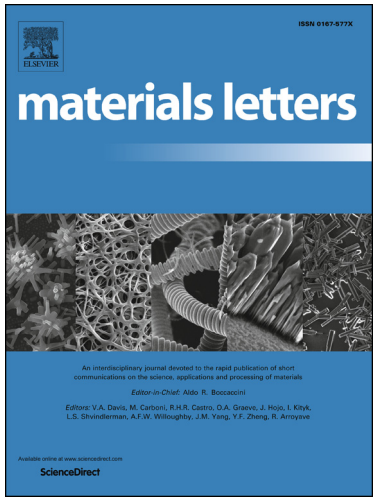

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Ionic liquid-assisted solvothermal synthesis of hollow $CoFe_2O_4$ microspheres and their absorbing performances

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ABSTRACT

Hollow $CoFe_2O_4$ microspheres were successfully synthesized in high yield using a solvothermal method in the presence of long-chain ionic liquid $[C_{18}MIM][Br]$. Uniform $CoFe_2O_4$ hollow spheres with a diameter of 100-200 nm and a shell thickness of approximately 10-50 nm are assembled by nanoparticles of 5-10 nm and have cubic spinel structures. A minimum reflection loss of -15.23 dB was observed at 16.98 GHz for hollow $CoFe_2O_4$ microspheres with a thickness of 5.5mm, and the effective absorption frequency ranged from 15.28 to 18 GHz. Hollow $CoFe_2O_4$ microspheres exhibited better microwave absorbing performance than solid microspheres. A possible formation mechanism of hollow $CoFe_2O_4$ microspheres was discussed.

Keywords: nanocomposites; hollow sphere; ionic liquid; structural; wave absorption

1. Introduction

Spinel ferrites ($CoFe_2O_4$, $ZnFe_2O_4$, etc.) are applied in many aspects such as biology, absorbing materials, sensitive elements, catalysts and high-density magnetic memories [1] due to their superior magnetic and physical properties. The substaintial properties of spinel ferrites are primarily dependent on their compositions, structures, morphologies and sizes [2, 3]. Therefore it is extremely important to explore strategies for synthesis of nanoscaled spinel ferrites with specific compositions.

Hollow ferrite spheres have drawn a lot of attention due to their excellent properties, such as high surface area, low density as well as special optical property. A hydrothermal/solvothermal method [4-6], template technique [7, 8], gas-phase diffusion method [9] can be used to prepare hollow ferrite spheres. Upon most occasions, a hydrothermal/solvothermal method has proven to be a versatile and economic route, which is appropriate to prepare monodispersed hollow ferrite crystals. Meng et al [10] prepared hollow $CoFe_2O_4$ spheres using glucose as a template by a hydrothermal method in combination with calcination. Yang et al [11] prepared hollow M-ferrite (M=Zn, Co) magnetic spheres with the introduction of dodecylamine in ethylene glycol solution. However, low yield and high cost of the product have limited the large-scale production and application. Hence, further development of a novel and high–yield synthetic method is very significant.

Ionic liquids (ILs), which are environmentally friendly solvents, have shown excellent properties such as low melting point, high polarity, low vapor pressure as well as good thermal and dissolving properties [12-14]. Many inorganic materials have been prepared in ILs. Xu et al [15] prepared hollow α-Fe_2O_3 microspheres in the presence of metal ion-containing reactable ionic liquid 1-octyl-3-methylimidazolium tetrachlorideferrate(III) ([Omim]$FeCl_4$) under the solvothermal condition.