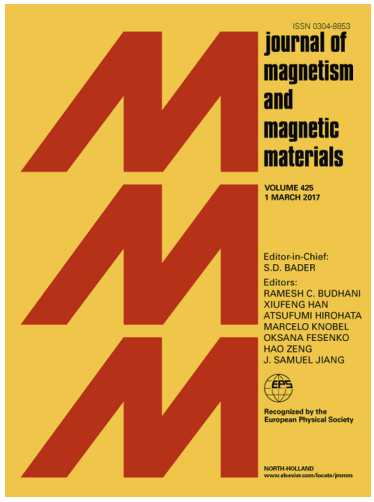

Effect of R^{3+} (R = Pr, Nd, Eu and Gd) substitution on the structural, electrical, magnetic and optical properties of Mn-ferrite nanoparticles

Mohd Mohsin Nizam Ansari, Shakeel Khan, Naseem Ahmad

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Effect of R^{3+} (R = Pr, Nd, Eu and Gd) substitution on the structural, electrical, magnetic and optical properties of Mn-ferrite nanoparticles

Mohd Mohsin Nizam Ansari, Shakeel Khan* and Naseem Ahmad

Department of Applied Physics, Z. H. College of Engineering and Technology, Aligarh Muslim University, Aligarh-202002, India.
* Email: skhanapd@gmail.com

Abstract

Undoped and rare earth substituted manganese ferrite (MF) nanoparticles, $Mn_{0.9}R_{0.1}Fe_2O_4$ (where R = Nd, Pr, Eu and Gd) were synthesized by sol-gel technique. The structural, morphological and magnetic properties of the as-synthesized samples were determined and characterized by X-ray diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Transmission Electron Microscopy (TEM) and Vibrating Sample Magnetometer (VSM). The XRD spectra reveal the formation of the single-phase cubic spinel structure. The average crystallite size evaluated from XRD data was found to be in the range of 8.19 to 21.4 nm and is consistent with the results of TEM. In addition, lattice parameter is found to increase with the rare earth (Pr, Nd, Eu, and Gd) substitution. DC electrical resistivity as a function of temperature was studied by using two-probe technique and found to decrease with increase in temperature which reveals the semiconducting nature of the samples. Simultaneously, the optical analysis shows significant decreases in band gap energy with rare earth content and ranging from 2.03 to 1.73 eV. It is also seen that rare earth substituted manganese ferrites show soft ferrimagnetic behavior and saturation magnetization decreases with the substitution of rare earths. Because of the soft ferrimagnetic behavior, samples have expected application in magnetic hyperthermia for cancer therapy and various other applications.

Keywords: Nano-ferrites, XRD, TEM, Magnetic properties, DC resistivity, Optical properties.