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Evolution of Magnetic Properties of Mn Substituted $CoFe_2O_4$ Thin Films

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Inverse spinel cobalt ferrite ($CoFe_2O_4$) has been paid a great deal of attention for its applications to high-density magnetic and magneto-optic recording media due to its moderate saturation magnetization, high coercivity, mechanical hardness, and chemical stability. Thin film growth of high-quality cobalt ferrite is important for realizing such applications and sol-gel method has been known to be attractive for such film preparation.

In the present study, magnetic properties of Mn-doped spinel $CoFe_2O_4$ thin films grown by a sol-gel method have been investigated by vibrating-sample magnetometry (VSM) and conversion electron Mössbauer spectroscopy (CEMS) measurements.

When Mn replaces Co content ($Mn_xCo_{1-x}Fe_2O_4$), an increase in saturation magnetization (M_S) was observed proportional to the increase of Mn content as shown in It is also found that the remnant magnetization (M_R) in the $Mn_xCo_{1-x}Fe_2O_4$ films increases with x while the coercivity (H_C) decreases with x. When Mn replaces Fe content ($Mn_xCoFe_{2-x}O_4$), H_C is found to decrease dramatically as shown in Fig. 2, becoming a softer ferrimagnet than $CoFe_2O_4$. These results are interpreted in terms of site preference and ionicity of the Fe ions in the compounds that were investigated by CEMS.

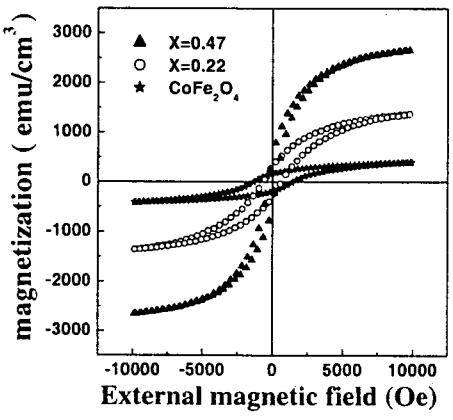

Fig. 1. Room temperature VSM measurement result for $Mn_xCo_{1-x}Fe_2O_4$ compounds.

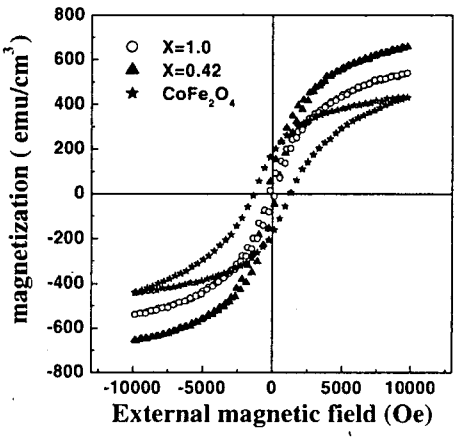

Fig. 2. Room temperature VSM measurement result for $Mn_xCoFe_{2-x}O_4$ compounds.