20p-E7-6

MgO/FeB/MgO 積層膜における磁気異方性の上部 MgO 層厚依存性

Top MgO layer thickness dependence of magnetic anisotropy in MgO/FeB/MgO stacks

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Double CoFeB-MgO interface structure in magnetic tunnel junction (MTJ) showed higher thermal stability factor Δ without increasing intrinsic critical current I_{C0} compared to single-interface CoFeB-MgO recording layer [1,2]. High effective perpendicular magnetic anisotropy energy density K_{eff} [3] and high Δ with low I_{C0} [4, 5] were also reported in similar structure using double ferromagnet-MgO interface. In this study, we investigated magnetic properties of the MgO/FeB/MgO stack structure with various FeB and top MgO layer thicknesses.

The stack structures of substrate/Ta(5)/MgO(1.0)/$Fe_{80}B_{20}$(t_{FeB} = 2-4)/MgO(t_{MgO} = 0-2)/Ta(5)/Ru(5) (in nm) were deposited by rf magnetron sputtering. These stacks were annealed at 300°C for 1 h under perpendicular magnetic field of 0.4 T. Magnetic moment per unit area versus magnetic field curves (*m-H* curves) were measured by vibrating sample magnetometer.

K_{eff} was determined by area encircled by in-plane and out-of-plane *m-H* curves. The interface anisotropy energy density (K_i) was determined from the intercept of a liner fitting to dependence of $K_{eff}t^*$ on t^*, where $t^* = t_{FeB} - t_d$ (t_d is dead layer thickness determined by the same way used in ref. [6]). As shown in Fig. 1, K_i increases from 1.4 mJ/m^2 to 2.3 mJ/m^2 with increasing t_{MgO}. The value of K_i for MgO/FeB/MgO stacks does not reach twice of that for single-interface FeB-MgO stack. The result indicates that K_i of top and bottom interfaces are different.

This work was supported by JSPS through its FIRST program, R&D for Next-Generation IT of MEXT and JSPS Grant-in-Aid for Scientific Research (C) 23560355.

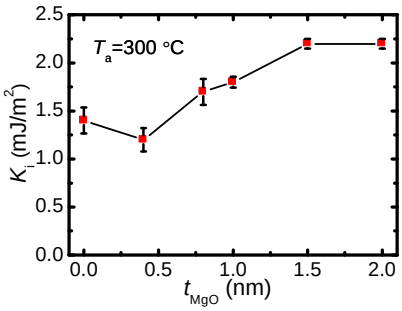

Fig.1 Top MgO layer thickness dependence of K_i in the MgO/FeB/MgO stacks annealed at 300°C.

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