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Re-orientation of BN nanosheet induced by pulsed electric field and its effect on thermal properties of epoxy resin-based nanocomposites

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In this study, low level of boron nitride (BN) nanosheets filler loading (5wt.%, 10wt.%) were incorporated in epoxy resin matrix to improve thermal conductivity of the nanocomposites by performing the alignment of BN nanosheets. The orientation of BN nanosheets in epoxy resin matrix are controlled by applying pulsed electric field during the curing process of epoxy resin/BN nanocomposites. The pulsed electric field has a pulse width of 1 μs, a field strength of 30 kV/mm, and a repetition frequency of 50 Hz to 50 kHz. Under the application of the pulsed electric field, the BN nanosheets are polarized and are subjected to electric field induced force, thermal motion and viscous drag. Scanning electron microscopy (SEM) and x-ray diffraction (XRD) show that the BN nanosheets are oriented parallel to the direction of the electric field. When the BN content is 5wt.%, the thermal conductivity of the nanocomposite with the application of the pulsed electric field is several times that without the pulsed electric field (0.215 W/mK). The results also show that the repetition frequency affects the thermal conductivity of the nanocomposites. The higher the repetition frequency, the higher the thermal conductivity of the nanocomposites. This paper provides guidance for the preparation of epoxy resin-based nanocomposites with high thermal conductivity at low BN loadings.

Authors: Prof. MI, Yan (Chongqing University); Ms LIU, Lulu (Chongqing University); GUI, Lu (Chongqing University); GE, Xin (Chongqing University)

Presenter: Ms LIU, Lulu (Chongqing University)

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