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Domain Patterns and Magnetization Reversal Behaviors in Oxide/Co/Pt Films

Jae-Chul Lee[1,2]*, Kang-Soo Lee[1], Cheong-Gu Cho[1], Kyoung-Woong Moon[1], Kyung-Ho Shin[2], Sug-Bong Choe[1]

[1]Center for Subwavelength Optics and School of Physics, Seoul National University, Seoul 151-742, Korea

[2]Center for Spintronics Research, Korea Institute of Science and Technology, Seoul 136-791, Korea

Magnetic films with the perpendicular magnetic anisotropy (PMA) draws great technological attention due to the possibility for smaller critical current and better thermal stability. Novel layer structures for PMA have been recently demonstrated using oxide/ferromagnet interface for application to the current-induced domain wall motion and the perpendicular spin-transfer-torque random-access-memory [1]. Here, we report the magnetic domain patterns and the magnetization reversal behaviors of Co films grown on Al2O3, MgO and SiO2 Oxide layers. 2-nm Oxide/x-nm Co/2-nm Pt samples are deposited by dc magnetron sputtering onto bare Si substrates with changing the Co layer thickness from 0.7 to 2 nm. The magnetic domain images are then monitored by a magneto-optical Kerr-effect microscope. Figure 1 illustrates the domain patterns of samples with respect to the Co thickness for each oxide layer. Each image is 230 μm×190 μm in size. The out-of-plane hysteresis loops are plotted onto the corresponding images, where the abscissa is ranging from -2 KOe to +2 KOe and the ordinate is normalized. For all the Oxide layers, clear circular magnetic domains are seen in 1-nm Co layers and then, the domain phase transition as well as the spin orientation transition is observed with increasing to the Co thickness, whereas the transition thicknesses are dependent on the Oxide layer. Such the transitions are ascribed to the counterbalance between the magnetic anisotropy and magnetostatic energy [2]. The saturation magnetization and the magnetic anisotropy are measured by the alternating gradient magnetometer and the rotating extraordinary Hall effect measurements, respectively [3]. The uniaxial anisotropy is summarized with respect to Co-thickness for various oxide layers in Table. I.

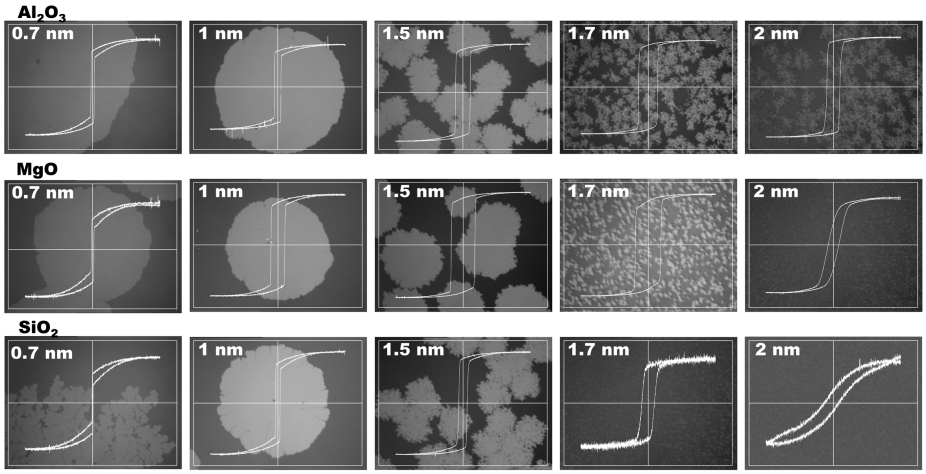

Figure 1. MOKE images and hysteresis loops of Co layers grown on Al_2O_3, MgO and SiO_2.

Table. I. The perpendicular anisotropy KU of oxide/Co(x nm)/Pt structure with different thickness of Co layers grown on Al_2O_3, MgO, and SiO_2.

K_U (10^5 J/m^3)

x (nm)	0.7	1.0	1.5	1.7	2.0
Al_2O_3	5.1±0.26	5.7±0.30	3.2±0.17	2.5±0.13	1.3±0.07
MgO	4.0±0.21	8.7±0.45	4.7±0.25	3.3±0.17	0.4±0.02
SiO_2	2.9±0.15	3.7±0.19	1.9±0.09	0.7±0.03	X

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