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Thermal conductivity enhancement in gold decorated graphene nanosheets in ethylene glycol based nanofluid

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ABSTRACT

We report on the synthesis and thermal conductivity of gold nanoparticles (AuNPs) decorated graphene nanosheets (GNs) based nanofluids. The GNs-AuNPs nanocomposites were synthesised using a nanosecond pulsed Nd:YAG laser (wavelength = 1064 nm) to ablate graphite target followed by Au in ethylene glycol (EG) base fluid to obtain GNs-AuNPs/EG hybrid nanofluid. The characterization of the as-synthesised hybrid nanofluid was carried out using high-resolution transmission electron microscopy (HR-TEM), scanning electron microscopy (SEM), energy dispersive X-ray (EDX), X-ray diffraction (XRD), Raman spectroscopy, Fourier transform infrared (FT-IR) spectroscopy and ultraviolet-visible spectroscopy (UV-Vis). The thermal conductivity of the as-synthesised hybrid nanofluid was measured by a guarded hot plate (GHP) apparatus at different temperatures in the range 25 – 45 ℃. The characterization of the as-synthesised GNs-AuNPs/EG hybrid nanofluid confirmed a sheet-like structure of GNs decorated with crystalline AuNPs with an average particle diameter of 6.3 nm. The thermal conductivity analysis showed that GNs-AuNPs/EG hybrid nanofluid exhibits enhanced thermal conductivity of 0.41 W/mK compared to GNs/EG (0.35 W/mK) and AuNPs/EG (0.39 W/mK) nanofluids, and EG base fluid (0.33 W/mK). The enhanced thermal conductivity of the hybrid nanofluid is due to the synergistic effect between AuNPs and graphene sheets which have inherent high thermal conductivities. GNs-AgNPs/EG hybrid nanofluid has the potential to impact on enhanced heat transfer technological applications.

KEYWORDS: Laser ablation; graphene nanosheets; Au nanoparticles; Ethylene glycol; Thermal conductivity; Nanofluid

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