Influence of oxygen pressure on electrical and magnetic properties of $CoFe_2O_4$ thin film

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〈Introduction〉

$CoFe_2O_4$ with inverse spinel structure is ferrimagnetic insulator. Because of the exchange splitting of the conduction band, a current in $CoFe_2O_4$ feel two distinct tunnel barrier heights for spin-up and spin –down electrons, leading to spin selective transport of electron. This effect is called spin filter. $CoFe_2O_4$ with high Curie temperature（T_C= 793K）is remarkable candidate for spintronics device material.［1］

As tunnel barrier materials, good insulating property is necessary. Hence, studying influence of deposition condition to electric properties is significant. In this study, we fabricated $CoFe_2O_4$ thin films in various O_2 pressure, and investigated electrical and magnetic property.

〈Experiments〉

Samples were grown on MgO(100) substrate by Molecular Beam Epitaxy method ,and film structures were MgO(100)/$CoFe_2O_4$(50 nm)/Al_2O_3(3 nm). Al_2O_3 is deposited for preventing oxidation of $CoFe_2O_4$ in the air. $CoFe_2O_4$ thin films were formed by reactive deposition at 300℃ in O_2 atmosphere. Surface form was observed by AFM, we measured electrical resistivity by Van der Pauw method and magnetization process by magneto-optical kerr effect (MOKE).

〈Results〉

O_2 pressure of 4×10^{-4}, 4×10^{-5}, 3×10^{-5} Pa was maintained during deposition. From AFM measurements, surface roughness Ra was estimated at 0.12~0.19 for all the films. This result indicates that film surface was very smooth. Fig.1 shows electrical resistivity of $CoFe_2O_4$ thin films. From fig.1, we saw that resistivity became lower as O_2 pressure during deposition decreased. Fig.2 shows results of MOKE measurements under out of plane magnetic field. The result of MOKE measurements suggests that these $CoFe_2O_4$ thin films have perpendicular magnetic anisotropy.

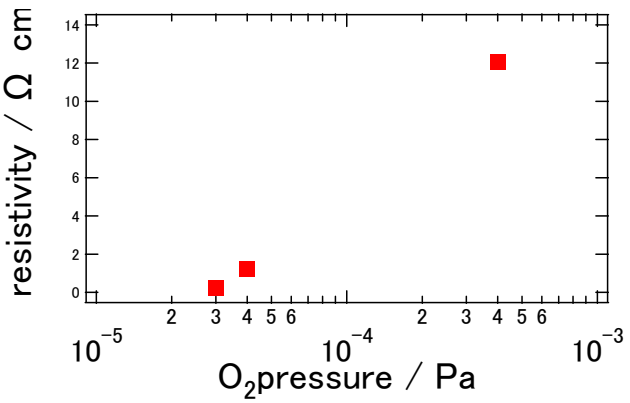

Fig.1 Resistivity of $CoFe_2O_4$ films as a function of O_2 pressure during deposition.

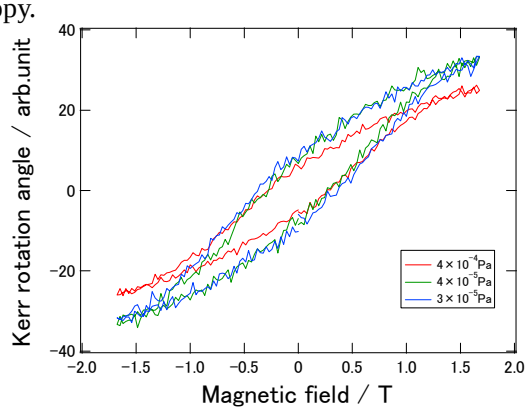

Fig.2 MOKE curves of $CoFe_2O_4$ films.

［1］Michael G. Chapline et al PHYSICAL REVIEW B 74, 014418(2006)