Study of Structural, Electrical and Magnetic Properties of Lithium Substituted Nanocrystalline Nickel-Zinc-Ferrite

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Abstract

Lithium substituted nanocrystalline Nickel-Zinc-ferrites with chemical formula $Li_xNi_{0.6-2x}Zn_{0.4}Fe_{2+x}O_4$ (where x = 0.00, 0.05, 0.10, 0.15, and 0.20) were prepared by auto-combustion synthesis route. Samples shaped in pellet and toroid forms for each composition were sintered at different sintering temperatures, T_s (1100-1250°C) for 5 h. The optimum T_s for each composition was selected based on maximum bulk density. The comprehensive investigations in this research were carried out solely for the samples sintered at their respective optimum T_s. The X-ray diffraction pattern for each composition confirmed the formation of cubic spinel structure. Moreover, the Rietveld refinement of X-ray diffractograms also assured the absence of impurity phases. The crystallite size calculated using Scherrer formula varied from 53 to 59 nm. The lattice constant found to decrease complying Vegard's law. However, the microstructural analysis showed that average grain size increased with accruing Li content up to an optimum concentration (x = 0.10). The magnetic properties (initial permeability, relative quality factor, and saturation magnetization) enhanced with accruing Li content up to the optimum concentration. The dielectric constant exhibited dispersive behavior with changing frequency. The ac conductivity and electric modulus remained low at lower frequency, but ascended with increasing frequency. In contrast, the complex impedance spectra followed the reverse trend with changing frequency.