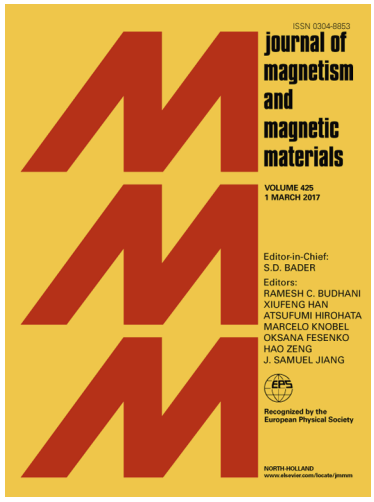

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Structural, optical, dielectric and magnetic studies of Gadolinium–added Mn–Cu nanoferrites

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Abstract

Spinel ferrite with the general formula $Mn_{1-x}Cu_xFe_{1.85}Gd_{0.15}O_4$ (x= 0.2, 0.4, 0.6 and 0.8) was synthesized using the standard sonochemical method. The structure, optical, morphology, dielectric and magnetic properties of the prepared $Mn_{1-x}Cu_xFe_{1.85}Gd_{0.15}O_4$ nanoferrites were exhaustively investigated using various characterization techniques. The phase purity, secondary phase and crystallite parameters were studied from X-ray diffraction patterns. Fourier transform infrared spectra showed two absorption bands of transition metal oxides in the frequency range from 400 to 650 cm^{-1}, which are related to asymmetric stretching modes of the spinel ferrites (AB_2O_4). Raman spectra have five active modes illustrating the vibration of O^{2-} ions at both tetrahedral (A) site and octahedral (B) site ions. The wide and narrow scan spectrum from X-ray photoelectron spectroscopy results confirmed the presence of Mn, Cu, Gd, Fe, C and O elements in the composition. The oxidation state and core level of the photo electron peaks of Mn 2p, Cu 2p, Gd 3d, Fe 2p and O 1s were analyzed. The influence of the Cu^{2+} concentration in $Mn_{1-x}Cu_xFe_{1.85}Gd_{0.15}O_4$ on the morphology, varying from nanorods, nanoflakes to spherical, was explored on the basis of scanning electron microscopy images. Ultraviolet diffuse reflectance spectroscopy studies indicated that the optical bandgap (5.12–5.32 eV) of the nanoferrites showed an insulating behavior. The dielectric constant, loss tangent and complex dielectric