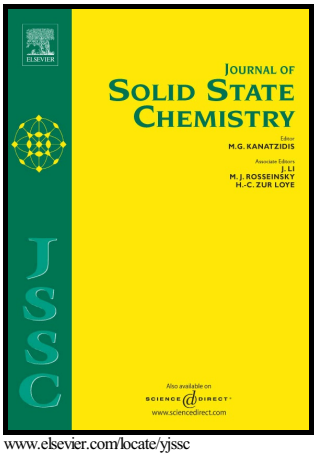

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The Role of Polymer Films on the Oxidation of Magnetite Nanoparticles

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Abstract

A detailed investigation about the role of polymer films on the oxidation process of magnetite nanoparticles (~ 7 nm diameter), under laser irradiation is performed employing micro Raman spectroscopy. To support this investigation, Fe_3O_4-np are synthesized by the co-precipitation method and assembled layer-by-layer with sodium sulfonated polystyrene (PSS). Polymer films $(Fe_3O_4\text{-np/PSS})_n$ with n=2,3,5,7,10 and 25 bilayers are employed as a model system to study the oxidation process under laser irradiation. Raman data are further processed by principal component analysis. Our findings suggest that PSS protects Fe_3O_4-np from oxidation when compared to powder samples, even for the sample with the greater number of bilayers. Further, the oxidation of magnetite to maghemite occurs preferably for thinner films up to 7 bilayers, while the onset for the formation of the hematite phase depends on the laser intensity for thicker films. Water takes part on the oxidation processes of magnetite, the oxidation/phase transformation of Fe_3O_4-np is intensified in films with more bilayers, since more water is included in those films. Encapsulation of Fe_3O_4-np by PSS in layer-by-layer films showed to be very efficient to avoid the oxidation process in nanosized magnetite.

Keywords: polymer films, iron oxide thin films, magnetite nanoparticles, oxidation process, layer-by-layer, Raman Spectroscopy.

1. Introduction

Iron oxide nanoparticle (ION) systems are of significant interest due to their size- and surface-related magnetic properties [1,2]. Controlled tailoring of these morphological features enables ION for a myriad of technological applications, ranging