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Effects of Cr Addition on the Interface Magnetic Anisotropy of Co-Cr/Pd Mutilayers

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Multilayers consisting of Co-based alloy and noble metal are promising materials for a high density magnetic recording media, because of their high perpendicular magnetic anisotropy (PMA). PMA in these multilayers is thought to originate from an interface between Co alloy and noble metal layers [1]. It is well known that partial replacement of Co by Cr is effective to enhance the isolation of magnetic particle and then to reduce a recording noise. Moreover, a reduction rate of magnetization as a function of Cr content in Co-Cr/Pt multilayers is much smaller than that in bulk Co-Cr alloys or in thick films [1]. Therefore, it is important to evaluate an effect of Cr addition on the interface magnetic anisotropy. Here, we report the result *of structural and magnetic investigations in Co-Cr/Pd multilayers with different Cr contents.*

Co-Cr/Pd multilayers were fabricated by RF magnetron sputtering on glass substrate at an ambient substrate temperature (~323K) in 2Pa Ar gas. The films have the forms of glass / Ti(10 nm) / Pd(50 nm) / [Co-Cr(t_{Co-Cr})/Pd(t_{Pd})]$_{12}$ / Pd(10 nm), in which the thickness parameters t_{Co-Cr} and t_{Pd} were varied in the range of 0.2~0.8 nm and 0.6~1.4 nm, respectively. The Cr content of the multilayer was controlled by using different alloy targets $Co_{100-x}Cr_x$ with various x = 0, 8, 14, 20. Magnetic properties were measured by vibrating sample magnetometer (VSM). Multilayered structure and crystal structure was characterized by grazing incidence X-ray diffraction (GIXD) and conventional X-ray diffraction (XRD) techniques, respectively. Surface morphology of the films was observed by atomic force microscopy (AFM).

Fig. 1 shows the normalized saturation magnetization $M_S/M_S^{x=0}$ as a function of Cr content x. The reduction rate of magnetization is much smaller than in the bulk Co-Cr alloys. This result is similar to the Co-Cr/Pt multilayers [1]. The effective magnetic anisotropy constant K_{eff} was evaluated by an area surrounded by easy- and hard-axis magnetization curves. We then tried to separate an interface anisotropy constant K_I from the volume anisotropy constant K_V, by assuming a simplified equation [2], $K_{eff} = K_V + 2K_I \cdot t_{Co-Cr}^{-1}$.

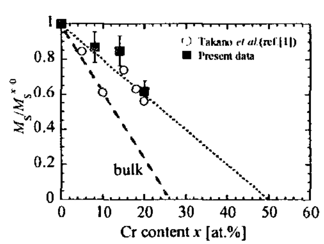

Fig. 1. Normalized saturation magnetization $M_S/M_S^{x=0}$ as a function of Cr content x.

We found that the reduction rate of K_I as a function of x is as small as that of magnetization in the present multilayers. This result then suggests that a phase separation is effectively promoted.

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Structural and Magnetic Properties of Ion-beam Bombarded Co/Pt Multilayers

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Ordered alloy thin films have been of great interest from the point of view of fundamental understanding as well as potential applications in data storage[1]. A series of Co/Pt multilayers were deposited by using a ion-beam deposition technique [2]. X-ray diffraction and transmission electron microscopy results have shown that as-deposited samples consist of h.c.p. Co and f.c.c. Pt phases. The coercivity of these as-deposited samples is small (H_c < 100 Oe), which we believe is mainly from the Co phase. After rapid thermal annealing, either f.c.t. CoPt (a= 3.83 Å, c = 3.68 Å) or f.c.c. $CoPt_3$ (a= 3.86 Å) phases were observed, depending on the initial [Pt(x nm)/Co(y nm)]z configuration. The largest coercivity and order parameter (S) has been estimated to be H_c ~ 6500 Oe and S~ 0.96 for an annealed [Pt (4 nm)/Co(4 nm)]2 sample. Ion-beam bombardment results have shown that the coercivities (ranging from 100 Oe to 300 Oe) of [Pt(2 nm)/Co(2 nm)]10/Pt(30 nm) multilayers decrease with increasing End-Hall voltage (VEH, that induces greater ion-beam bombardment energy). This indicates that formation of a $CoPt_3$ phase will be suppressed by energetic ion-beam bombardment. After annealing, the formation of $CoPt_3$ is observed in these ion-beam bombarded samples, however, with lower coercivities (H_c ~ 50 Oe). Results also indicate that increasing ion-beam bombardment (V_{EH}) decreases the transition temperature of $CoPt_3$, as films deposited with the greatest V_{EH} exhibited no magnetism.

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