Polymer Composites with Graphene Nanofillers: Electrical Properties and Applications

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Abstract

Graphene with extraordinary high elastic modulus and excellent electrical conductivity has good prospects for use as the filler material for fabricating novel polymer composites designed for electrostatic discharge and EMI shielding protection, field emission, gas sensor, and fuel cell applications. Large amounts of graphene oxide (GO) can be obtained by wet chemical oxidation of graphite into a mixture of concentrated sulfuric acid, sodium nitrate and potassium permanganate. Accordingly, carbon atoms in the basal plane and edges of GO are decorated with oxygenated functional groups, forming an electrical insulator. To restore electrical conductivity, chemical reduction or thermal annealing is needed to eliminate oxygenated groups of GO. However, such treatments induce internal defects and remove oxygenated atoms of GO partially. The remnant-oxygenated groups affect electrical conductivity of graphene greatly. Nevertheless, reduced graphene oxide and thermally reduced graphene oxide are sufficiently conductive to form polymer nanocomposites at very low percolation threshold. This review provides the fundamentals and state-of-the-art developments in the fabrication methods and electrical property characterizations as well as the applications of novel graphene/polymer nanocomposites. Particular attention is paid to their processing-structural-electrical property relationships.

Keywords

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