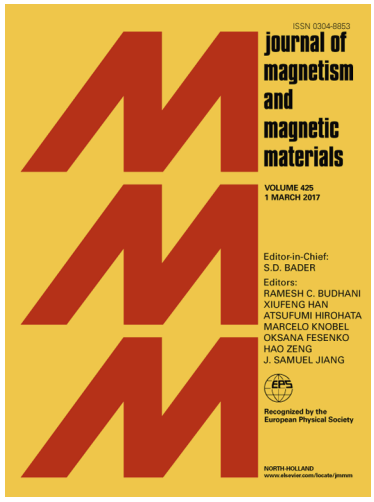

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Pankaj Choudhary, Dinesh Varshney

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Elucidation of structural, vibrational and dielectric properties of transition metal (Co^{2+}) doped spinel Mg-Zn chromites

Pankaj Choudhary[1], Dinesh Varshney[1#]

[1]Materials Science Laboratory, School of Physics, Vigyan Bhavan, Devi Ahilya University, Khandwa Road Campus, Indore 452001, India.

Abstract: Co^{2+} doped Mg – Zn spinel chromite compositions $Mg_{0.5}Zn_{0.5-x}Co_xCr_2O_4$ ($0.0 \leq x \leq 0.5$) have been synthesized by the high-temperature solid state method. Synchrotron and X-ray diffraction (XRD) studies show single-phase crystalline nature. The structural analysis is validated by Rietveld refinement confirms the cubic structure with space group *Fd*3*m*. Crystallite size is estimated from Synchrotron XRD which was found to be 30 – 34 nm. Energy dispersive analysis confirms stoichiometric $Mg_{0.5}Zn_{0.5-x}Co_xCr_2O_4$ composition. Average crystallite size distribution is estimated from imaging software (Image - J) of SEM is in the range of 100 – 250 nm. Raman spectroscopy reveals four active phonon modes, and a pronounced red shift is due to enhanced Co^{2+} concentration. Increased Co^{2+} concentration in Mg – Zn chromites shows a prominent narrowing of band gap from 3.46 to 2.97 eV. The dielectric response is attributed to the interfacial polarization, and the electrical modulus study supports non – Debye type of dielectric relaxation. Ohmic junctions (minimum potential drop) at electrode interface are active at lower levels of doping ($x < 0.2$) give rise to a low-frequency semicircle as evidenced from the complex impedance analysis. The low dielectric loss and high *ac* conductivity of Co^{2+} doped Mg – Zn spinel chromites are suitable for power transformer applications at high frequencies.

Keywords: Spinel chromites, XRD, Synchrotron XRD, Raman scattering, SEM, FTIR, UV-Visible spectroscopy, Dielectric properties.

[#]**Corresponding author:** Tele fax: +91-731-2467028
E-mail: vdinesh33@rediffmail.com