High temperature dielectric and hopping mechanism of thin flexible mats of (1-x)PU/PMMA- x $(PrFeO_3)_{0.24}$-$(PbTiO_3)_{0.76}$

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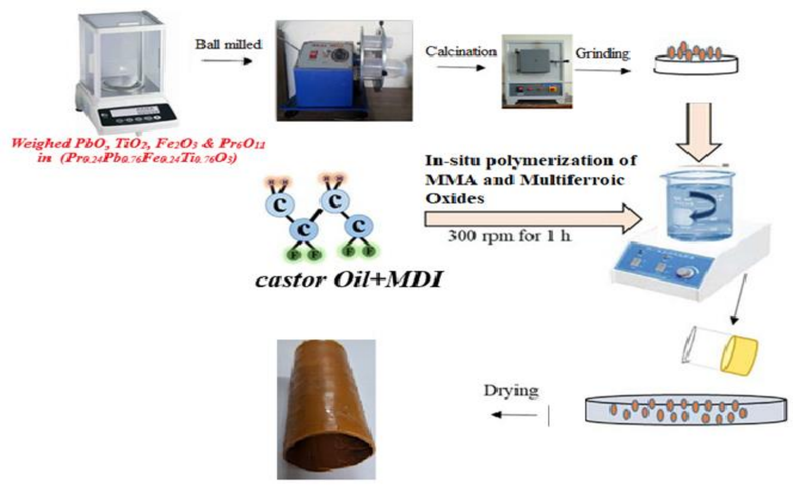
Abstract

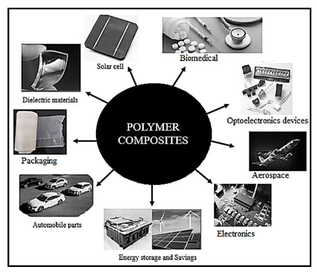
The development of high-performance dielectric materials has been a significant focus in the field of flexible electronics and energy storage devices [1-3]. Flexible electronic materials are increasingly important for a wide range of advanced technological applications, including wearable electronics, 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 and dielectric properties.

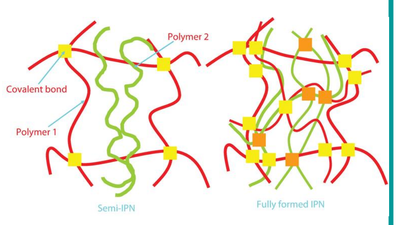
Set up



Introduction

- Materials with multifunctional properties have become potential candidates in various industrial sectors, especially the microelectronic semiconducting industry.
- In recent years, polymer-based composites of polymer-magnetic oxides have been most frequently studied because of their flexible nature.
- For multiferroism in mixed oxide perovskite, PbTiO3 is one of the most preferred parent ferroelectric perovskites due to its high ferroelectric to para-electric transition temperature (T_{cFE} ~767 K), and its enhanced ferroelectric and dielectric properties.
- . The large dielectric constant and polarization of PbTiO3 make it a promising candidate for the synthesis of multiferroic perovskites. For the synthesis of multiferroics using the mixed perovskite approach, transition metal ions have been substituted at the B-site of the ferroelectric perovskite[22-24], resulting in the establishment of magnetic properties but also increasing leakage current.
- The issue of leakage current has been addressed by using rare earth ion substitution at the Pb2+ site.

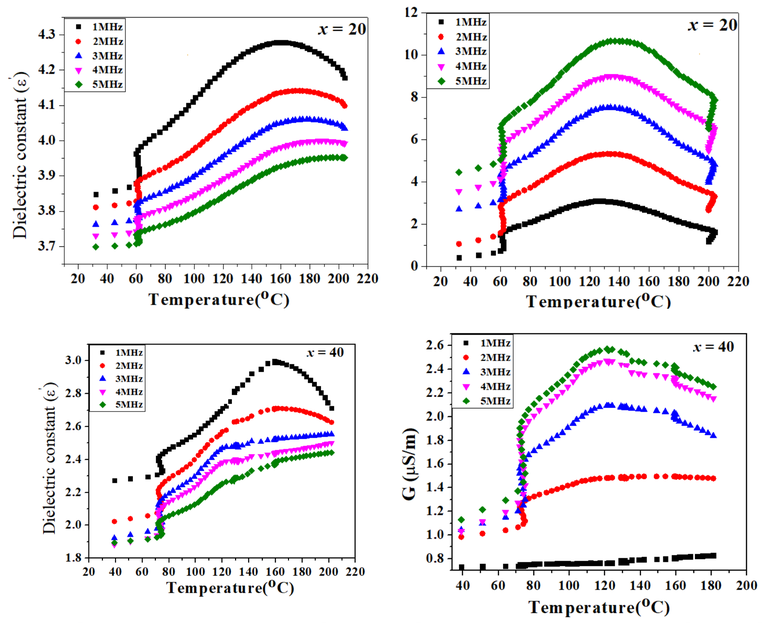




Design/Other information

- The castor oil is dehydrated at temperature 105 °C and then put over molecular sieves to avoid further hydration.
- Castor oil and Diphenyldiisocynate in 1:1 ratio by weight and stirred at 45 °C and then MMA and 0.5% BPO and 1% N,N dimethyl anilne is added.
- All solution is stirred for 45 minutes.
- The mixing of multiferroic ceramics in castor oil has been done with the help of shearing mixer and sonicator.
- Multiferroic ceramics plus oil was kept in the sonicator for four to five hours and after that high shearing mixing was done for 2-3 minutes and then again put into the sonicator.

Results



- ✓ The dielectric constant has been measured with varying temperature at fixed frequency for x = 20 & 40 %.
- ✓ It is clear from graph that behaviour of the dielectric constant is same as the conductivity with respect to temperature.
- ✓ The increase of the dielectric with temperature is due to increase of the ion conduction.
- ✓ The increase in the conductivity is due to thermal activated hoping mechanism.

Conclusions

- Flexible mats of PU/PMMA- $(PrFeO_3)_{0.24}$-$(PbTiO_3)_{0.76}$ has been successfully prepared using in-situ Polymerization.
- .
- The increase of the dielectric constant in the thin flexible mats at higher frequency is due hopping mechanism.

References

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