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SYNTHESIS AND CHARACTERIZATION OF Fe_3O_4@C@γ-Al_2O_3 CORE@DOUBLE-SHELL NANOCOMPOSITE

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Abstract An efficient magnetic carbon nanospheres supported γ-Al_2O_3 as a core@double-shell nanocomposite has been prepared by a three-step process in this report. The morphology, inner structure and magnetic properties of all products were studied with X-ray powder diffraction (XRD), energy dispersive X-ray spectroscopy (EDX), field-emission scanning electron microscopy (FE-SEM) and vibrating sample magnetometer (VSM) tests. The Fe_3O_4@C@γ-Al_2O_3 nanocomposite showed excellent particle monodispersity and uniform particle diameter of 100-300 nm. The synthesized nanocomposite showed great magnetic property (52.3 emu/g), which made it has potential for application in magnetic nanodevices and nanocatalysts.

Keywords: Magnetic, Nanocomposite, Core-shell, Fe_3O_4@C@γ-Al_2O_3.

1. INTRODUCTION

Recent advances in the field of novel functional composites are paving the way for exciting applications in modern science and technology, because composite materials not only inherit the properties from their individuals, but also provide the possibility for enhanced functionality and multifunctional properties owing to the interaction between individual parents. During the past decades, there has been a tremendous increase in constructing composites based on iron oxides particles because of their compatible magnetic and electrochemical properties, which endowed these composites with potential applications in many fields, such as Li-ion batteries, microwave absorption, catalysis, absorption and separation, biosensors, etc [1,2].

Magnetic catalysts have the incomparable advantages over the traditional catalysts because of their high activity, magnetic recyclability, and reusability. However, due to their high specific surface areas and magnetic properties, magnetic nanoparticles are often easily self-agglomerated. Therefore, SiO_2, C and polymers are usually used to modify the magnetic nanoparticles. Therefore on one hand, the magnetic nanocomposite matrices serve both as the support as well as the stabilizer of the nanoparticles thus providing a mechanism to prevent aggregation. On the other hand, magnetic separation is an alternative to filtration or centrifugation as it prevents loss of catalyst and increases the reusability [3,4].

More recently, many scientists have shown their interests in constructing core−shell structures as an effective route to improve the chemical homogeneity and enhance the functionality of Fe_3O_4@C composites. For example, Xuan et al. designed a simple method for synthesis of Fe_3O_4@C composites under hydrothermal conditions by using glucose as both the reducing agent and carbon precursor, where the amount of glucose had a great impact on the morphology of the final products [5].

γ-Al_2O_3 has been used as supporter, adsorbent, and catalyst, owing to its low cost, good chemical stability, high surface area, acidic sites and controllable synthetic process. The γ-phase is formed upon the dehydration of the aluminum oxyhydroxide boehmite at temperatures ranging from 400 to 700 °C. In the catalytic industry, γ-Al_2O_3 is an ideal supporter. Particularly, the catalysts that are formed by loading the noble metal on the γ-Al_2O_3 like ZnO-Al_2O_3 [6], Au-Al_2O_3 [7] and Pd/Al_2O_3 [8] were used in organic reactions. It is still difficult, however, to separate the catalyst from the liquid phase after the reaction. To solve this problem in this article, we demonstrate the synthesis of core−shell Fe_3O_4@C@γ-Al_2O_3 nanocomposite and investigate their morphology, inner structure and magnetic properties.

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