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On the structural and magnetic properties of La-substituted NiCuZn ferrites prepared using egg-white

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Abstract

$\text{Ni}_{0.50}\text{Cu}_{0.25}\text{Zn}_{0.25}\text{La}_x\text{Fe}_{2-x}\text{O}_4$ ferrites (with $x = 0.00\text{--}0.09$) were prepared by a simple method using metal nitrates and freshly extracted egg white. The proper calcination temperature for ferrites formation was estimated using thermo-gravimetry technique (TG). The samples were characterized using X-ray diffraction (XRD), transmission electron microscopy (TEM) and infrared spectroscopy (FT-IR) measurements. XRD of the powders calcined at 550 °C for 2 h showed single-phase crystalline cubic ferrites with crystallite sizes in the range 17.2–21.6 nm. Both the lattice parameter and X-ray density are found to increase by the addition of rare earth ion. TEM image showed agglomerated nano-particles with irregular sizes and shapes. FT-IR spectra showed two absorption bands (ν_1 and ν_2) attributed to stretching vibration of tetrahedral and octahedral complex $\text{Fe}^{3+}\text{--O}^{2-}$, respectively. The shifting of the ν_2 band towards lower frequencies indicates the preference of lanthanum ions to occupy the octahedral sites. The effect of La-substitution on the magnetic properties was studied using vibrating sample magnetometry (VSM) and susceptibility measurements. The decrease in the saturation magnetization with increasing La content can be attributed to the decreasing of $\text{Fe}^{3+}\text{--Fe}^{3+}$ interactions in the octahedral sites. Coercivity shows size dependent behavior due to the combination of surface effect and surface anisotropy. The obvious decrease in the Curie temperature (T_C) with increasing La content indicates that the highly paramagnetic character of La^{3+} ions decreases the ferromagnetic region at the expense of the paramagnetic one.

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