

Pt/Co/Pd 構造における磁壁移動に対する電界効果

Electric field effect on magnetic domain wall motion in Pt/Co/Pd structures

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Recently, electric field (EF) effect on magnetic properties in a capacitor structure has been actively studied. In particular, we have reported the influence of the Pd layer insertion between a Co and an insulator layer (Pt/Co/Pd structure) on the EF effect. The change in the proximity-induced magnetic moment in the Pd [1] and a huge anisotropy modulation at low temperature [2] have been observed. In this study, we investigated the EF effect on the magnetic domain wall (DW) motion [3] in Pt/Co/Pd structures.

The multilayers of Ta(3.0 nm)/Pt(2.4)/Co(t_{Co})/Pd(0.4)/MgO(2.0) were deposited from the bottom side on thermally oxidized Si substrates and the films were patterned into a 20- μm -width wire structure. Then, HfO₂ gate insulator layer and Cr(1)/Au(10) electrode were deposited on the wire. The HfO₂ layer was formed using an atomic layer deposition at 150°C. The reference samples without the Pd layer were also prepared. The DW creep velocity (v) under the gate voltage (V_G) was determined using a magneto-optical Kerr microscope.

Figure 1 shows $v - (\mu_0 H_{\perp})^{-0.25}$ plots under $V_G = \pm 15$ V for $t_{\text{Co}} = 0.96$ nm sample, where $\mu_0 H_{\perp}$ is an external perpendicular magnetic field. The linear dependences of v are confirmed for both V_G . Large difference of v depending on V_G can be seen, and the difference between the results for $V_G = \pm 15$ V was approximately 100 times. Such a large magnitude of v modulation was not observed in the reference samples (without Pd). We found that the effective DW pinning strength, which can be determined from the slope of the $v - (\mu_0 H_{\perp})^{-0.25}$ relation was significantly modulated by V_G in the Pt/Co/Pd sample, resulting in the large change in v .

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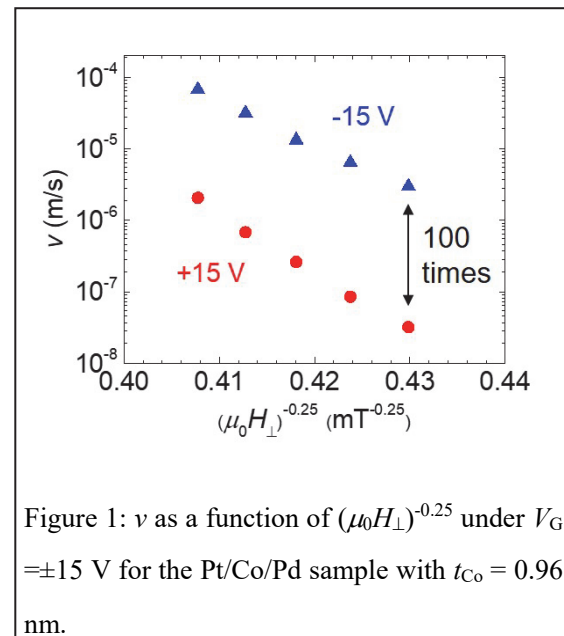


Figure 1: v as a function of $(\mu_0 H_{\perp})^{-0.25}$ under $V_G = \pm 15$ V for the Pt/Co/Pd sample with $t_{\text{Co}} = 0.96$ nm.

[1] A. Obinata, *et al.*, Sci. Rep. **5**, 14303 (2015). [2] Y. Hibino *et al.*, Appl. Phys. Lett. **109**, 082403 (2016).

[3] D. Chiba *et al.*, Nat. Commun. **3**, 888 (2012).