Enhancement of Epoxy properties by surfactant-assisted dispersion of nanoparticles

Michael Shtein and Oren Regev

Department of Chemical Engineering, Ben-Gurion University of the Negev, Beer Sheva 84105, Israel

Both carbon nanotubes (CNT) and graphene nanoplatelets (GNP) possess excellent electrical/thermal conductivity as well as mechanical properties, which make them ideally suited as fillers to enhance the properties of epoxy composites. However, the high aspect ratios of these objects along with the strong van der Waals (vdW) attraction between them result in CNT bundling and GNPs stacking to graphite flakes. Furthermore, the chemically inert nature of carbon-based nanofillers yields poor dispersability and weak interfacial interactions with the matrix. The present study aims at obtaining surfactant-assisted dispersion of GNPs and CNT dispersions at high concentration, 1 mg/ML, in water. The dispersion is then lyophilized and integrated in an epoxy matrix. The effect of nanofillers addition on the thermo-mechanical, mechanical and electrical properties of CNT-GNP-Epoxy nanocomposite is then evaluated. We employ a variety of surfactant-assisted exfoliation procedures to obtain a stable dispersion of GNP and CNT in water. The solution is first characterized by cryo-transmission electron microscope (CNT/water solution) where individual NT are found. The solid composite (Epoxy/CNT after hardening) is microtomed and imaged by TEM at room temperature indicating no NT aggregation. The dispersion stability and the final concentration are determined by UV-VIS spectroscopy, filtration methods and TGA. Excellent dispersions, using nonionic (polyoxyethylene octyl phenyl ether) and protein-based surfactants (β-Lactoglobulin) are obtained in both water and Epoxy.

[1] Grossiord N, Loos J, Regev O, Koning CE. Chem. Mater., **2006**, 18, 1089-99.

Toolbox for dispersing carbon nanotubes into polymers to get conductive nanocomposites

[2] Vaisman L, Wagner HD, Marom G. Adv. Coll. Interface Sci. ,**2006**,128–130:37–46

The role of surfactants in dispersion of carbon nanotubes.

[3] Geng Y, Wang SJ, Kim J. J. of Coll. Interface Sci., **2009**, 336 ,592–598

Preparation of graphite nanoplatelets and graphene sheets