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Investigation of Mechanical Properties of Epoxy-Nanocomposite Reinforced with Copper Coated MWCNTs

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Abstract : Mechanical properties of epoxy based nanocomposites containing copper coated MWCNTs were investigated and a comparative study between nanocomposites containing functionalized MWCNTs and copper coated MWCNTs which are already functionalized was conducted. The MWCNTs was deposited with copper nanoparticles through electroless deposition process after accomplishment of "two-step" method as sensitization and activation procedures on oxidized MWCNTs. In addition, functionalization of MWCNTs was carried out through combination of two covalent and non-covalent funcionalization methods using HNO3 for acid solution of covalent treatment and Triton X100 as non-ionic surfactant of non-covalent treatment. The presence of functional groups and removal of impurities of MWCNTs were confirmed by FTIR and Raman spectroscopy, respectively. The layer of copper nanoparticles on the MWCNTs wall increasing its diameter was observed by SEM. Utilizing solution blending process, 0.1%, 0.5% and 1.5% wt loading of both copper coated MWCNTs and non-coated MWCNTs were used to prepare epoxy-based nanocomposites. The tensile, flexural and impact properties of nanocomposites were investigated. The results of tensile test demonstrated that nanocomposites containing copper coated MWCNTs exhibited brittle behavior compared to those reinforced with functionalized MWCNTs, whereas former one exhibited higher values of modulus than latter one for concentrations more than 0.4% wt. Presence of copper particles on MWCNTs surface decreased the tensile strength of nanocomposites. In comparison to pure epoxy, nanocomposites with treated-MWCNTs and Cu-MWCNTs loading of 0.1% wt showed an increase of 35% and 51.6% for flexural strength beside 20% and 30% increase in flexural modulus, respectively, whereas flexural properties of both naocomposites decreased with increasing of CNTs concentration. The results of impact strength of nanocomposites with Cu-CNTs demonstrated that impact properties decreased with increasing of filler content with a optimum value at 0.1% wt while in high concentrations impact properties of Cu-nanocomposites exhibited lower values than f-MWCNT nanocomposites.

Keywords : epoxyresin, nanocomposite, functionalization, copper, electroless deposition process, mechanical properties
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