Fe|Co|MgO 多層膜の垂直磁気異方性と磁化反転過程

Perpendicular magnetic anisotropy and magnetization switching process in Fe|Co|MgO multilayer

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Magnetic tunnel junction is a key device for next generation memory candidates. To control magnetization of MTJ, it is necessary to investigate the stability of magnetization direction due to interfacial anisotropy between ferromagnet and insulator [1]. Recently, monoatomic layer Co insertion at Fe|MgO interface has been reported with using x-ray fluorescence spectroscopy [2]. The Co insertion can enhance the magnitude of voltage induced magnetic anisotropy [2, 3] without using heavy metal. However, the magnetization switching process and its stability have not been studied systematically yet.

In this study, we investigate the magnetization switching process and its stability in the Fe|Co|MgO film stack with various Co thickness. The film stack, MgO (5 nm)|V (30 nm)|Fe (0.3 nm)|Co (t_{Co})|MgO (5 nm)|SiO_2 (5 nm), was deposited on MgO (001) substrate by molecular beam epitaxy and sputtering as shown in Fig. 1. The reflection high energy electron diffraction (RHEED) patterns at Fe and Co surfaces show clear epitaxial growth on MgO (001) substrate. We measured the magnetization process with using magneto-optical Kerr effect (MOKE) as shown in the inset of Fig. 2. The blue and red lines show the out-of-plane magnetic field dependence of MOKE signal at Co thickness of 0 nm and 0.15 nm. Figure 2 also shows the Co thickness dependence of coercive field H_c obtained from MOKE signal. We found that the easy axis of Fe|Co layer changes from out-of-plane to in-plane at Co thickness of 0.13 nm that equals approximately one atomic layer of Co. This research is supported by JSPS KAKENHI (Grant No. JP16H03850).

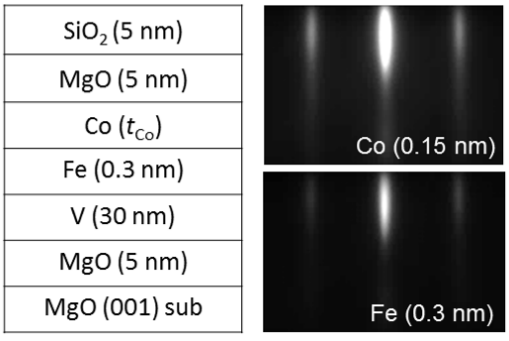

Fig. 1 Film structure and RHEED pattern of Fe and Co.

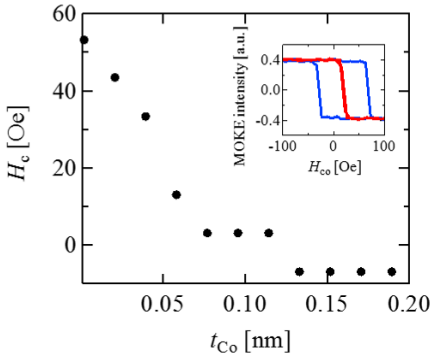

Fig. 2 Thickness dependence of coercive field

[1] P. Bruno *et al.*, Phys. Rev. B, **39**, 865 (1989) [2] T. Kawabe *et al.*, Phys. Rev. B, **96**, 220412 (2017) [3] J. Suwardy *et al.*, the 62nd MMM conference, FF-04 (2017).