Highly directional heat management of thermoplastic composites via the addition of graphene nanoplatelets

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Polymer composites, including nanocarbon based fillers have proven to be extremely successful in light of modern electronics due to their outstanding properties, like thermal conductivity, electrical conductivity and electromagnetic shielding (see Figure 1). The addition of graphene nanoplatelets (GNP) greatly enhances thermal conductivity (κ) of normally nonconductive polymer matrices. However, little to no interest have been given to anisotropy of κ, which can be crucial in applications that require highly directional heat management, like spacecraft heat shields [1]. Here we show the in-depth analysis of κ anisotropy (axial and radial) of low GNP loading (<15 wt%) thermoplastic (acrylonitrile butadiene styrene, ABS) composites. We observed the κ in composites with changing GNP loading, different GNP sizes and varied fabrication methods that influence the nanofiller orientation, to understand what causes the anisotropy to manifest and how can it be controlled. Finally, we report on axial and radial κ (as well as thermal diffusivity) difference by at least two times at low GNP loadings.

References

[1] Xie, Bin-Huan, Xiao Huang, and Guo-Jun Zhang, Composites Science and Technology 85 (2013): 98-103

Figures

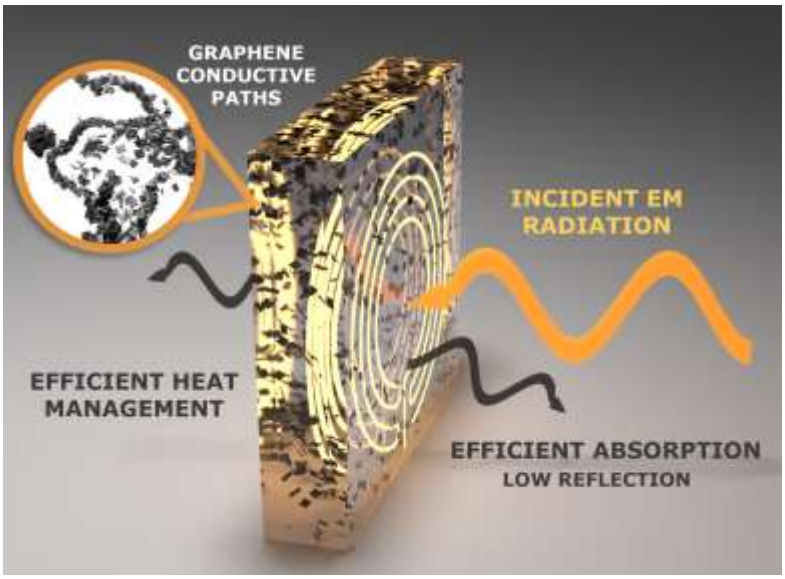

Figure 1: Schematic of a multifunctional graphene based polymer composite.