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Effect of the Orientation of Graphene-Based Nanoplatelets upon the Young's Modulus of Nanocomposites

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Abstract

The spatial orientation of the reinforcing elements in polymer-based composites plays a vital role in controlling mechanical properties but there is no generally-accepted way of quantifying the spatial orientation at the nanoscale of plate-like fillers in nanocomposites. A previous study found that the intensity of scattering of the Raman band is dependent on the axis of laser polarization when the laser beam is parallel to the surface of the graphene plane and demonstrated that this could be used to quantify the spatial orientation of the graphene. Based on this approach, polarized Raman spectroscopy is used here to quantify, as an example, the level of spatial orientation of graphene oxide (GO) flakes in different nanocomposites. Furthermore, the spatial orientation of nanoplatelets is quantitatively linked to the stress transfer to the reinforcement in nanocomposites and, in particular, a method for determining the Krenchel orientation factor for these plate-like fillers directly from the Raman data is