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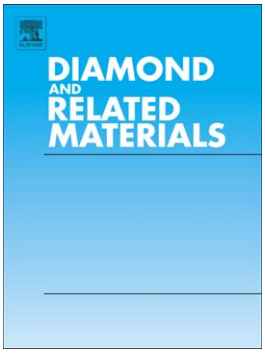

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Synthesis and properties of modified graphite encapsulated iron metal nanoparticles

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Abstract

Graphite encapsulated iron metal nanoparticles (FeGEM) are a core/shell nanostructured material. By introducing various liquid alcohols as carbon source during modified arc-discharge synthesis procedures, we succeeded in raising the yield rate of FeGEM from 10 wt% to 40-50 wt%. However, the hydrophobic outer graphite (graphene) shells and the strong magnetic attraction between inner ferromagnetic iron cores can easily lead to rapid agglomeration and precipitation of FeGEM nanoparticles in a polar solvent such as water. As a result, it may impede many potential applications of FeGEM nanoparticles in numerous fields.

To overcome the problem, it is necessary to change the hydrophobic surface of FeGEM nanoparticles to a hydrophilic one. In this work, we show that progressive sequential refluxing in nitric acid, thionyl chloride and tetraethylenepentamine (TEPA) can modify FeGEM nanoparticles with different functional groups. After refluxing with nitric acid solution, the grafted FeGEM is able to disperse in polar solvent, such as deionized water or ethanol for over 24 h. Zeta potential analysis and SQUID were used to characterize the grafted FeGEM at the refluxing step, and ultraviolet-visible spectrophotometry was used to measure the suspension ability of modified FeGEM nanoparticles in a colloidal system.

Keywords: agglomeration, ferromagnetic metal, hydrophilic, refluxing, modification.

Scope: Nanocarbon Science and Technology

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