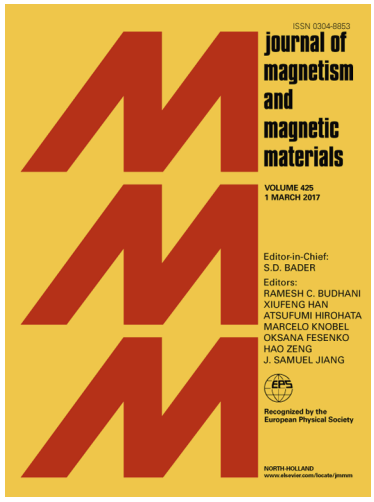

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Effect of cobalt doping on crystallinity, stability, magnetic and optical properties of magnetic iron oxide nano-particles

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Abstract

This paper is dedicated to investigate the effect of Co^{2+} ions in magnetite Fe_3O_4 nano-particles with stoichiometric formula $Co_xFe_{3-x}O_4$ where (x = 0, 0.05, 0.1 and 0.15) prepared by co-precipitation method. The structural, thermal, morphological, magnetic and optical properties of magnetite and Co^{2+} doped magnetite nanoparticles have been carried out using X-ray Diffractometer, Fourier Transform Infrared Spectroscopy, Themogravimetric Analysis, Scanning Electron Microscopy, Vibrating Sample Magnetometer (VSM) and UV-Vis Spectrometer (UV-Vis) respectively. Structural analysis verified the formation of single phase inverse spinel cubic structure with decrease in lattice parameters due to increase in cobalt content. FTIR analysis confirms the single phase of $Co_xFe_{3-x}O_4$ nanoparticles with the major band at 887 cm^{-1}, which might be due to the stretching vibrations of metal-oxide bond. The DSC results corroborate the finding of an increase in the maghemite to hematite phase transition temperature with increase in Co^{2+} content. The decrease in enthalpy with increase in Co^{2+} concentration attributed to the fact that the degree of conversion from maghemite to hematite decrease which shows that the stability increases with increasing Co^{2+} content in B-site of Fe_3O_4 structure. SEM analysis demonstrated the formation of spherical shaped nanoparticles with least agglomeration. The magnetic measurements enlighten that the coercivity and anisotropy of $Co_xFe_{3-x}O_4$ nanoparticles are significantly increased. From UV-Vis analysis it is revealed that band gap energy increases with decreasing particle size. This result has a great interest for magnetic fluid hyperthermia application (MPH).

Keywords: co-precipitation, nanoparticles, enthalpy, anisotrophy, band gap energy