Modulation of magnetic anisotropy through self-assembled surface nanoclusters: evolution of morphology and magnetism in Co-Pd alloy films

Wen-Chin Lin[1]

[1] *Department of Physics, National Taiwan Normal University, Taipei 11677, Taiwan*

In this study, the self-assembly of surface nanoclusters on 10-20-nm-thick $Co_{50}Pd_{50}$ (Co-Pd) alloy thin films deposited on the $Al_2O_3(0001)$ substrate was systematically investigated. When the Co-Pd alloy films were stored in an ambient environment, small nanodots gradually gathered to form large nanoclusters. Approximately 30 days after growth, a nanocluster array formed with an average lateral size of 100 $\pm$ 20 nm and average height of 10 $\pm$ 3 nm. After 100 days, the average lateral size and average height had increased to 140 $\pm$ 20 and 25 $\pm$ 5 nm, respectively. Cross-sectional investigation through transmission electron microscopy coupled with energy dispersive spectroscopy showed that the nanoclusters were mostly composed of Co oxide. A uniform Pd-rich underlayer had ben maintained underneath the self-assembled Co-oxide nanoclusters. With the formation of a Co-oxide nanocluster array, the magnetic easy axis of the Co-Pd film gradually altered its direction from the pristine perpendicular to in-plane direction. The hydrogenation-induced spin-reorientation transition was also suppressed with the evolution of the surface Co-oxide nanoclusters.