Effect of Mn Substitution on the Structural and Magnetic Properties of Nanocrystalline $Li_{0.2}Zn_{0.6-x}Mn_xFe_{2.2}O_4$

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ABSTRACT

Structural and magnetic properties of mixed ferrite with nominal compositions $Li_{0.2}Zn_{0.6-x}Mn_xFe_{2.2}O_4$ ranging from x=0.00 to 0.60 have been synthesized by auto combustion technique. Disk- and toroid-shaped samples prepared from these powders are sintered at various temperatures (1050°C-1250°C). The optimum sintering temperature, T_s, for various compositions were selected from the bulk density versus Mn content plots. At optimum T_s, samples show their maximum bulk density. The samples sintered at their respective optimum T_s are considered for further characterization. The X-ray diffraction patterns confirm that the sample forms cubic spinel structure for Mn content up to x = 0.30. Beyond these values of x, major phase of the composition is cubic spinel along with minor impurity phases α-Fe_2O_3 and $Mn_3Li_2O_8$.for $x \geq 0.40$ which influenced the structural, electric and magnetic behavior of ferrites. Morphological parameter have been investigated and found that average grain size significantly depends on Mn substitution. The initial permeability, relative quality factor, saturation magnetization increase with Mn content up to x=0.30. The dielectric constant and dielectric loss shows dispersion in the low frequency range. AC conductivity shows frequency independent behavior at lower frequency region and increases with increasing the frequency. Complex impedance spectra have been studied in the frequency range 20Hz to 10 MHz. The value of real part of complex impedance decreases with increasing frequency up to 10^5 Hz, and beyond this it becomes frequency independent.