

Fabrication of perpendicular magnetized spin filter junctions

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【Introduce】

The spin filter effect is the effect that spin-polarized current is generated due to exchange splitting in the magnetic tunnel barrier. Although, perpendicular magnetic tunnel barrier will enable the perpendicular spin filter junction, it has not been realized yet. In this study, we fabricated FePt and CoFe_2O_4 epitaxial films for perpendicular magnetized spin filter device. FePt films are very popular as perpendicular magnetization films. For CoFe_2O_4 , the perpendicular magnetic anisotropy can be induced by lattice strain[1]. CoFe_2O_4 is the ferromagnetic insulator with high Curie temperature, so that the room temperature operation of spin filter devices is expected.

【Experiment】

L_{10} -FePt and CoFe_2O_4 thin films were prepared on MgO(100) substrate by MBE method. Sample structures were MgO(100)/Cr(30 nm)/Pt(20 nm)/[Fe/Pt]₁₀(3.4 nm)/Fe(t_{Fe} =0-1.5 nm)/MgO(2 nm) and MgO(100)/MgO(20 nm)/ CoFe_2O_4 (3-5 nm)/ Al_2O_3 (3 nm). FePt films were prepared by alternating deposition of Fe and Pt monatomic layers at 500°C. Then Fe layers were deposited in wedge shape using linear shutter at RT and annealed at 300°C. CoFe_2O_4 thin films were grown at 300°C in the oxygen atmosphere of 4×10^{-4} Pa and annealed at various temperatures. The epitaxial growth and surface structures were observed by RHEED and AFM. The magnetic properties were measured by MOKE at RT.

【Result】

Fig.1 shows MOKE loops of FePt/Fe (t_{Fe}) layers for various thickness of Fe layer. The magnetic field was applied perpendicular to the film plane. The films showed clear perpendicular magnetic anisotropy. The coercivity decreased with increasing t_{Fe} monotonically. The H_c at t_{Fe} =1.5 nm was half as large as H_c for t_{Fe} =0 nm. Fig.2 shows the RHEED pattern of CoFe_2O_4 annealed at 600°C. The clear streak pattern was observed. The surface roughness R_a of CoFe_2O_4 was estimated as 0.28 nm from the AFM measurements.

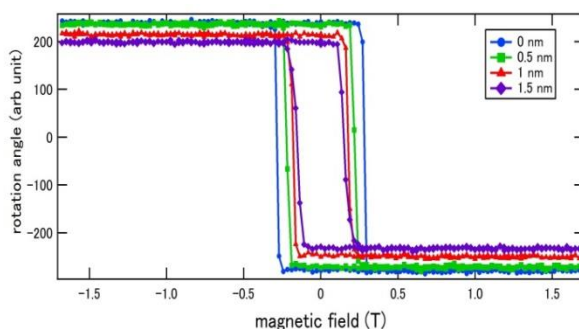


Fig.1. MOKE loops of FePt/Fe (t_{Fe}) layers for various thickness of Fe layer.

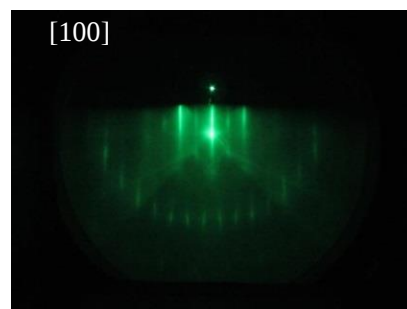


Fig.2. The RHEED pattern of CoFe_2O_4 annealed at 600°C.

[1] Huang et al. Appl. Phys. Lett. 89, 262506 (2006)