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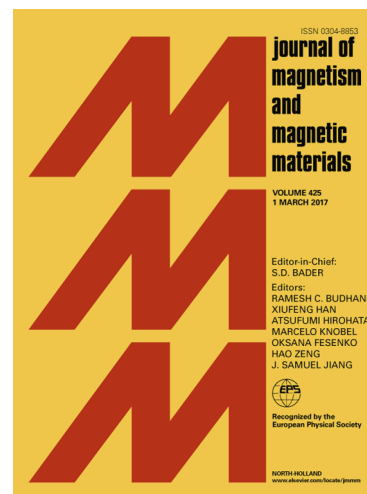
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# Elucidation of structural, vibrational and dielectric properties of transition metal ( $\text{Co}^{2+}$ ) doped spinel Mg-Zn chromites

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**Abstract:**  $\text{Co}^{2+}$  doped Mg – Zn spinel chromite compositions  $\text{Mg}_{0.5}\text{Zn}_{0.5-x}\text{Co}_x\text{Cr}_2\text{O}_4$  ( $0.0 \leq x \leq 0.5$ ) 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  $Fd3m$ . Crystallite size is estimated from Synchrotron XRD which was found to be 30 – 34 nm. Energy dispersive analysis confirms stoichiometric  $\text{Mg}_{0.5}\text{Zn}_{0.5-x}\text{Co}_x\text{Cr}_2\text{O}_4$  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  $\text{Co}^{2+}$  concentration. Increased  $\text{Co}^{2+}$  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  $\text{Co}^{2+}$  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.

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