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

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Abstract

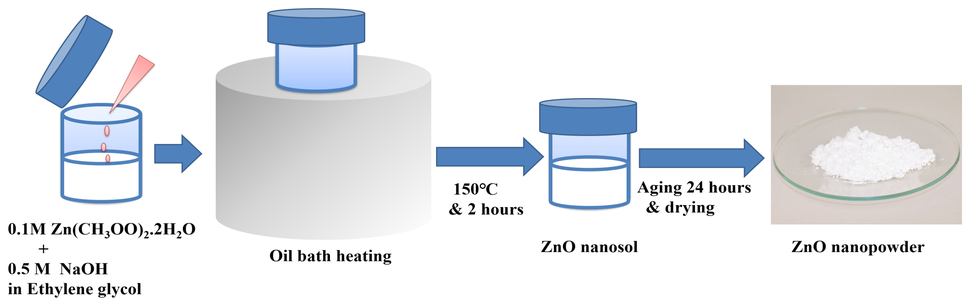
In the present work stable ZnO-ethylene glycol, ZnO-water, and ZnO-ethylene glycol-water nanofluids are synthesized using a two-step method, and their photothermal properties are studied using dual beam thermal lens techniques. ZnO-based nanofluids show better heat transfer performance compared to their base fluid.

Introduction

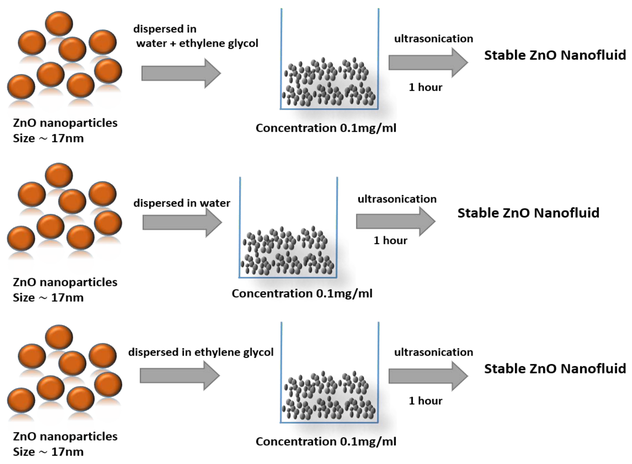
Nanofluids are currently used technique in heat transfer mechanisms. The size and shape of nanomaterials, nanoparticle volume concentration, pH, temperature, and surfactants are the key parameters for the enhanced performance of nanofluids. Thermal lensing spectroscopy is a very powerful tool for determining the change in thermal conductivity. The mechanism in the thermal lens technique is the sample absorption of optical radiation produces a temperature rise as a result of nonradiative relaxation.

Synthesis Methods

Synthesis of ZnO Nanofluid



Two-step method of ZnO-nanofluid preparation



Conclusions

The present work investigated the thermal diffusivity of ZnO nanoparticles dispersed in water, ethylene glycol, and water-ethylene glycol mixture. Thermal diffusivity is found to increase with the addition of ZnO nanoparticles. This increase is due to the phonon scattering at the interface of liquid. A significant enhancement in thermal diffusivity was observed when the ZnO nanoparticles dispersed in water-ethylene glycol mixture. This enhancement in thermal diffusivity is due to the higher stability of the nanofluid. This work suggested that ZnO nanofluid can be used as a coolant for thermoelectric devices

References

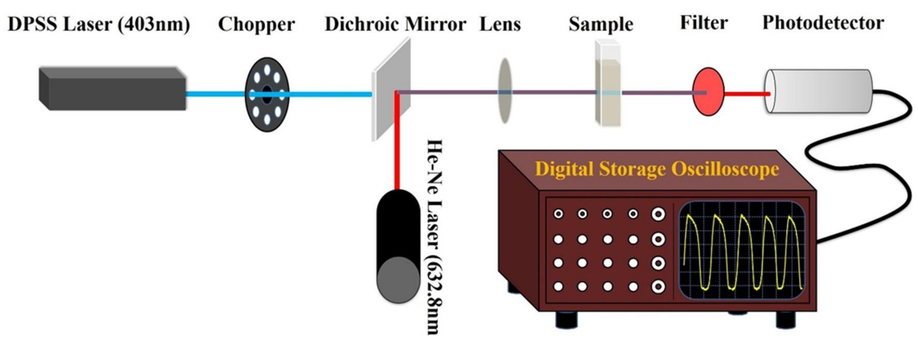
1. M. Ramya, T. K. Nideep, V. P. N. Nampoori, and M. Kailasnath, Sci. Rep., 2021, 11, 1–14.

2. Ramya M, Nideep T. K., Nampoori V. P. N., Kailasnath M, Surfaces and Interfaces, 2021, 26, 1–10.

3. M. Ramya, T. K. Nideep, V. P. N. Nampoori, and M. Kailasnath, Appl. Phys. B, 2019, 125, 1–9.

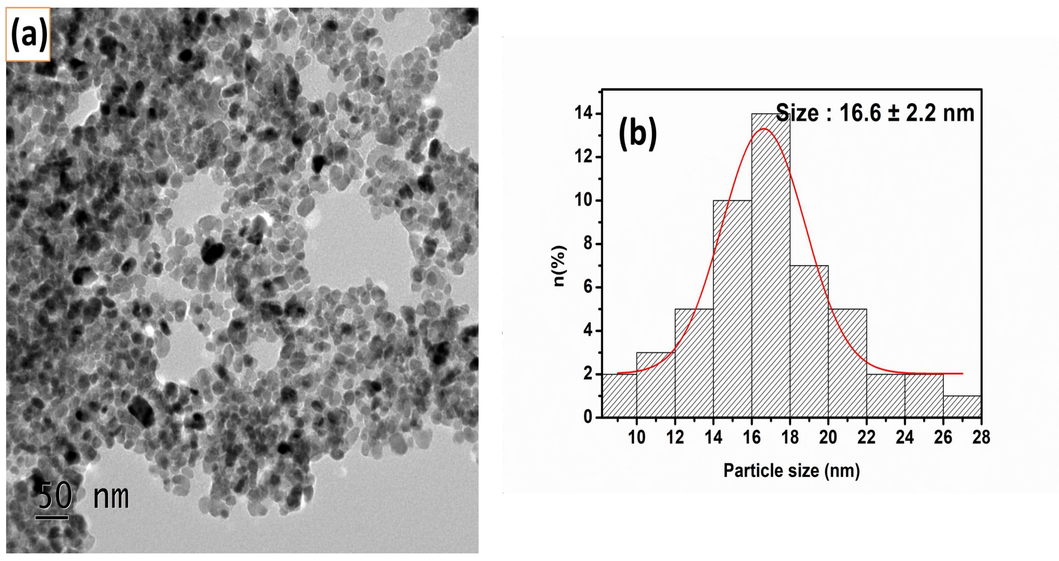
Experimental Set up

Thermal lens experimental set up

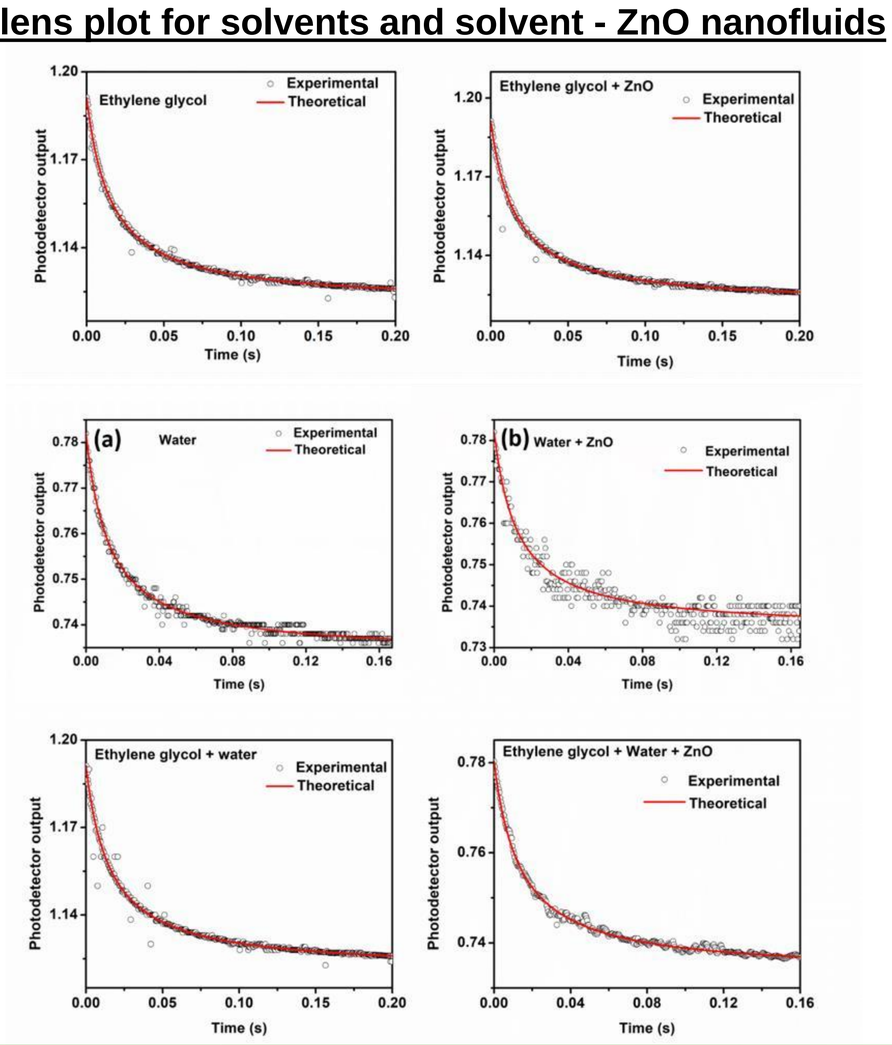


Results

TEM image and particle size distribution of ZnO nanoparticles



Thermal lens plot for solvents and solvent - ZnO nanofluids



Solvents	Thermal Diffusivity (α) × 10^{-3} cm^2/s	
	Solvent only	Solvent + ZnO
Water	1.40	1.42
Ethylene Glycol	0.96	1.06
Ethylene Glycol + Water	1.03	1.70

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