Large enhancement of magnetoresistance in thin NiAl-inserted $Co_2FeGa_{0.5}Ge_{0.5}$/Ag/$Co_2FeGa_{0.5}Ge_{0.5}$ CPP-GMR devices

National Institute for Materials Science [1], Kyoto Institute of Technology [2], ○Jinwon Jung[1], Yuya Sakuraba[1], Taisuke Sasaki[1], Yoshio Miura[1,2] and Kazuhiro Hono[1]

E-mail: Jung.Jinwon@nims.go.jp

Current-perpendicular-to-plane giant magnetoresistance (CPP-GMR) devices using Heusler alloy ferromagnetic (FM) layers have attracted much interest recently for potential applications as read sensors of future ultra-high density magnetic recording system above 2Tbit/in^2 due to the low devices resistance. [1] However, In order to produce a sufficient signal-to-noise, further enhanced the magnetoresistance (MR) output i.e., resistance-change area product (ΔRA) are desired in CPP-GMR devices.

We have investigated the effect of the insertion of a thin NiAl layer ($\leq$ 0.63 nm) to the $Co_2FeGa_{0.5}Ge_{0.5}$(CFGG)/Ag interface on the MR properties in CFGG/Ag/CFGG devices. The Insertion layer of NiAl was selected because a good band structure matching between NiAl and Heusler compounds has been implied from the similar band dispersions along the <001> at $k_{//}$ = (0,0). [2,3] We also have high magnetoresistance over than 100% in tunneling magnetoresistance (001)-Ag/CFGG interface from our First-principles calculations of the ballistic transmittance. As, a result, the insertion of NiAl layers at $Co_2FeGa_{0.5}Ge_{0.5}$/Ag interfaces effectively improved the intrinsic MR output; the highest ΔRA of 31 mΩμm^2 (78 mΩμm^2) and intrinsic MR ratio of 82% (285%) were obtained at room temperature (10 K), that are 2-3 times higher than those without NiAl insertion. Microstructure analysis using scanning transmission electron microscopy confirmed the existence of thin NiAl layers at the Ag interfaces with only modest inter-diffusion even after annealing at 550℃. The improvement of interfacial spin-dependent scattering by very thin NiAl insertion can be a predominant reason for the enhancement of MR output.

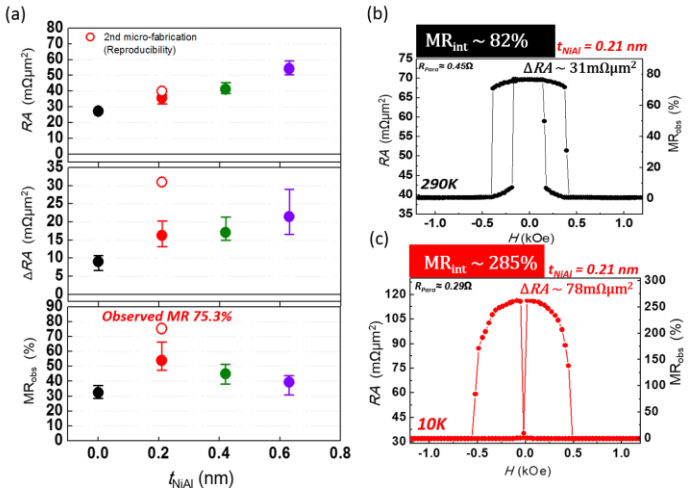

Fig. 1. (a) Inserted t_{NiAl} dependence and MR curves with t_{NiAl}=0.21 nm at (b) 290K and (c) 10K.

[1] M. Takagishi et al., IEEE Trans. Magn. **46**, 2086 (2010).

[2] S. -C. Lui et al., Phys. Rev. B **42** 1582 (1990).

[3] T. M. Nakatani. *Spin-dependent scattering in CPP-GMR using Heusler alloy and the selection of the spacer material*. PhD Thesis. University of Tsukuba (2011).