**Solvent-Free Synthesis of Epoxy/Graphene Nanocomposites**

*Jun Ma, Mohannad N. H. Al-malichi*

School of Engineering and Future Industry Institute, University of South Australia, SA 5095, Australia

The exceptional stiffness and strength of graphene hold a great potential for reinforcing and toughening polymers as well as providing new functionality – electrical and thermal conductivity. Solvents are often used to exfoliate and disperse graphene sheets in hydrophobic polymers, and such a practice is not acceptable to the existing polymer processing industry. This challenge is addressed herein by developing graphene precursor – a new graphite intercalation compound – which is able to directly exfoliate into thin platelets in hot epoxy, with no assistance of any solvent. Single-layer graphene is found by microscopy analysis, and in general these platelets have 5–9 nm in thickness and 3–14 µm in lateral dimension; as their surface is rich in oxygen-containing functional groups, these are named functionalized graphene platelets. Having a Raman *Id/Ig* ratio of 0.177, they have an electrical conductivity of 871 S/cm. A percolation threshold of electrical conductivity is observed at 0.80 vol% for their epoxy nanocomposites. The composites show highly improved mechanical and dynamic thermo-mechanical properties. At 1.03 vol%, the nanocomposite has shown fracture energy release rate of 850.78 ± 58.00 J m-2 corresponding to an increase of 170.6% over the neat epoxy. The toughness improvement is attributed to the matrix plastic deformation due to strong interfacial interaction between graphene and epoxy. This approach would inspire research community to search for solvent-free means to produce multifunctional, environmentally friendly and mechanically resilient polymer nanocomposites for varying applications.