Thermal and electrical properties of graphene-based thermoset composites: a study on the role of graphene nano-platelets morphology

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ABSTRACT

Graphene reinforced polymer composites show important improvements in their electrical and thermal conductivity and other thermo-physical properties, as compared to other more conventional materials [1, 2]. One of the main challenges to achieve the large-scale potential for technological and engineering applications is to achieve homogeneous dispersion of the thin graphene nano-platelets (GNPs) within the polymer matrix. In this work, a combination of various techniques has been used to prepare well-dispersed and well-performing graphene/epoxy composites, exploiting to achieve efficient mixing shear micromechanical forces with high shear-speed mixing followed by a calendering technique.

The fabrication method for epoxy composites is quite simple, based on mechanical mixing using a combination of different techniques following by casting in a metallic mould. A main advantage in this technique is the absence of volatile and harmful solvent as carrier for a filler. Two different graphene nano-platelets (GNPs), with different thickness and flake size, were added in order to analyse the influence of the size of the nano-filler: thickness and lateral dimensions. Various amounts of graphene ranging from 0% to 2% w/w were added to the composite.

Electrical conductivity measurements were performed on macroscopic samples (7 cm) and present the typical percolative behavior, with a strong dependence of conductivity on filler's morphology as shown in figure 1.

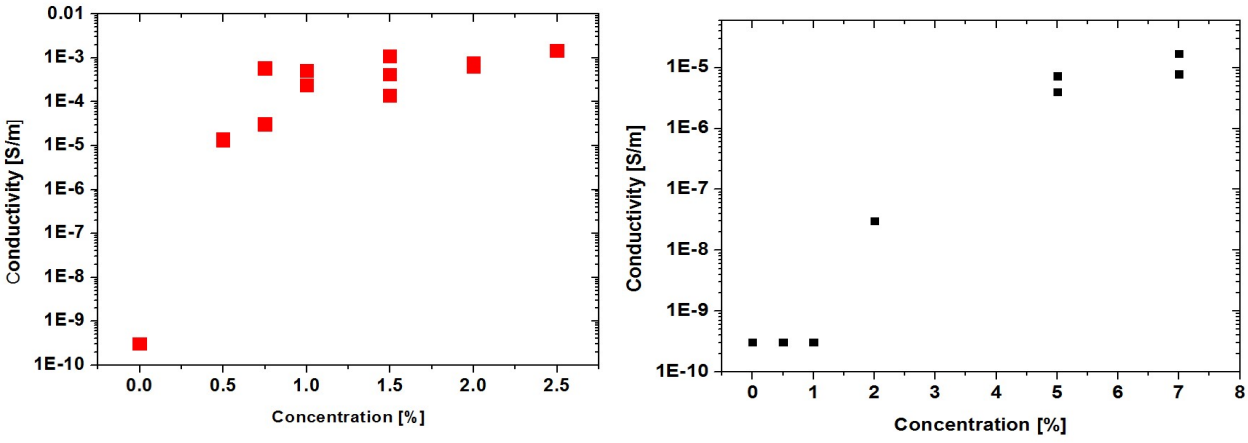

Figure 1. Electrical conductivity measurements of (A) GNP 1, (B) GNP 2

Thermal conductivity was also measured in accordance with UNI EN ISO 22007-2 by using a TPS 2500S from HotDisk AB (Sweden); the results shows an excellent improvement of the thermal conductivity for a graphene based composites.

References

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