Velram Balaji Mohan et al., Trends in Green chem 2017, 3:3
DOI: 10.21767/2471-9889-C1-005

Graphene: A promising nano-reinforcement for functional composite materials

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Graphene is a unique carbon material and its derivatives can be used as functional reinforcements in polymers for applications, such as sensors, flexible devices and functional nanocomposites. This article focuses on the preparation and characterisation of superconducting graphene derivatives and manufacturing of complex blends of primary and secondary polymers reinforced with highly conductive graphene material. The electrical conductivity can be established in conventional non-conductive thermoplastics by melt blending process through systematic approach and the right choice of additional electrically conductive components. Conducting polymers such as polyaniline-complex (PANI-complex) and polypyrrole (PPY) can be blended with thermoplastics even at higher temperatures of 280°C. Hence, hybrids of polypropylene (PP-non-polar), polymethylmethacrylate (PMMA-polar) and polyoxymethylene (POM-highly polar) as primary polymer matrices while polypyrrole and polyaniline as secondary conducting polymer matrices reinforced with graphene (G). The maximum electrical conductivity of 0.7 S/cm has been acquired with POM/PPY/G blend with 4 wt% and 3 wt% of polypyrrole and graphene loading, respectively. Furthermore, electrically conductive wires were produced using graphene particles' different fibre yarns (including natural fibres) as wires and epoxy resin as a binding material. Three different dip-coating approaches were used and electrical conductivity and morphology of the samples were investigated. By systematically varying material composition and manufacturing techniques, and applying optimisation methods, it will identify sets of coating parameters that will allow improving electrical conductivity and mechanical properties. This will demonstrate that conducting yarns can be produced using off-the-shelf technologies, inexpensive natural fibres and easily synthesisable conducting organic materials. These points are critical if graphene and reduced graphene oxide are to be produced and used in large-scale devices or bulk commercial applications.

Biography

Velram Balaji Mohan received a BTech in Polymer Technology from Anna University, India and an ME (Hons) in Materials and Process Engineering from the University of Waikato, New Zealand. He has gained a PhD from the Centre for Advanced Composite Materials (CACM) at the University of Auckland on the development of functional graphene/polymer nanocomposites. Currently, he is working as a Research Fellow at the Centre for Advanced Composite Materials (CACM) and Plastics Centre of Excellence (PCoE) at the University of Auckland, Auckland, New Zealand

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