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Effect of structural change on the magnetostriction coefficient in the CoCrPt alloy thin films

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1. INTRODUCTION

CoCrPt alloy films are one of the most promising candidates for high-density perpendicular magnetic recording media due to their strong perpendicular magnetic anisotropy (PMA) and high coercivity [1].

In order to achieve high-density magnetic recording media, it is essential to characterize the magnetoelastic properties since experimental and theoretical research has revealed a significant magnetoelastic contribution to the magnetic properties in magnetic thin films. One of the significant parameters to investigate the magnetoelastic properties is the magnetostriction constant [2]. However, very little work has been done for measure of magnetostriction constant in alloy thin film due to the limitation of measurement facilities. In this work, we have measured the magnetostriction constant in CoCrPt alloy thin films and clarify the influence of the structural properties on magnetoelastic constant.

2. EXPERIMENT

Serial samples of 500-Å $(Co_{72}Cr_{18})_{100-x}Pt_x$/1300-Å Ti films were prepared under an optimal condition to achieve PMA by dc-magnetron co-sputtering under an Ar pressure of 3 mTorr at ambient temperature with changing Pt composition x from 0 to 35. The film growth orientation was characterized using a high-angle x-ray diffractormeter (XRD). The magnetostriction constant of CoCrPt alloy thin film was measured by a highly sensitive laser deflection system using a one-dimensional position sensitive detector (PSD). The position resolution of our one-dimensional PSD was 0.3 μm.

3. RESULTS AND DISCUSSION

Fig. 1 shows the magnetostriction constant for the 500-Å $(Co_{72}Cr_{18})_{100-x}Pt_x$/ 1300-Å Ti alloy thin films as a function of Pt concentration. It is clearly seen from the figure that the magnetostriction constant is sensitively dependent on the Pt concentration. The magnetostriction constant is increased from -7.23×10^{-6} to 8.5×10^{-6} with increasing the Pt concentration from 0 at.% to 35 at.%. It is worthwhile to note from Fig.1 that the sign of magnetostriction constant is varied from negative to positive at 21 at.% Pt. To understand the magnetostriction constant dependent on the Pt concentration, we have investigated

structural properties via high angle x-ray diffractormetry, considering the fact that the structural properties have a considerable influence on magnetoelastic properties.

Fig. 2 (a), (b) illustrate the relative intensity and the shift of the hcp (002) peak position with varying the Pt concentration. As the Pt concentration increases, the relative peak intensity is increased and the peak position is shifted toward lower angle. The increase of relative peak intensity indicates that the c-axis ordering of CoCrPt films was improved with increasing the Pt concentration and the shift of the peak position can be explaned by taking into account lattice expansion of CoCrPt alloy. Thus, it could be conjectured that the observed magnetostriction coefficient variation with the Pt concentration could be understood to be from enhancement of c-axis ordering and induced strain of CoCrPt films.

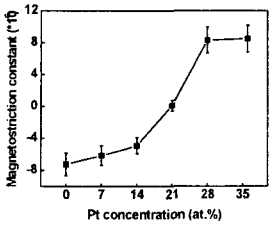

Fig.1. Magnetostriction constant of 500-$(Co_{72}Cr_{18})_{100-x}Pt_x$/ 1300-Å Ti allo films as a function of the P concentration.

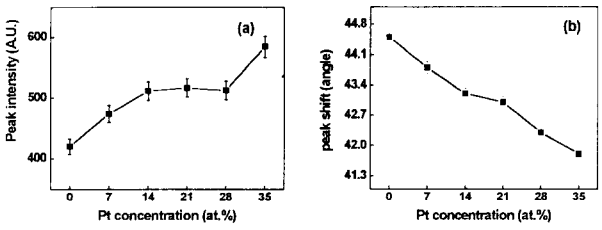

Fig.2. (a) relative intensity (b) position of hc (002) peak in 500-Å $(Co_{72}Cr_{18})_{100-x}Pt_x$ 1300-Å Ti alloy films as a function of the P concentration.

4. ACKNOWLEDGMENTS

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5. REFERENCES

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