

The crystal structure and magnetotransport properties of $\text{Co}_x\text{Fe}_{3-x}\text{O}_4$ films and $\text{Co}_x\text{Fe}_{3-x}\text{O}_4/\text{MgO}$ or AlO_x/FePt multilayers

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[Introduction] $\text{Co}_x\text{Fe}_{3-x}\text{O}_4$ has a potential as a spintronic material with perpendicular magnetization. The transport characteristics and magnetic anisotropy are controllable by varying the composition of Fe and Co^[1]. Such material is a candidate for the electrode of perpendicular magnetic tunnel junctions. However, there have been few reports about the relation between the electric and magnetic transport and compositions. In this study, we fabricated the $\text{Co}_x\text{Fe}_{3-x}\text{O}_4$ with various compositions and investigated the characteristics. Furthermore, we prepared $\text{Co}_x\text{Fe}_{3-x}\text{O}_4/\text{MgO}$ or AlO_x/FePt multilayers to realize the MTJs.

[Experiment] The thin films were prepared by the MBE method. The film structure was MgO (001) substrate / $\text{Co}_x\text{Fe}_{3-x}\text{O}_4$ (30 nm) / AlO_x (2.0 nm), and MgO (001) substrate / $\text{Co}_x\text{Fe}_{3-x}\text{O}_4$ (30 nm) / MgO (2.7 nm) or AlO_x (1.2 - 3.0 nm) / FePt (10 nm). Each of the $\text{Co}_x\text{Fe}_{3-x}\text{O}_4$ thin films was deposited in a radical oxygen atmosphere at 300 °C, and then annealed for 30 minutes in an oxygen atmosphere at 450 °C. FePt was deposited at 500 °C, and then annealed at 500 °C for 30 minutes. RHEED, XRD and STEM were used for the structure evaluation of the thin film, and MOKE and VSM were used at room temperature for evaluating the magnetic properties.

[Result] Fig.1 shows the magnetic hysteresis curve of $\text{Co}_{0.5}\text{Fe}_{2.5}\text{O}_4$ with perpendicular magnetic field. From the hysteresis curve, the coercive force and squareness ratio were estimated at ± 0.34 T, and 0.59, respectively. Fig. 2 shows a cross-sectional TEM image of the $\text{Co}_{0.5}\text{Fe}_{2.5}\text{O}_4/\text{AlO}_x/\text{FePt}$ multilayer film structure. From the electron diffraction image, it was found that $\text{Co}_{0.5}\text{Fe}_{2.5}\text{O}_4$ is a spinel type structure. We compared the order parameter of FePt between $\text{CFO}/\text{MgO}/\text{FePt}$ and $\text{CFO}/\text{AlO}_x/\text{FePt}$ by XRD measurements. It was estimated 0.38 in the case of AlO_x , whereas it was 0.86 for MgO . The difference is attributed to the crystallinity of the AlO_x and MgO .

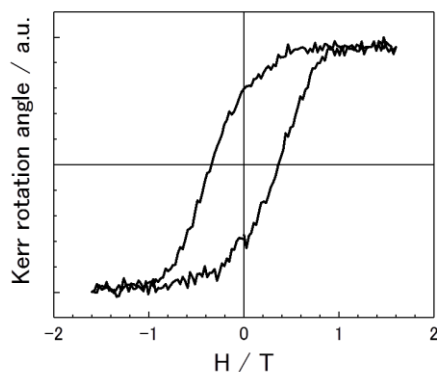


Fig.1 MOKE curve of $\text{Co}_{0.5}\text{Fe}_{2.5}\text{O}_4$ thin film

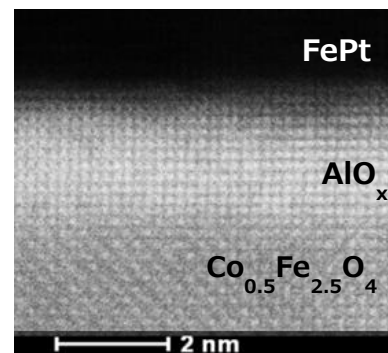


Fig.2 Cross-sectional TEM image

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