Mechanical and Electrical properties of epoxy-graphene nanocomposites

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Abstract

Epoxy resins are polymers that harden in the presence of a catalyst. For some time ago carbon based materials have been used to improve the properties of the resin. Taking into account the outstanding properties of graphene, researchers have focused in studying which reinforcement gives better mechanical and electrical properties to the matrix. Some researchers compared graphene reinforcement with carbon nanotubes and other materials [1]. It has been proved that critical parameters in these nanocomposites are the dispersion of graphene [2] and its aspect ratio [3]. However, in electrical properties the dispersion is not so important, only a big aspect ratio helps to form the conductive path [4].

In this work the maximum stress of different nanocomposites has been measured in order to improve the production method. A method that involves a degasification process enhances the mechanical properties of the epoxy-graphene product.

Once the method has been improved, the influence of the aspect ratio has been analyzed. Here three different pristine graphenes produce by liquid phase exfoliation (G1, G2 and G3) [G1: < 100 nm XY plane, aspect ratio: 50:1; G2: 250 nm XY plane, aspect ratio 90:1 and G3: aspect ratio 8000:1; we have use the Coleman paper [5] for their characterization, and determination of number of layers and TEM, SEM and AFM for the characterization of the lateral size and thickness; the defects and type of defects [6] have been characterized using RAMAN microscopy] have been used to prepare the dogbone samples. Furthermore the samples with the highest graphene content have been electrically measured.

The influence of the aspect ratio in the electrical conductivity can be observed and it is in agreement with the electrical percolation theory [7]; moreover, in the mechanical properties it is more important presenting a good dispersion than having a graphene with a massive aspect ratio. Graphene with a higher aspect ratio is more difficult to disperse and it has a tendency to form agglomerations which act like stress concentration points.

References

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