Cr_2O_3 バリア上の Co の電圧誘起保磁力変化

Voltage induced coercivity change of Co film grown on Cr_2O_3 barrier

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Voltage-controlled magnetic anisotropy (VCMA) effect is a promising spin manipulation technique that can be utilized for a voltage induced dynamic magnetization switching with ultra-low power consumption. This effect has been mainly studied in bcc-Fe based materials compatible with MgO-based magnetic tunnel junctions, and a VCMA effect exceeding 320 fJ/Vm has been demonstrated[1]. However, a wide range of materials research to obtain larger VCMA coefficient and perpendicular magnetic anisotropy (PMA) are required. From this point, hcp-Co-based materials are a promising candidate. In this study, we fabricated Co film on corundum-type Cr_2O_3 dielectric material, which has good lattice matching with the Co (lattice mismatch ~1.6%), and investigated the coercivity (H_c) change by voltage application.

The film structure is c-Al_2O_3 sub/Pt (20 nm)/Cr_2O_3 (30 nm)/Co (1 nm)/Pt (5 nm). Cr_2O_3 was prepared by an oxygen radical assisted molecular beam epitaxy (MBE). The samples were micro-fabricated into a pillar of about 10 μm square. The out of plane magnetization curve and the H_c change by voltage application were measured by MOKE.

So far, a degradation of dielectric breakdown voltage for sputtered Cr_2O_3 thin film thinner than 100 nm was reported. However, we succeed to fabricate 30 nm-thick Cr_2O_3 thin films exhibiting dielectric properties comparable to thicker films, by MBE. A perpendicular magnetic anisotropy was obtained for the Co film grown on Cr_2O_3, due to interfacial perpendicular anisotropy at both Cr_2O_3/Co and Co/Pt interfaces[2]. An obvious H_c change was observed by voltage application; the H_c linearly decrease by positive voltage application (electron depletion) and ~20 Oe change in H_c by the application of 5V (1.67 MV/cm) was obtained. The H_c change is relative large compared to the previous results of Co-based materials[3,4].

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