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The X-Pt (X=Ge, Cr) Underlayer Thickness Effect on Magnetic Properties of $L1_0$ FePt Films

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We explored the GePt underlayer thickness effect on the ordering of $L1_0$ FePt film. The GePt underlayer was deposited on quartz at 800oC and the thickness changed from 10 to 120 nm. The underlayer surface morphology changed from continuous to island-like structure when the thickness is smaller than 30 nm. As a result, different GePt surface roughness and stress field distribution were supplied before FePt deposition. After FePt deposition, the bilayer was post-annealed at 400℃. The in plane coercivity (H_c) decreased from 14 to 2 kOe when the underlayer thickness increased form 10 to 120 nm. First, we suggested the stress enhanced FePt ordering on the island-like underlayer and the coercivity were larger than 7.3 kOe. Second, with GePt underlayer thickness 120 nm, the Ge atoms diffused into the FePt film that suppressed the ordering and the coercivity was 2 kOe.

To compare the underlayer surface morphology effect, we studied $L1_0$ FePt(60 nm)/CrPt films at different CrPt thickness from 20 nm to 120 nm with fixed post annealing temperature 400℃. By introducing the equal-atomic CrPt underlayer, the in-plane and out-of plane corecivity and squareness ration are higher than the single layer FePt (H_c ~ 7.3 kOe). The $L1_0$ CrPt (001) diffraction peak enhanced the $L1_0$ FePt (001) peak when the CrPt underlayer thickness increased. Comparing to the single layer FePt, the ordering parameter (S) increased from 0.82 to 0.96. The FePt grain size in bilayer is larger than in single layer but the FePt annealed twins in bilayer is less than in single layer. We suggest the improvement of hard magnetic properties in bilayer was caused by the underlayer structure and growth orientation. The surface roughness increased with the CrPt underlayer thickness increased, and higher coercivity, squareness ratio was obtained when the FePt film deposited on the rougher CrPt underlayer.

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Perpendicular Magnetic Anisotropy of Co_3Pt Electroplated on the Ru Buffer

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To overcome the limit of conventional continuous magnetic media with the increase of the areal density, such as superparamagnetic effect, Co-Pt and Fe-Pt alloys having perpendicular magnetic anisotropy has been suggested as one of potential solution [1,2]. Among these materials, Co_3Pt has been a promising material for high density magnetic recording media due to the high magnetic anisotropy and high coercivity without high deposition temperature or post annealing.

In this study, Co-Pt alloy thin films were galvanostatically electrodeposited from an aqueous electrolyte consisting of Co sulphamate solution and PtP salt. The pH was controlled by using NaOH. The seed layers consisted of 5 nm thick Ta as an adhesion layer and 20 nm thick Ru film grown by dc magnetron sputtering. The electroplating was carried out at current density of 20 mA/cm^2 and solution temperature of 65 ℃. These films were analyzed by TEM, EDS, XRD and measurements of magnetic properties were performed using a vibrating sample magnetometer and torque magnetometer. These films exhibited high perpendicular magnetic anisotropy, as well as its coercivity and squareness were confirmed very highly up to 6414 Oe and 0.86, respectively without heat treatment. The composition of Co-Pt alloy electroplated were Co-25.19 at. % Pt corresponding to Co_3Pt phase. Results in TEM analysis showed that this film had columnar structure and HCP structure of Co_3Pt by Ru buffer.

Fig. 1. Cross-sectional TEM image for Co3Pt electroplated on the Ru buffer.

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