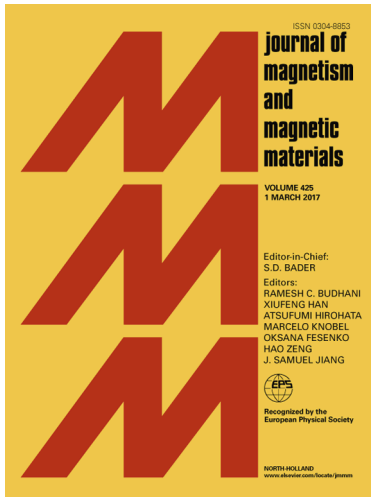

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Majid Niaz Akhtar, Muhammad Azhar Khan

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Effect of rare earth doping on the structural and magnetic features of nanocrystalline spinel ferrites prepared via sol gel route

Majid Niaz Akhtar[a,*], Muhammad Azhar Khan[b]

[a]Department of Physics, Muhammad Nawaz Sharif University of Engineering and Technology (MNSUET), 60000 Multan, Pakistan.
[b]Department of Physics, The Islamia University of Bahawalpur, Bahawalpur-63100, Pakistan.
Corresponding author: majidniazakhtar@mnsuet.edu.pk
majidniazakhtar@gmail.com Tel:+923336856069

Abstract

Rare earth Ce doped NiZn with composition of $Ni_{0.8}Zn_{0.2}Ce_xFe_{2-x}O_4$ at x=0.00, 0.02, 0.04, 0.06, 0.08 and 0.10 were synthesized via sol-gel route. Rare earth Ce was doped to tune the structural and magnetic properties of the spinel ferrites. Therefore, the systematic effect of Ce on the structural, morphological and magnetic studies was carried out. FTIR, XRD, FESEM and VSM were carried out to investigate the metal stretching vibrations, structure, phase, morphology and magnetic characteristics of $Ni_{0.8}Zn_{0.2}Ce_xFe_{2-x}O_4$ nanoferrites respectively. The size of the crystallites, cell volume and lattice parameters (theoretical and experimental) were decreased with Ce^{3+} doping. The size of the crystallites was in the range of 41 to 9 nm. The physical characteristics such as X-ray density, bulk density and porosity were also decreased with Ce^{3+} substitution. However, the lattice strain was increased with Ce^{3+}substitution in the NiZn ferrite lattice. The cations distributions study was determined using Bertaut method. Force constants at tetrahedral and octahedral sites were calculated from the FTIR studies. Saturation magnetization, remanent magnetization, coercivity, anisotropy constant (K) and Bohr magneton were evaluated from the magnetic hysteresis loops. Saturation, remanence, initial permeability and Bohr magneton were decreased whereas the coercivity was increased with Ce^{3+} doping. Yafet and Kittle (Y-K) angles were increased with Ce doped NiZn nanoferrites from x=0 to x=0.04 respectively. Switching field distribution (SFD) evaluations for Ce doped NiZn nanoferrites were determined by taking first derivative of the demagnetization data respectively. In conclusion, Single phase Ce doped NiZn nanoferrites have large magnetic saturation, remanence whereas other samples have higher coercivity accordingly. Ce-doped NiZn nanoferrites with varying structural and magnetic properties have potential applications in various fields such as switching, security, core, microwave absorption applications, nanofabrication and nanodevices.

Keywords*:* Nanoferrites; Fourier Transform Infrared Spectroscopy(FTIR); X-ray Diffraction(XRD); Field Emission Scanning Electron Microscopy (FESEM); Vibrating Sample Magnetometer (VSM); Switching field distribution (SFD).