

Effects of Cr doping on Magnetic Properties of Inverse Spinel CoFe_2O_4 Thin Films

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As an inverse spinel compound, cobalt ferrite (CoFe_2O_4) has been under a great deal of attention for its applications to high-density magnetic and magneto-optic recording media. In the present work, effects of Cr doping on the magnetic properties of CoFe_2O_4 have been investigated. Spinel compounds $\text{Cr}_x\text{Co}_{1-x}\text{Fe}_2\text{O}_4$ were prepared as thin films by a sol-gel method and probed by x-ray diffraction (XRD), vibrating sample magnetometry (VSM), and conversion electron Mössbauer spectroscopy (CEMS) in comparison with CoFe_2O_4 .

VSM measurements indicate a large increase (by more than a factor of 2) of saturation magnetization (M_S) by a small amount of Cr doping ($x = 0.09$) in CoFe_2O_4 films. For the higher Cr doping, a decrease of M_S was observed but still larger than that of CoFe_2O_4 . Substitution of octahedral Co^{2+} sites by Cr^{3+} ions is expected to entail a reduction of octahedral Fe^{3+} ions to Fe^{2+} and the resultant change of magnetic structure of the compound.

The present $\text{Cr}_x\text{Co}_{1-x}\text{Fe}_2\text{O}_4$ films were found to remain cubic up to $x = 0.49$ by XRD and an increase of the lattice constant was observed for $x = 0.09$ while the other Cr-doped samples showed similar lattice constant to that of CoFe_2O_4 . Detailed CEMS investigation was performed for figuring out cationic distribution and explaining the magnetic properties of the Cr-doped compounds.

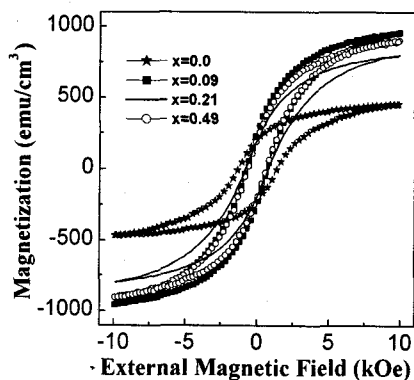


Figure 1. VSM measurement result of $\text{Cr}_x\text{Co}_{1-x}\text{Fe}_2\text{O}_4$ films at room temperature.