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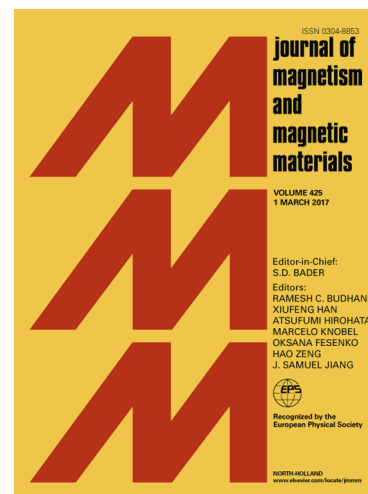
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Structural, optical and magnetic studies of CuFe_2O_4 , MgFe_2O_4 and ZnFe_2O_4 nanoparticles prepared by hydrothermal/solvothermal method

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Abstract

In this paper we report the structural, optical and magnetic studies of three spinel ferrites namely CuFe_2O_4 , MgFe_2O_4 and ZnFe_2O_4 prepared in an autoclave under the same physical conditions but with two different liquid medium and different surfactant. We use water as the medium and trisodium citrate as the surfactant for one method (Hydrothermal method) and ethylene glycol as the medium and poly ethylene glycol as the surfactant for the second method (solvothermal method). The phase identification and structural characterization are done using XRD and morphological studies are carried out by TEM. Cubical and porous spherical morphologies are obtained for hydrothermal and solvothermal process respectively without any impurity phase. The optical studies are carried out using FTIR and UV-Vis reflectance spectra. In order to elucidate the nonlinear optical behaviour of the prepared nanomaterial, open aperture z-scan technique is used. From the fitted z-scan curves nonlinear absorption coefficient and the saturation intensity are determined. The magnetic characterization of the samples is performed at room temperature using vibrating sample magnetometer measurements. The M-H curves obtained are fitted using theoretical equation and the different components of magnetization are determined. Nanoparticles with high saturation magnetization are obtained for MgFe_2O_4 and ZnFe_2O_4 prepared under solvothermal reaction. The magnetic hyperfine parameters and the cation distribution of the prepared materials are determined using room temperature Mössbauer spectroscopy. The fitted spectra reveal the difference in the magnetic hyperfine parameters owing to the change in size and morphology.

Key words: Hydrothermal; Solvothermal; Z- Scan; Optical limiting; Mössbauer spectroscopy; M-H curves.

1. Introduction

Spinel ferrites are fascinating materials in the world of nano regime. Scientists all over the world are keen to make new materials with novel properties. The unusual magnetic, optical and dielectric properties associated with these spinel ferrites in nano form make them suitable for biomedical applications, telecommunications, high frequency transformers, magnetic recording media etc. [1-4]. Due to the presence of iron in two cationic sites namely tetrahedral and octahedral sites, the properties of these spinels can be varied in a great extent by varying the synthesis conditions as well as reducing the size of particles. Due to its high electrical resistivity, low eddy current loss, high saturation magnetization and very good optical properties in the visible region, spinel ferrites are used in a variety of application[5, 6]. There are a number of methods to prepare these materials in nano form

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