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Graphene/Polymer Nanocomposites

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Graphite has attracted large attention as a reinforcement for polymers due to its ability to modify electrical conductivity, mechanical and gas barrier properties of host polymers and its potentially lower cost than carbon nanotubes. If graphite can be exfoliated into atomically thin graphene sheets, it is possible to achieve the highest property enhancements at the lowest loading. However, small spacing and strong van der Waals forces between graphene layers make exfoliation of graphite via conventional composite manufacturing strategies challenging. Recently, two different approaches to obtain exfoliated graphite prior to blending were reported: thermal treatment (Schniepp et al., JACS 2006) and chemical modification (Stankovich et al., J Mat Chem 2006). Both start from graphite oxide. We will describe and evaluate these exfoliation approaches and the methods used to produce graphene reinforced thermoplastics, particularly polyester, polycarbonate and polyurethane nanocomposites. Three different dispersion methods - melt blending, solution mixing and in-situ polymerization – are compared. Characterization of dispersion quality is illustrated with TEM, rheology and in electrical conductivity, tensile modulus and gas barrier property improvement.