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Heat transport in tetra-functional epoxy resin containing low percentage of exfoliated graphite nanoparticles

Carlo Naddeo
University of Salerno, Italy

Thermal management with conductive polymeric nano-composites has become a central task of industrial interest for many applications ranging from exchangers in electric and electronic systems to electronic packaging and photovoltaic devices. In order to enhance the thermal conductivity of polymeric composites there is a tendency to incorporate thermally conductive nano-fillers in the polymeric matrix. Actually the most widely used are the carbon nanotubes (CNTs) due to their outstanding mechanical, electrical and thermal properties together with a high aspect ratio and surface area. The incorporation of CNTs into the polymer matrix has significantly enhanced mechanical and electrical performance of final composite material but until now the desired enhancement in thermal conductivity has not been achieved. The aim of this work is to carry out a preliminary experimental investigation of thermal properties and heat conduction in epoxy nanocomposites prepared by dispersing low concentrations of different kinds of nanofillers, such as 1-D multiwall carbon nanotubes and 2-D predominant shape exfoliated graphite (EG) within an aeronautic resin based on a tetrafunctional epoxy precursor. For the analyzed epoxy formulations the best results are obtained using EG as nanofillers. The curing degree for the EG-based epoxy nanocomposites cured up to 200°C is very high compared to unfilled epoxy resin, reaching up to 100%. EG nanoparticles also accelerate the curing process of the epoxy resin of about 20°C and this is most likely due to better phonon conduction through carbonaceous nanostructures with predominantly two-dimensional flat shape. This is confirmed by experimental values of thermal conductivity that show an increase of 300% for 3% of Exfoliated Graphite embedded in tetrafunctional epoxy resin. In light of these results it is clearly evident the potential of 2-D graphene sheets as promising nanofillers able to meet the ambitious requirements in the thermal management for high-performance nanocomposites.

Biography

Carlo Naddeo is a Physicist currently in service at University of Salerno - Department of Industrial Engineering as Assistant Researcher. He actively collaborates in research activities related to the study of physical properties and durability of functional and structural polymeric materials and nanocomposites. As part of these collaborations, he has produced over 50 publications in international journals and more than 40 contributions at conferences.

cnaddeo@unisa.it

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