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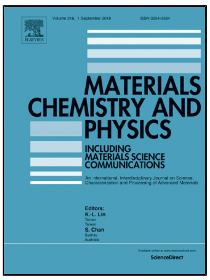

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Synthesis and characterization of graphene modified by iron oxide nanoparticles

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Abstract

The process of interaction of graphene with iron oxide nanoparticles was investigated. First, graphene oxide (GO) modified with magnetite Fe_3O_4 nanoparticles was successfully synthesized. Raman and Mössbauer spectroscopy revealed that the magnetite Fe_3O_4 in combination with GO became non-stoichiometric, and the maghemite phase γ-Fe_2O_3 appears. Subsequent reduction of graphene oxide by thermal treatment leads to an increase in the fraction of maghemite content and, in addition, the hematite phase α-Fe_2O_3 appears in the sample annealed at above 500 ^{o}C. Meanwhile, the core-shell nanocomposites of FexOy/G appear, were FexOy consists of a mixture of the Fe3O4 , γ-Fe2O3 and α-Fe2O3 phases. The content of each phase can be varied by the annealing temperature. Magnetic, Mössbauer and Raman spectroscopy measurements indicate that graphene can interact with iron oxide. Charge-transfer from iron to graphene can occur due to delocalization of 3*d* electrons, which reduces the overall magnetic moment of the charge-transfer complexes. These properties can have potential applications in electronic such as supercapacitors, advanced anode materials for lithium-ion batteries, magnetically targeted drug delivery, photothermic therapy, and magnetic resonance imaging.

1. Introduction

Graphene, like fullerene and carbon nanotubes are classified as a low-dimensional carbon structure. In the last decade, the study of various kinds of materials and composites based on graphene has been developing significantly for the purpose of their application in such fields as nanotechnology, nanoelectronics, materials science, chemistry and many others. So far, quite a number of possible applications of graphene have been proposed [1, 2], due to the abundance of its