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Observation on coexistence of magnetic anisotropy in Co/Pd(111) using surface magneto-optical Kerr effects

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표면 광자기 Kerr 효과를 이용한 Co/Pd(111)의 자기이방성의 공존현상 연구

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Magnetic anisotropies of Co/Pd(111) are investigated with *in situ* surface magneto-optical Kerr effects (SMOKE) in an ultrahigh vacuum (UHV). Fig. 1 shows the evolution of polar- and longitudinal-SMOKE hysteresis loops as a function of thickness of cobalt layer. The evolution is characterized with several regions, such as (i) 0~1.5 ML, (ii) 1.5~2.5 ML, (iii) 2.5~9 ML, and (iv) 9~11.4 ML. Region (i) is characterized as a paramagnetism. And in regions (ii) and (iii), coexistence of perpendicular and in-plane anisotropy is found.

Most features of the perpendicular magnetic anisotropy shown in Figs. 2(a) and 2(b) might be understood with a coherent-incoherent transition of growth mode at region (ii) and a spin reorientation transition at region (iv). In region (iii), Kerr amplitude increases linearly due to incoherency and coercivity decreases with a power law as ~ $t_{Co}^{-1.24}$, which is slow but enough condition for spin reorientation transition in this system. Also, from the offset found in Kerr amplitude, contribution of Pd is estimated to be ~ 1.4 ML of Co.

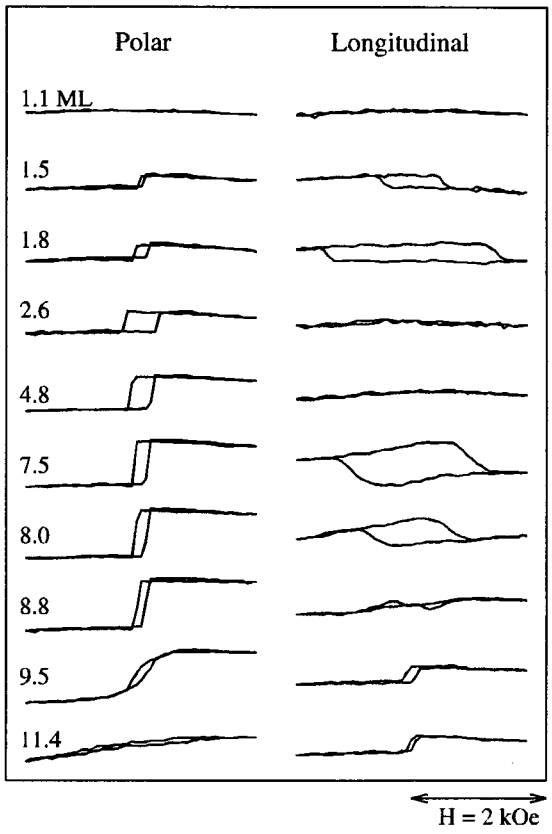

FIG. 1: Polar- and Longitudinal-SMOKE hysteresis loops of Co/Pd(111). The corresponding Co thickness are indicated for each loops.

As shown in Figs. 3(a) and 3(b), the in-plane magnetic anisotropy is found even below the spin reorientation transition. Anomalies in the plane are attributed to the in-plane crystal symmetry of Pd(111) and rotation of easy axis.

Along with the coexistence of magnetic anisotropies, the remarkable feature in our work is that the remanence is nearly 100% of its saturated value for both polar and longitudinal hysteresis loops. And this feature is better described with the field-induced reorientation by Millev et al.,[1] rather than with a simple canted magnet.

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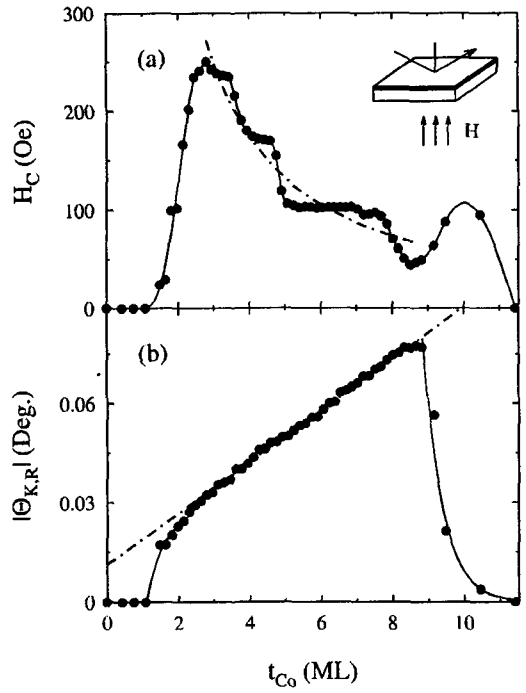

FIG. 2: (a) Coercivity (H_c) and (b) remanence of Kerr amplitude ($|\Theta_{K,R}|$) of Co/Pd(111) in the polar geometry with 45° incidence.

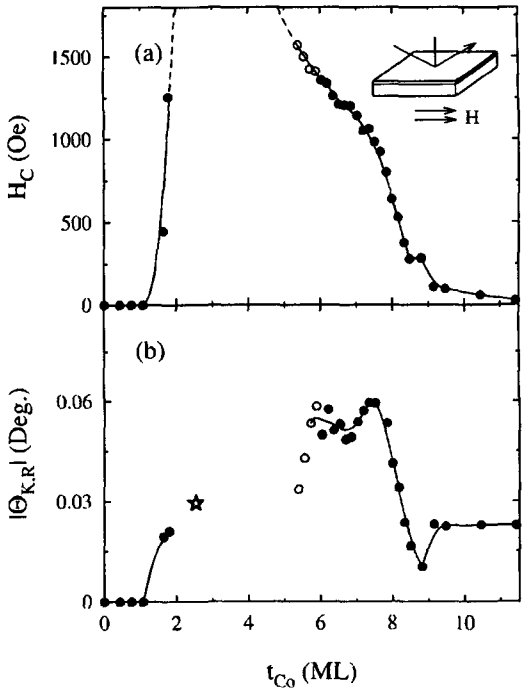

FIG. 3: (a) Coercivity (H_c) and (b) remanence of Kerr amplitude ($|\Theta_{K,R}|$) of Co/Pd(111) in the longitudinal geometry with 45° incidence.

REFERENCES

[1] Y. T. Millev, H. P. Oepen, and J. Kirschner, Phys. Rev. B **57**, 5848 (1998); **57**, 5837 (1998).