasing brain delivery of active compounds while lowering off-target effects. In particular, NPs have a strong potential for the targeted transport of therapeutics over the BBB, specifically to GBM cell receptors, pathways, or the TME. They improve drugs bioavailability by increasing blood retention time, lessening toxicity, and enhancing site-specific targeting. Combinational therapies for GBM may benefit from nanotechnology-based drug delivery approaches such as nano-chemotherapy, nano chemotherapy-radiation, nano-chemotherapy-phototherapy, and nano-chemotherapy immunotherapy. Such a synergy may have a potent therapeutic effect on GBM. Inspired by nanoparticles ability to cross the BBB. We synthesized a metal nanoparticle capped with an aromatic amino acid and characterized it using spectroscopic and microscopic techniques such as fluorescence spectrophotometer, absorbance spectrophotometer, Fourier transform infrared spectroscopy (FTIR), transmission electron microscope (TEM), X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS). Further, we will attach a bioactive molecule to the nanoparticle surface and evaluate the anti-cancer properties of the synthesized bioconjugate. We hypothesized that bioactive moiety would recognize the alteration pattern on GBM cells and act as a site-specific targeting bioconjugate.

Keywords: Glioblastoma, Blood-brain barrier, tumor microenvironment, central nervous system .

References:

1. Gregory, Jason V., et al. "Systemic brain tumor delivery of synthetic protein nanoparticles for glioblastoma therapy." Nature communications 11.1 (2020): 5687.
2. Barzegar Behrooz, Amir et al. "Nanotechnology-Based Combinatorial Anti-Glioblastoma Therapies: Moving from Terminal to Treatable." Pharmaceutics vol. 14,8 1697. 15 Aug. 2022, doi:10.3390/pharmaceutics14081697

Chalcogenide based Thermoelectrics: A window from history to future

Isha Sihmar, Neeru Chaudhary
Department of Physics, Panjab University, Chandigarh, 160014, India

Abstract

Thermoelectric (TE) materials offers a sustainable solution for energy generation and waste heat recovery. Chalcogenides, encompassing compounds of sulfur, selenium, and tellurium have gained significant attention as TE materials due to their remarkable ability to convert heat into electrical energy. This work delves into the fundamental properties and recent advancements in the development of chalcogenide-based TE materials. We investigate the intrinsic electronic structure, lattice dynamics, and defect chemistry that contribute to their high TE performance. Key strategies to enhance their efficiency, such as doping, nanostructuring, and alloying, are critically analyzed. Through comprehensive experimental studies and theoretical modeling, we identify the mechanisms by which chalcogenides achieve low thermal conductivity and high electrical conductivity, essential for superior TE performance. Additionally, this work explores the potential of novel chalcogenide compounds and their composites, highlighting the latest synthesis techniques and characterization methods. The implications of these findings for practical applications in energy harvesting, waste heat recovery, and cooling technologies are discussed. Our results demonstrate that with targeted material design and engineering, chalcogenides hold immense promise for next-generation TE devices, paving the way for efficient and sustainable energy solutions.

Keywords: Thermoelectric, Chalcogenide, electronic structure.

MXenes: Synthesis, Properties, and Applications in Advanced Energy Storage Technologies

Sahil Jangra[1], Bhushan Kumar[2], Jaishree Sharma[1], Subhankar Das[2], M.S. Goyat[1, 3]
[1]Department of Applied Science, School of Advanced Engineering, UPES, Dehradun-248007, India
[2]Department of Mechanical Engineering, School of Advanced Engineering, UPES, Dehradun 248007, India
[3]Mads Clausen Institute, NanoSYD, University of Southern Denmark (SDU), Denmark

Abstract

MXenes have emerged as highly promising materials in the field of advanced energy storage technologies, owing to their distinctive properties and versatile applications. This review offers a comprehensive analysis of MXenes, focusing on their synthesis methods, fundamental properties, and applications in rechargeable batteries and supercapacitors. In response to increasing global energy demands, MXenes present compelling solutions due to their exceptional electrical and electrochemical characteristics. These include high conductivity, large surface area, hydrophilicity, and a unique two-dimensional structure comprising metal carbides, nitrides, and carbonitrides. Additionally, this review incorporates a detailed bibliometric analysis using computational tools such as VOSviewer, which examines the global landscape of MXene research spanning from 2012 to 2024. This analysis identifies collaborative trends among different countries, institutions, authors, and journals, highlighting leading research areas. Overall, this review underscores the significant potential of MXenes in advancing energy storage technologies. It provides insights into future research directions and practical applications that could effectively meet the growing energy demands driven by electric vehicles and portable electronics.

Keywords: MXene; 2D materials; Energy storage; Supercapacitor; bibliometric.

State-of-the-Art Developments in MXenes: A Comprehensive Review

Bhushan Kumar[1], Sahil Jangra[2], M.S. Goyat[2,3c], Subhankar Das[1]

[1]Department of Mechanical Engineering, School of Advanced Engineering, UPES, Dehradun, Uttarakhand-248007, India

[2]Department of Applied Science, School of Advanced Engineering, UPES, Dehradun, Uttarakhand-248007, India

[3]Smart Materials, Mads Clausen Institute, University of Southern Denmark, Alsion 2, Sønderborg 6400, Denmark

Abstract

In recent years, two-dimensional (2D) materials have garnered significant attention due to their unique properties and potential applications in a wide range of applications. Among these materials, MXenes, a family of transition metal carbides, nitrides, and carbonitrides, have emerged as a prominent class of 2D materials with remarkable structural, electrical, thermal, optical, mechanical, and chemical properties. This review explores recent advancements in the synthesis techniques, properties, and diverse applications of MXenes in energy storage, electromagnetic interference (EMI) shielding, sensors and environmental applications. Additionally, it provides a bibliometric overview, analyzing 10,957 research papers to assess global scientific trends and future research directions using Web of Science (WOS) data and VOSviewer software. This review aims to provide a comprehensive understanding of the state of-the-art developments in MXene technology, offering insights into future directions and potential advancements in this rapidly evolving field.

Keywords: 2D materials; MXenes; selective etching; applications; bibliometric analysis.

Optical Analysis of Single- and Double-Layer Thin Film Using Nickel and Chromium Transition Metal as a Neutral Density Filter

Mini Yadav[1], Ajay Shankar[1], Sandeep Yadav[2], Mamta Rani[1]
[1]Dept. of Physics, Guru Jambheshwar University of Science &Technology, Hisar-125001, Haryana, India
[2]Dept of Physics, Choudhary Charan Singh Haryana Agriculture University, College of Agriculture Bawal-123501, Rewari Haryana, India

Abstract

Nickel, Nichrome and Cr/Ni double layer thin film with optimum thickness 10nm was fabricated using E-Beam evaporation coating system at same deposition parameter. The deposition was operated in a high vacuum environment (5×10^{-5} mbar) on the borosilicate glass substrate. The optical analysis was done using UV-Visible spectrophotometer (LAMBDA 750 (Perkin Elmer) with step of 1nm in the visible range of spectrum. The transmittance data were used to calculate the optical density of filter. The optical density of Cr/Ni double layer was found to be higher than another sample i.e. 0.84 and has more neutrality i.e. ΔOD = 0.06. The variation in transmission of Nickel, Nichrome and Cr/Ni was 7%,5% and only 2% respectively. The transmittance was uniform throughout the visible range. The optical parameter such as refractive index and extinction coefficient were derived from the reflectance and absorbance data. From AFM analysis it was depicted that surface roughness and RMS value were also decreases with double layer of transition metal for stable and durable Neutral Density Filter (NDF). The reduced roughness indicates that there is no loss of scattering of light in the filter. The topographical analysis of thin films was confirmed that uniform and smooth coating was achieved.

Keywords: Optical parameter, Thin film, Transmittance, Surface roughness, NDF.

Preparation of Mesoporous CuO Nanoparticles: Structural and Optical Properties

Avinash Kumar Patel, Shilpi Banerjee
P.G. Department of Physics, Magadh University, Bodh Gaya

Abstract

CuO nanoparticles with disordered mesoporous structure were prepared and characterized in this work. CuO nanoparticles were synthesized using a simple and facile soft template method. The morphology and microstructure of the CuO nanoparticles were characterized using powder x-ray diffraction pattern (XRD), transmission electron microscopy (TEM) and N_2 adsorption-desorption isotherm. The optical property of the specimen was investigated by carried out UV–Vis absorption studies and room temperature photoluminescence (PL) measurement. From the study of UV–Vis spectrum of the prepared CuO nanoparticles, a blue shift in the absorption band was found. This was explained due to the quantum confinement effect. The photoluminescence spectrum of the prepared CuO consists of two overlapping peaks after excitation at 428 nm. This was ascribed due to presence of some defect states in the mesoporous structure of CuO nanoparticles.

Keywords: Nanoparticle; Mesoporous: CuO: Optical Property.

Enhanced dielectric and optical properties of PVDF/$(LaBiFeO_3)_{0.5}$ $(BaTiO_3)_{0.5}$ composite films

Saurabh Prasad[1], B. N. Parida[1], R. K. Parida[2]

[1]Department of Physics, Central Institute of Technology, Kokrajhar (Deemed to be University, MHRD, Govt. of India), BTR, Assam-783370

[2]Department of Physics, Siksha O Anusandhan University (Deemed to be University), Khandaigiri, Bhubaneswar-751030

Abstract

The study presents the synthesis and comprehensive characterization of (1- x)PVDF/(x)LaBiFO-BTO composite films, where x varies as 0.05, 0.1, and 0.15, prepared through the solution casting method. X-ray diffraction (XRD) analysis confirmed the presence of various PVDF phases (α, β & γ), while Fourier Transform Infrared (FTIR) spectroscopy validated the existence of distinct vibrational modes associated with these phases. Surface morphology and roughness, evaluated using Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM), demonstrated an increase in roughness proportional to the LaBiFO-BTO concentration. Optical absorption spectra were used to determine the direct and indirect bandgap energies of the composites by applying Tauc's relation, revealing a decrease in bandgap with the addition of LaBiFO-BTO from 0 to 15 wt%, alongside an increase in Urbach energy. Dielectric measurements indicated a significant enhancement in the dielectric constant at lower frequencies with the 15 wt% LaBiFO-BTO. Dielectric loss was found to decrease with higher filler concentrations in the frequency range of 1 kHz to 1 MHz. Impedance spectroscopy results displayed a distinctive semicircular pattern, indicating specific conduction mechanisms within the composites. AC conductivity analysis, interpreted via Nyquist plots, provided insights into the conduction processes. These findings underscore the potential of LaBiFO-BTO/PVDF composites in applications requiring high dielectric constants and improved electrical properties.

Keywords: PVDF composites; SEM; AFM; FTIR; UV-Vis spectroscopy; Dielectric & Impedance.

Recent Techniques to Identify Round Spermatid Injection in Azoospermic Male Sheep Model

Alshifa Memon, Priyanka Singh
Department of Biotechnology, Nims Institute of Allied Medical Science and Technology, NIMS University (Rajasthan), India, 303121

Abstract

Testicular biopsies has been commonly used for investigation of process of round spermatid injection (ROSI) in an azoospermic male sheep model. In current scenario, advance techniques like flow cytometer, RT-PCR, electrophoresis has been also effectively used for its investigation. For these study, Azoospermia was firstly induced in mature male sheep using chemical and/or surgical methods, followed by testicular biopsies to obtain spermatogenic cells. Enzymatic digestion was used to isolate spermatids, which were then sorted using flow cytometry based on size, granularity, and specific surface markers. The isolated spermatids were further identified through morphological evaluation under a phase-contrast microscope and RT-PCR analysis. Electrophoresis further validated the genetic integrity and potential developmental competence of the selected spermatids. These round spermatids were injected into oocytes retrieved from female sheep via intracytoplasmic injection, and the fertilization rates and subsequent embryo development were monitored. Flow cytometers has allowed for the precise isolation of a high-purity spermatid population. Genetic composition and functional characteristics were further studied using RT-PCR and electrophoresis techniques. This ROSI procedure had resulted fertilization rate of XX%, with YY% of injected oocytes progressing to the blastocyst stage. These outcomes align with studies conducted in rodent and primate models, highlighting the feasibility of ROSI in larger mammals such as sheep. This study emphasizes the crucial role of advanced molecular and cytological techniques in optimizing ROSI procedures for potential clinical application in treating male infertility.

Keywords: Azoospermia, Round spermatid injection, Male sheep model, Flow cytometer.

Polarization Phase Shifting Interferometery as an application of 2-D Refractive Index Distribution of liquids

Mamta Rani, Ajay Shankar, Sujata Sanghi, Mini Yadav
Department of physics, Guru Jambheshwar University of Science & Technology, Hisar-125001

Abstract

An alternative method for the measurement of 2-D refractive index distribution of mixed liquid (water, acetic acid, toluene, glycerin) based on the combination of polarization phase shifting interferometry (PPSI) using Twyman- Green and total internal reflection (TIR) is presented. Achievement of the present technique is that measured phase using TIR is independent of sample thickness .The s-polarized light strikes the boundary of a right angle prism and a tested liquid droplet. When TIR occurs on the interface, the incident light has a phase variation which depends on the refractive index of adhered liquid on prism surface. Two dimensional index distributions can be easily calculated using the Fresnel's relation among reflection phase shift difference and the liquid index with assumption that refractive index of air near prism surface is constant. The results of the tested mixed liquid by proposed techinque shows the refractive index and its distribution in range 1.4336±0.02 to 1.4336±0.08.

Advancements and Applications of Rare Earth-Doped Phosphors: A Review

Kanishk Poria[1], Sanjana Bhatia[1], Nisha Deopa[2], Jangvir Singh Shahi[1]
[1]Department of Physics, Panjab University, Chandigarh-160014
[2]Department of Physics, Chaudhary Ranbir Singh University, Jind-126102

Abstract

The review article examines advancements in RE-doped phosphors, focusing on synthesis, luminescence properties, and technological applications. It begins by highlighting the evolution of luminescent materials, noting the efficiency, eco-friendliness, and reliability of solid inorganic phosphors compared to traditional lighting sources. RE ions like cerium (Ce), europium (Eu), and terbium (Tb) are essential activators and sensitizers, enabling optical transitions crucial for luminescence. The paper details how different host lattices—aluminates, oxides, phosphates, silicates, and sulfides—influence these transitions, affecting phosphor efficiency and stability. Mechanisms behind photoluminescence, electroluminescence, and cathodoluminescence are explored, with emphasis on selecting suitable host matrices and engineering crystal phases to optimize luminescence. Factors such as structural arrangement, chemical composition, and activator-host coupling are identified as critical for enhancing emission spectra and performance. Beyond white light-emitting diodes (WLEDs), the review highlights applications in field emission displays, 3D display technologies, luminescent paints, safety indications, and agriculture. In agriculture, phosphors enhance photosynthesis and improve crop yields when used as light conversion agents in greenhouse films. The authors underscore ongoing research to develop efficient, sustainable phosphors for clean energy technologies, acknowledging that while significant progress has been made, further advancements are needed for broader commercial and technological applications. This will contribute to environmental sustainability and economic benefits. Overall, the review provides a comprehensive overview of RE-doped phosphors, discussing their preparation, properties, and potential applications, and emphasizing the importance of continued research and development in this field.

Keywords: Rare earth; Phosphors; Luminescence.

A Novel Approach to Design Combinational Digital System Blocks (Demultiplexer and Encoder) based on Reversible Logic Gates

Indranil Maity[1], Archy Dey[2]

[1]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM), Kolkata, University of Engineering and Management (UEM), Kolkata

[2]Department of Electronics and Communication Engineering (ECE), Institute of Engineering and Management (IEM), Kolkata

Abstract

The present paper focuses on the implementation of two vital combinational digital systems viz. demultiplexer and encoder following some new design approaches with the help of reversible logic gates (one to one correspondence between I/P-O/P vectors). The proposed designs were hybrid in nature having different reversible logic gate (RLG) components compared to unitary RLG element. The entire simulations were performed using Verilog hardware description language in Xilinx Vivado 2018.2 simulator. Here, the investigation was performed on (i) designing of 1:4 demultiplexer (demux) using two NFT (New Fault Tolerant gate) RLGs (with 3 I/Ps and 3 O/Ps parity level), and one TKS RLG with the same 3*3 parity level. While, the second one was the implementation of 8:3 encoder using seven URG RLGs (with 3*3 parity level) and one Twin SJ RLG (with 5*5 parity level). The first configuration (1:4 demux) comprised of two gate level (GL) stages, where the first GL stage consisted of one TKS RLG, and the second GL stage had two NFT RLGs, thus the overall design had three number of RLGs. Moreover, the second configuration (8:3 encoder) consisted of three numbers of GL stages, where the initial stage contained of two URGs (universal reversible gates) and one Twin SJ RLG. Additionally, the second and third GL stages comprised of three URGs, and two URGs, respectively. Hence, the design had total eight number of RL gates. The following key parameters were computed here for both the considered cases (i.e., demux and encoder) viz. ancilla inputs, garbage outputs, quantum cost, and hardware complexity. It was observed that the first configuration had three number of garbage outputs, while the second case had fifteen garbage outputs. All the results were analyzed to compare the performance metrics against the existing reversible systems. Implementation of such kind of combinational logic circuits are of great use in different critical applications like communication systems, serial to parallel converters, optical computing, quantum computing along with an aim of minimal heat dissipation, and low power consumption.

Keywords: Demultiplexer, Encoder, Reversible logic gates, Verilog, Garbage outputs, Quantum cost.

Unveiling the Potential of a Novel Inorganic Perovskite for NTC Thermistor and Multifunctional Applications

Harshavardhan Chouhan, B. N. Parida
Department of Physics, Central Institute of Technology, Kokrajhar (Deemed to be University, MHRD, Govt. of India), BTR, Assam-783370

Abstract

The inorganic perovskite-oriented material displays remarkable multifunctional characteristics, with some reported to exhibit multiferroic properties. In this study, a novel inorganic perovskite material (Ni0.5 Sm0.5FeO3)0.5(BaTiO3)0.5 was synthesized. The structural/micro-structural investigation reveals some vital information like formation of phase, influence of different dimensional grains etc. towards the multifunctional feature. The investigating sample is found to possess dual phase formation of the compound, with the cubic phase belonging to space group P m -3 m making up 99.51% of the composition, while the remaining 0.49% corresponds to the cubic phase of space group F d -3 m symmetry. Using a scanning electron microscope (SEM), the morphology of the sample was examined. Using ImageJ software, the average grain size was calculated to be 461 nm. Some prominent modes of the sample are identifies through FTIR analysis. The properties of the dielectric material, as well as related characteristics, were assessed over varying frequencies and temperatures using an impedance analyzer (LCR meter). Room temperature dielectric investigations suggest potential applications in storage. For NTC thermistor applications, the thermistor coefficient (β) and sensitivity factor (α) were evaluated by fitting data from the resistance variation with temperature graph.

Keywords: Inorganic perovskite; SEM; NTC-Thermistor; Multiferroic.

Spectral characterization of nanorod structured polypurrole-nickel oxide polymer nanocomposites

N. Dhachanamoorthi[1], K.Oviya[2], Sathish Sugumaran[3], Bhakyalatha M[4], P. Suresh[5], K.C. Sekhar[6], K. Kamakshi[4]

[1]Department of Physics, Vellalar College for Women, Erode, Tamilnadu, India
[2]Research Scholar, Department of Physics, Vellalar College for Women, Erode, Tamilnadu, India
[3]Department of Physics, MVJ College of Engineering (Autonomous), Affiliated to Visvesvaraya Technological University, Bangalore, 560067, India
[4]Indian Institute of Information Technology, Tiruchirappalli, 620 015, India
[5]Department of Physics, Erode Arts and Science College, Erode- 638 009
[6]Department of Physics, School of Basic and Applied Sciences, Central University of Tamil Nadu, Thiruvarur, 610 005, India

Abstract

The nanocomposites composed of Polypyrrole and one of the proposed nano metal oxides namely, Nickel oxide (PPy-NiO) is prepared employing mechanical mixing method. Properties of the prepared organic/inorganic nanocomposites were characterized by different techniques such as FT-IR, UV-Vis, XRD, TGA-DSC, SEM and EDAX, which demonstrated a strong interaction between PPy and NiO. The functional absorptions emerged in the observed FTIR results confirmed the existence of PPy and the interactions of NiO in the obtained PPy-NiO nanocomposites. The FT-IR spectrum reveals the significant variations, the intensity as well as the sharpness of the peaks was observed at N-H stretching (3273.38 cm^{-1}) and C-H stretching (2910.23 cm^{-1}) vibrations. These vibrations were pronounced only at higher concentration (100 wt.%) of metal oxide and it attributes due to the higher degree of interaction between these groups and NiO molecules. In UV-Vis results, the distinct peaks of PPy were found at 473 and 931nm in the absence of NiO. However, while increasing the NiO content as 25 wt.%, two distinct absorption peaks were emerged at 416 and 953nm. It confirms the change in energetic position π-π^* and this electronic transition indicates the strong interaction of polypyrrole with NiO. From the XRD analyses, the decrease in crystallite size and the peak intensity was observed with increasing the dopant concentration (50 wt.%) of NiO nanoparticles. The weight loss pattern of PPy-NiO was conformed from TGA-DSC data that NiO nanoparticles are encapsulated by polypyrrole. The SEM photograph shows that the pure PPy has bulky and porous appearance whereas, the morphology of the PPy-NiO nanocomposites are found to be densely packed nanorods in nature. The EDAX result reveals that the decreasing content of carbon particles and increasing content of nickel particles as the composition of PPy-NiO nanocomposites changes. The optical application material is conformed by the photocatalytic activity that suggested the best results.

Keywords: Polymer nanocomposites; Polypyrrole; Photocatalytic activity; Thermal Properties; Hybrid Composites.

Structural and Photoluminescence Properties of Eu^{3+} doped $BaZrO_3$ Phosphors: Effect of two synthesized temperatures

Leela Kumari, A. K. Choudhary
Department of Physics, Gram Bharti College, Ramgarh (Kaimur), 821110 Bihar
(A Constituent Unit of V. K. S. U. Ara, Bihar, India)

Abstract

In this work, the down conversion (DC) behaviour of Eu^{3+}(1, 3, 5, 7, 9, 10 &12 mol%) ions doped in $BaZrO_3$ have been investigated. The samples were synthesized by solid state reaction method. All prepared phosphor samples were heated at two different temperatures (i.e., 873K & 1473K). The samples were structurally and morphologically characterized by x-ray diffraction (XRD) and scanning electron microscope (SEM) measurements. The vibrational behaviour of the phosphor samples was investigated by Fourier transform infrared (FTIR) measurements. All the phosphors emit intense red emission at 595 nm ($^5D0 \rightarrow {}^7F1$) & 613 nm ($^5D0 \rightarrow {}^7F2$) transition of Eu^{3+} ion under the excitation with 296, 314, and 393 nm wavelength. The PL emission intensity at 595 nm and 613 nm are increased with increasing Eu^{3+}concentrations. PL emission intensity is optimized at concentration of 9mol%Eu^{3+} ions and further emission intensity decreased at higher concentration. Simultaneously, emission intensity of defect level decreased. This material can be a potential red emitting phosphor for UV-based white LED and other display devices.

Keywords: Photoluminescence; Zirconate; Solid state reaction, red emission; Europium ion.

References:

1. T. Ghrib, A.Ben Ali, F. Ercan, M.H.A. Mhareb, S.Y. Al-muteliq, I. Ercan, O. Kaygili, M.kh. Hamad, N. Sfina, M. Mhiri, M.Y. Alqahtani, M. Younas. Structural, optical, photoluminescence and radiation-shielding investigation of Magnesium doped Barium Zirconate ($BaZrO_3$) ceramics. Radiation Physics and Chemistry 2024, 26, 111976.
2. Moreira, M. L.; Buzolin, P. G.; Longo, V. M.; Nicoleti, N. H.; Sambrano, J. R.; Li, M. S.; Varela, J. A.; Longo, E. Joint experimental and theoretical analysis of order-disorder effects in cubic $BaZrO_3$ assembled nanoparticles under decaoctahedral shape. J. Phys. Chem. A 2011, 115 (17), 4482−4490.
3. Som, S.; Kunti, A. K.; Kumar, V.; Kumar, V.; Dutta, S.; Chowdhury, M.; Sharma, S. K.; Terblans, J. J.; Swart, H. C. Defect correlated fluorescent quenching and electron phonon coupling in the spectral transition of Eu^{3+} in $CaTiO_3$ for red emission in display application. J. Appl. Phys. 2014, 115 (19), 193101.

Biomedical Applications of Nanotechnology: applications in the field of medicine and healthcare

Sukhpreet Kaur[1], Dr. Sanjeev Kumar[2]
[1]University Institute of Teacher Training and Research, Chandigarh University, 140413, Mohali, India
[2]Department of Physics, Chandigarh University, 140413, Mohali, India

Abstract

Nanotechnology has emerged as a transformative force in the biomedical field, offering innovative solutions that span diagnostics, therapeutics, and regenerative medicine. The unique properties of nanoparticles, such as their small size, large surface area, and ability to be functionalized, make them ideal for medical applications. In drug delivery, nanoparticles can be engineered to target specific cells or tissues, improving the precision and effectiveness of treatments while reducing adverse side effects. This targeted approach is particularly beneficial in cancer therapy, where nanoparticles can deliver chemotherapeutic agents directly to tumor cells, sparing healthy tissues. In the realm of diagnostics, nanomaterial enhance the sensitivity and specificity of detection methods. Quantum dots, gold nanoparticles, and magnetic nanoparticles, for instance, are used in various imaging techniques and biosensors, enabling the early detection of diseases at the molecular level. These advancements facilitate timely intervention and improve the prognosis for patients. Furthermore, nanotechnology is making significant strides in regenerative medicine. Nanoparticles are being utilized to develop scaffolds that mimic the extracellular matrix, promoting tissue repair and regeneration. These scaffolds support the growth of new cells and tissues, offering potential treatments for conditions such as bone fractures, nerve damage, and cardiovascular diseases. The integration of nanotechnology in biomedicine also brings challenges, including concerns about the toxicity and long-term effects of nanoparticles. Addressing these issues through rigorous research and regulatory frameworks is crucial to ensuring the safe and effective use of nanomaterial in healthcare. This abstract delves into the multifaceted applications of nanotechnology in biomedicine, underscoring its potential to revolutionize healthcare and enhance patient outcomes through innovative and precise medical solutions.