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THERMAL CONDUCTIVITY OF 3D GRAPHENE FILLED POLYMER COMPOSITES

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Summary: Graphene foam (GF), graphene sheet (GS) and carbon black (CB) were filled into polydimethylsiloxane (PDMS) to make novel polymer composites such as GF/PDMS, GS/PDMS and CB/GF/PDMS composites. Then thermal properties of those composites were investigated. The graphene foam was grown by CVD on Ni substrate. The graphene sheets were obtained by breaking GF into thin pieces under ultrasonic agitation. In this way, they have the same growth condition. GF was infiltrated with liquid PDMS, GS was mixed with liquid PDMS, while CB was dispersed in PDMS and then the mixture was infiltrated with PDMS. The curing process was same for all composites. The thermal conductivity was measured by both Laser flash and two-copper bar methods.

It is found that at 0.5 and 0.7 wt% graphene foam, the thermal conductivity of GF/PDMS composites increases from 0.40 to 0.56 Wm-1K-1, which are 200-300% that of pure PDMS, and about 20% higher than that of GS/PDMS composite. This result proves the effectiveness of interconnected network of GF on the thermal transportation inside the composites. Furthermore, the adding of CB into the space of GF network and the interior of GF arms reinforces the thermal transportation, manifested by the increased thermal conductivity with CB content.

The coefficient of thermal expansion of GF/PDMS is (80-137)×10-6/K within 25-150 oC, much lower than those of GS/PDMS composite and pure PDMS. In addition, thermal and dimensional stability of GF/PDMS composite are superior over GS/PDMS composite, and they are further improved by CB adding

In summary, all above results demonstrate that the GF/PDMS composite is a good candidate for thermal interface materials, which could be applied in the thermal management of electronic devices, etc. Besides, the addition of carbon blacks can further improve the thermal properties of composites.