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Enhanced mechanical and thermal performances of epoxy resin by oriented solvent-free graphene/carbon nanotube/Fe_3O_4 composite nanofluid

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Abstract：In this work, we report a simple strategy for improving the mechanical and thermal performances of epoxy resin using a novel magnetic composite nanofluid as filler. The magnetic nanofluid, composed of multicomponent core of graphene oxide (GO)/carbon nanotube (MWCNTs)/Fe_3O_4 (GMF) and shell of polyether, is fabricated via a combination of ultrasonic assisted chemical coprecipitation process and post-modification. Subsequently, epoxy/GMF composite is prepared under magnetic field, in which the GMF nanoparticles are well dispersed in the epoxy resin matrix without obviously agglomeration and exhibit a directional arrangement along magnetic field. i.e., the GO sheets are induced to align parallel to the magnetic field direction, and the MWCNTs are uniformly dispersed on graphene sheets with the orientation along magnetic field, Fe_3O_4 nanoparticles are further encapsulated on GO/MWCNTs composites to form GMF core. The orientation degree of GMF is enhanced with an increase in the magnetic field strength. The results indicate that the Tg of composite material increases by 17 ℃ with increasing of GMF content. Moreover, the impact and bending performances of epoxy resin are apparently enhanced by 136.5% and 30.9% with the 1.5 wt% of oriented GMF nanofluid at 0.6 T. In addition, the epoxy/GMF composite exhibits an anisotropy in the thermal conductivity.