16p-P3-4

垂直磁化 FePd/Co_2MnSi エピタキシャル薄膜の作製

Fabrication of perpendicularly magnetized FePd/Co_2MnSi epitaxial films for an electrode of magnetic tunnel junctions

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Half-metallic Heusler compounds such as Co_2MnSi attract much interest because of their potential to enhance properties of various spintronic devices. Very high TMR ratio nearly 600% and 2000% at LT have been realized in the Co_2MnSi/Al-O/Co_2MnSi and Co_2MnSi/MgO/Co_2MnSi-MTJ, respectively, suggesting a high spin-polarization of Co_2MnSi.[1,2] One of the disadvantages of CMS is, however, small crystal magnetic anisotropy due to its cubic crystal structure, which results in poor endurance for thermal fluctuation in small devices with the size of a few tens nano-meters. Previously our group have fabricated the stacking structures with $L1_0$-FePt(001) or CoPt(001)/CMS(001) and successfully applied high uniaxial magnetic anisotropy to CMS from $L1_0$-Fe(Co)Pt.[3] However, high temperature annealing process nearly 500°C is necessary to obtain a highly $L1_0$-chemical ordering for FePt or CoPt, which is not suitable for practical application applications such as magnetic random access memory. In this study, we fabricated (001)-oriented epitaxial stacking films of $L1_0$-FePd(001)/CMS(001) because FePd has a relatively low $L1_0$-ordering temperature.

The FePd and FePd/CMS stacking films were fabricated on MgO (001) single crystalline substrate by a UHV magnetron sputtering system. The (001)-oriented epitaxial growth of FePd was confirmed by a grazing incidence XRD. Figure 1 shows the *M-H* loops for the FePd(10 nm)/CMS(2 nm) stacking film by applying magnetic filed to in-plane and out-of-plane directions. The perpendicular uniaxial magnetic anisotropy was clearly confirmed with a large K_u of 7.4×10^6 erg/cc. The perpendicularly magnetized CMS film is promising for an electrode of MTJs because of a high spin-polarization and thermal endurance.

[1] Y.Sakuraba et al., Appl. Phys. Lett. **88**, 192508 (2006).

[2] H-x. Liu et al., Appl. Phys. Lett. **101**, 132418 (2012)

[3] T.Hiratsuka et al., J. Appl. Phys. **107**, 09C714 (2010).

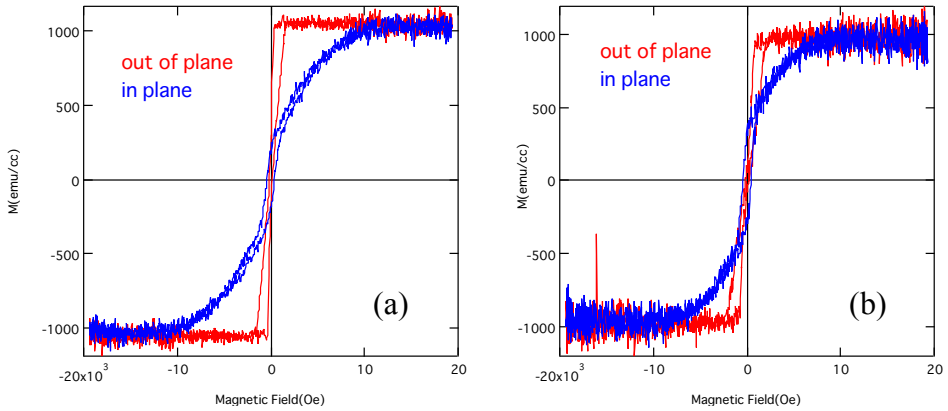

Fig. 1 M-H loops for (a)FePd(10 nm), (b)FePd(10 nm)/CMS(2 nm) films by applying magnetic field to the out-of-plane and in-plane directions.

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