Magnetic and thermoelectric properties of $Fe_{3-x}Co_xO_4$ thin films on MgO (100)

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Microcrystalline ferrites are used as a medium for the magnetic recording and storage of information.[1] Magnetite, Fe_3O_4, is a ferrimagnet with a cubic inverse spinel structure and exhibits a metal-insulator, Verwey, transition at about 120 K.[2] It is predicted to possess as half-metallic nature, 100% spin polarization, and high Curie temperature (850 K). Cobalt ferrite, Co_3O_4, is one of the most important member of the ferrite family, which is characterized by its high coercivity, moderate magnetization and very high magnetocrystalline anisotropy. The electrical and magnetic properties of bulk ferrites are found to be sensitive to grain size, grain structure, doping content, porosity and distribution of the metal cations among the lattice sites in the spinel structure.[3] Here we report on the magnetic and thermoelectric properties of $Fe_{3-x}Co_xO_4$ ($0 \leq x \leq 1$) thin films grown on MgO (100) substrate by MBE. XRD patterns confirmed the inverse spinel structure of the films. Magnetic properties of the $Fe_{3-x}Co_xO_4$ films are markedly sensitive to the Co concentration. The Verwey transition was disappeared in Co-doped films. The electrical resistivities of films increased with x; 1.6 Ω-cm for x =1. A transition in electrical resistivity at room temperature for x = 1 was suggested as a ferromagnetic to antiferromagnetic phase transition. A negative magnetoresistance with butterfly shape was observed with low Co content but disappeared for the samples with x = 0.8 and 1. Seebeck coefficients increased with Co concentration; -70 μV/K for x=0 and -220 μV/K for x=1. In this talk, we will also discuss on the relationship between magnetic and thermoelectric characteristics $Fe_{3-x}Co_xO_4$ ferrite films.

Keywords: Magnetic, oxide, thermoelectric, $Fe_{3-x}Co_xO_4$

References

[1] Yu. A. Mirgoroda *et al.,* Russ. J. Phys. Chem. A **86**, 418 (2012).

[2] D. Tripathy *et al.,* Appl. Phys. **101**, 013904 (2007).

[3] A. V. Ramos *et al.,* Phys. Rev. B **7**5, 224421 (2007).