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Electron Paramagnetic Resonance Studies of Nanocrystalline $CoGd_xFe_{2-x}O_4$ Particles

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A series of samples of the system $CoGd_xFe_{2-x}O_4$ (x=0.0, 0.1, 0.3, 0.5) were prepared by the co-precipitation method. Electron paramagnetic resonance (EPR) spectroscopy has been used to study the mixed ferrite $CoGd_xFe_{2-x}O_4$. EPR spectra of different Gd^{3+} ion doped cobalt ferrite nanocrystalline powder were recorded at ambient temperature on reflection type CW X-band E-line Century EPR spectrometer (Varian Make, Model E-112) at ambient temperature. Magnetic field was modulated at 100 kHz and 10 mW microwave power was used to avoid saturation effect. DPPH was used as a standard reference material for the determination of g-value. As we know the Gd^{3+} ion has $4f^7$ electronic configuration ($^8S_{7/2}$) having eightfold spin degeneracy. This is attributed to the strong crystal field which splits the free-ion level into four doubly degenerate energy levels. Zeeman field removes the remaining degeneracy and this results transition of unpaired electrons between these eight levels. The additional spectral lines of g-value ≥ 2 and g-value < 2 are observed due to strong crystalline field effect. In these measurements, Gd^{3+} ions have seven hyperfine line spectrum with g-values 1.9573, 2.2566, 2.6342, 3.2863, 4.2345, 5.5163 and 12.5683 is observed for 0.1 % Gd^{3+} ion doped cobalt ferrite sample. As the concentration of Gd^{3+} ions increases to 0.3 % and 0.5 %, the hyperfine lines weakens and broadness of the spectra starts increasing due to increase in strong spin-spin interactions of Gd^{3+} ion. The details of the work are presented in paper.

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Investigation on Fe-Zn Substituted Nano-magnetic Ferrite Particle

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Fine magnetic nano particles have received growing and renewed interests in both scientific and technological applications. Due to many interesting behavior of these fine magnetic particles, spanning from superparamagnetic to ferromagnetic, it is essential to explore the properties of these nano particles for a particular application. There are various applications of nano-magnetic particle such as catalysts, medical diagnostics, color imaging, drug delivery systems, pigment in paints and ceramics which are primarily based on various properties.

In the present investigation we have synthesized $Zn_xFe_{1-x}Fe_2O_4$ (x = 0.1, 0.3, 0.5, 0.7) by chemical co-precipitation. These nano-magnetic particles are further characterized using various analytical instruments viz. XRD/TGA and LCR meter etc to study their physical properties. The x-ray diffraction pattern of the synthesized particles confirms the single crystalline phase in all the stochiometic composition. The results indicate a decrease in the crystallite size with increasing Zn concentration as the Zn^{2+} ion substitution contributes less in the growth rate as compared to Fe^{+2}. The effects of annealing in air on sample physical properties have also been studied at 573 K.

The grown particles were further studied for electrical conductivity measurements over a wide frequency range. The variation of resistance of different concentration of Zn ion substitution has been plotted by keeping sample dimensions same and is shown in Fig. 1. An increase in conductivity has been observed with increase in Zn ion doping in the ferrite sample. The details of the investigations have been presented in the paper.

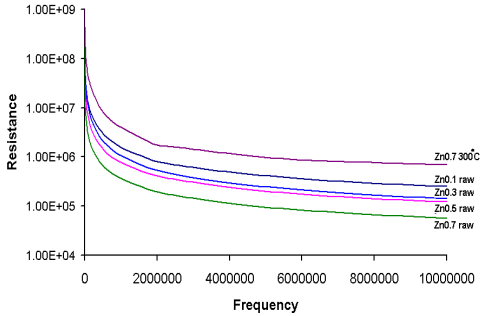

Fig. 1. Variation of electrical resistance with frequency in different Zn^{2+} ion concentration ferrites.