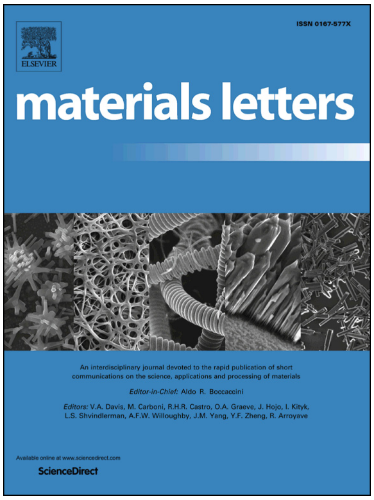

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PII: S0167-577X(17)31828-1
DOI: https://doi.org/10.1016/j.matlet.2017.12.070
Reference: MLBLUE 23568

To appear in: *Materials Letters*

Received Date: 14 April 2017
Revised Date: 11 November 2017
Accepted Date: 17 December 2017

Please cite this article as: J. Jin, Y.Q. Ma, Controllable electrochemical anodization method for the synthesis of Fe@γ-Fe_2O_3 core-shell nanoparticles, *Materials Letters* (2017), doi: https://doi.org/10.1016/j.matlet.2017.12.070

Controllable electrochemical anodization method for the synthesis of Fe@γ-Fe_2O_3 core-shell nanoparticles

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Abstract

The Fe@γ-Fe_2O_3 core-shell nanoparticles were synthesized by an electrochemical anodization method in a potentiostatic way. The core-shell structure was clearly shown by the HRTEM observation; With increasing the anodization potential and time, the thickness of γ-Fe_2O_3 shell increased, which was proved by the measurements of XRD and magnetization. Compared with the naked Fe nanoparticles, the anodized Fe@γ-Fe_2O_3 core-shell nanoparticles show the better magnetization stability and can be more easily functionalized by TiO_2.

Key words: Fe nanoparticle; Electrochemical anodization; Fe/γ-Fe_2O_3 core-shell structure

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1. Introduction

The core-shell structured two-component system generally exhibits the novel properties or expands the applicable fields as compared with the single component [1-7]. For examples, in the Fe@Fe_3O_4 or Co-Fe@$CoFe_2O_4$ magnetic nanoparticles, the Fe_3O_4 or $CoFe_2O_4$ ferrite shell can prevent the Fe or Co-Fe from the oxidation and corrosion, stabilizing the high moment of Fe or Co-Fe; Furthermore the ferrite shell is biocompatible [8]. Therefore these core-shell nanoparticles are expected to be promising materials for biological, photocatalytic and bio-sensing applications [9,10].

The aforesaid core-shell structures were synthesized by the oxidation of metal or alloy in air at high temperature [5,9,10], inevitably leading to the agglomeration of nanoparticles. To solve this problem, before the oxidation, the metallic nanoparticles were dispersed into the MgO or SiO_2 matrix [11-14]; Then the MgO or SiO_2 matrix was removed in the acidic or alkaline solution after the oxidization in order to recover the dispersity of metallic nanoparticles. These processes are complex and non environment-friendly; Moreover MgO or SiO_2 cannot be removed completely,