From Molecular Vibration to Mechanical Properties: The Carbon Fiber/Epoxy Nano-Modified Composites Investigation

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From the literature [1-2], it is clear that CNTs and graphene nanosheets (GN) are promising as reinforcement for nanocomposites, but the dispersion process and the cluster formation are problems to be overcome. To incorporate CNTs and graphene into composite materials it is essential to achieve their stable suspension. Due to the van der Waals forces between nanotubes and graphene sheets this structures have the tendency to form clusters/agglomerates. Although covalent chemical functionalization has been proposed to improve the dispersion of these carbon based nanostructures, this method could affect some of their properties. This paper focuses on non-covalent functionalization of CNT and graphene by employing non- and ionic surfactants. From the stiffness point of view, no significant changes were notice, however, the peak stress was affected by the carbon based nanostructures dispersion. The increase on peak stress was approximately the same for GN and CNTs, i.e. around 11 %, but in different concentrations. The GN concentration was the lowest (0.075 wt.%) while for the CNT (0.15 wt.%). This phenomenon can be explained by the Raman spectroscopy associated to the FTIR and the AFM. As discussed by Tkalya et al. [3], the increase on ID/IG peaks on Raman spectroscopy is an evidence of good interaction. The original GN ration is around 0.17, the addition of CO890 lead to an aspect ratio of 0.26. For the CNT used in this research, the ID/IG ratio was equal to 1.0, and a moderate increase on ID/IG, i.e. 1.08 was noticed with the usage of SDBS. In all cases, the interactions between CNTs/GNs and surfactants were improved. The FTIR analysis show a strong interaction between the SDBS and CNT (peaks 2922 and 2853 cm^{-1}) and between the CO890 and GN (peaks 2883, 947 and 841 cm^{-1}). These interactions can be “translated” as formation of nanostructures that are responsible to the increase on peak stress as the energy required for breaking these nanostructures is higher.

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