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Structural and Vibrational Study of $Ni_{1-x}Co_xFe_2O_4$ Ferrites

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Abstract—*In recent years, spinel ferrites attracted great attention towards the scientific community due to its potential application in diverse fields such as high frequency devices, recording media, magnetic resonance imaging, drug delivery, hyperthermia [1,5] etc. Spinel structure $NiFe_2O_4$ is a soft ferromagnetic material with tetrahedral A sites are occupied by half of the Fe^{3+} cations while rest of Fe^{3+} and Ni^{2+} cations are occupied at B sites. Usually the cation distribution of A and B site depends on the bonding between them, ionic radii and preparation method. There are very less number of reports on the systematic doping of the Co^{2+} ions in $NiFe_2O_4$ nanoparticles and thereby study of the occupancy of the Co^{2+} ions on the tetrahedral and the octahedral sites.*

In this report, we synthesis $Ni_{1-x}Co_xFe_2O_4$ (x= 0.0, 0.4, 0.5, 0.6 and 1.0) nanoparticles by sol-gel method. Nitrate precursors of the corresponding metal salts have been used in the molar ratio of 1:2 for the synthesis of nanoparticles. XRD patterns (Fig. 1) of the nanoparticles with different substitution of Co^{2+} ions reveal the single phase synthesis of the nanoparticles. Williamson-Hall method has been used to determine the residual strain and crystallite size of the nanoparticles. Shift in the XRD peaks towards the lower diffraction angle (2θ) with increase Co^{2+} substitution confirms the incorporation of Co^{2+} ions at the lattice sites. Raman spectroscopy is powerful technique to identify Cobalt ion distribution between the tetragonal and octahedral sites in ferrites. In Fig. 2, five active phonon modes in the Raman spectra are found for all the samples at room temperature which are well correlated with Co ion substitution and its distribution in $NiFe_2O_4$. Chemical analysis of $Ni_{1-x}Co_xFe_2O_4$ was carried out by EDX and found that the samples contain Ni and Co in the expected range in all the samples.

Keywords: *Ferrites, XRD, Raman spectra*

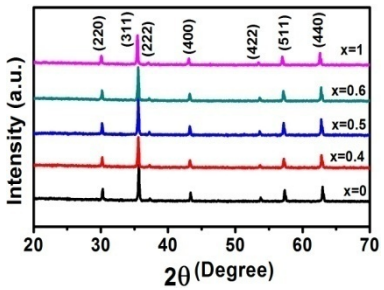

Fig. 1: X-ray powder diffraction patterns of CoxNi(1-x)Fe2O4 with x = 0.0, 0.4, 0.5, 0.6, 1.0 sintered at 1100˚C for 6 h.

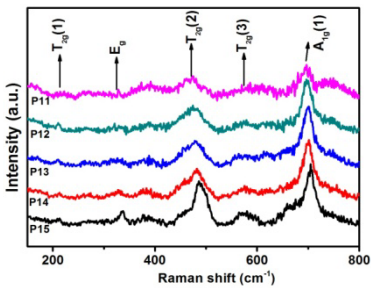

Fig. 2: Raman spectra of CoxNi(1-x)Fe2O4 with x = 0.0, 0.4, 0.5, 0.6, 1.0. sintered at 1100˚C for 6 h.

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