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## Magnetic Nanoparticles: Synthesis, Characterization and Magnetic Properties of Cobalt Aluminum Ferrite

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### Abstract

Nanoparticles of the ferrite system  $\text{CoFe}_2\text{-xAl}_x\text{O}_4$  ( $x = 0.0, 0.3, 0.7$  and  $1.0$ ) were synthesized through the co-precipitation technique. Thermal decomposition process and formation of a single crystalline phase were followed using thermal differential analysis technique (DTA). X-ray powder diffraction patterns of the samples confirmed the formation of a nano-size single spinel phase. The average crystallite size was found to be in the range 20-63 nm for all samples. This was further confirmed by TEM of one of the samples, with concentration  $x = 1.0$  which was found statistically to be 27 nm. This agrees well with the value of 24 nm deduced by means of X-ray diffraction method for the same sample. A considerable decrease in the intensity of the octahedral bands is observed as the aluminum concentration increases, and even vanishes completely at  $x = 1.0$  indicating the migration of cations between the octahedral and tetrahedral sites. The magnetic hysteresis loops at room temperature showed decrease in both, coercivity and saturation magnetization as the nonmagnetic  $\text{Al}^{3+}$  ions content increases. The relative values of  $M_r/M_s$  were found to be between 0.44 and 0.31 for the samples with a remarkable change in the squareness of the loops. This is highly beneficial for the microwave and memory devices applications of these nano sized ferrite system.

### Keywords

**Author Keywords:** Magnetic Material; Chemical Synthesis; Infrared Spectroscopy; X-ray Diffraction; Crystal Structure; Magnetic Properties

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