Observation of perpendicular exchange bias in Ir-doped Fe_2O_3/Co thin film system

S. Ye[1], S. P. Pati[1], Y. Shiokawa[1], M. Al-Mahdawi[1], T. Nozaki[1], and M. Sahashi[1, 2]
[1]Department of Electronic Engineering, Tohoku University, Sendai 980-8579, Japan
[2]ImPACT Program, Japan Science and Technology Agency, Tokyo 102-0076, Japan

The exchange coupling phenomenon at the interface between a ferromagnet (FM) and an antiferromagnet (AFM) has possible applications in spintronic devices. α-Fe_2O_3 (Hematite) is the most stable iron oxide, and it has high Neel temperature (T_N) of 955 K. Thus α-Fe_2O_3/FM system is expected to work at high temperature with high stability. Till now, perpendicular was not observed for α-Fe_2O_3 /FM thin film system; only H_{ex} for in-plane direction was reported [1]. Because the spin direction of α-Fe_2O_3 lies parallel to ab-plane above Morin temperature T_M ~ 263 K, it was difficult to observe perpendicular H_{ex}. On the other hand, in the present spintronic devices, spin direction perpendicular to the film plane is necessary. Our group successfully enhanced T_M of α-Fe_2O_3 thin film to around 400 K by Ir doping [2]. In this work, we fabricated the Ir-doped α-Fe_2O_3 (Ir-Fe_2O_3)/Co exchange coupled thin film and investigated its dependence on Ir-Fe_2O_3 thickness. The sample structures are c-Al_2O_3 substrate/Ir-Fe_2O_3 x/Co 1/Pt 5 (nm). The perpendicular H_{ex} was observed in this thin film system even for 1-nm-thick Ir-Fe_2O_3 film. Fig. 1 shows temperature dependence of perpendicular H_{ex} and H_c of c-Al_2O_3 substrate/Ir-Fe_2O_3 5/Co 1/Pt 5 (nm). Details of thickness dependence will be reported.

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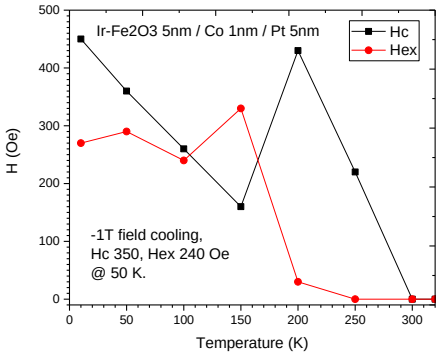

Fig. 1 Temperature dependence of perpendicular exchange bias H_{ex} and coercivity H_c of c-Al_2O_3 substrate/Ir-Fe_2O_3 5/Co 1/Pt 5 (nm) thin film system.