Enhancing Thermal Conductivity of Liquid Crystalline Epoxy Resin with Graphene Fillers and an Anionic Initiator

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Abstract

Liquid crystalline epoxy resin (LCER) featuring improved thermal conductivity of up to 3.14 Wm-1K-1 is developed by incorporating graphene as the filler. Anionic initiator, 1-methyl imidazole (IMI) is employed as the promoter for the ring opening polymerization of oxirane groups to afford LCER with microscopically aligned liquid crystal mesogens that exhibit more ordered structures than amine cross-linked LCER. Because of the lower phonon scattering, such that lattice vibration predominately transfers through the ordered liquid crystal structure, a significant improvement in the thermal conductivity of the resultant LCER is achieved. Specifically, the thermal conductivity of our newly synthesized LCER is 40% higher than the amine cross-linked LCER. Furthermore, the thermal conductivity of anionic-polymerized LCER composition contained 80 wt% alumina and 1 wt% graphene was 3.14 Wm-1K-1 , which was 175% higher than amine cross-linked LCER. The higher-ordered aligned structure of the anionic-polymerized LCER on the thermal conductivity was then investigated systematically with differential scanning calorimetry, X-ray diffraction, and thermal conductivity measurements. This new approach to synthesize LCER can be of a practical method for economical production of heat-dissipating materials.