

Non-Fourier Thermal Conduction of Polymers and their Interfaces

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Abstract

How to dissipate excessive heat and ensure stable operation of components in relatively low temperature environments is a common problem faced by the modern semiconductor industry [1]. The heat dissipation process of chips involves an important step: heat is conducted to the heat sink through the integrated circuit. This makes it particularly important to study the heat transfer mechanism of thermal interface materials. This talk mainly focuses on the recent progresses of thermal conductivity mechanism in organic compounds and the related thermal interface materials in our group: 1 We studied the thermal conductivity and elastic modulus of polymethyl methacrylate/graphene (PMMA/Gr) nanolayered materials and found that, when the volume fraction of graphene was only 1%, the in-plane thermal conductivity of PMMA/Gr nanolayered materials could reach $8.9 \pm 0.9 \text{ W m}^{-1}\text{K}^{-1}$, with a anisotropy of 53 in thermal conductivity. Polarization infrared imaging indicates that this is due to the highly oriented graphene within the plane and the oriented arrangement of PMMA molecular chains near the graphene interface. This work reveals the re-conformation of polymer chains in graphene/polymer composites, emphasizing the regulatory role of organic conformation at the interface on the composite material [2]; 2. We investigated the anomalous heat conduction effect within the molecular chain of one-dimensional poly (methyl methacrylate) (PMA). By regulating the molecular weight of grafted PMA, we obtained a series of polymer grafted silica nanoparticles with PMA molecular chains of different lengths. The thermal conductivity of the composite film was measured, and the thermal conductivity of PMA was extracted using the effective medium theory. The divergence index $\alpha=1/2$ was obtained, confirming the anomalous thermal conduction effect within the one-dimensional molecular chain [3].

References:

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