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Pt 함량에 따른 CoCrPt 합금박막의 국소보자력 분포 변화

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Variation of Local Coercivity Distribution in CoCrPt Alloy Films with Pt Composition

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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 local magnetic variation that relates to the microstructure of films. Moreover, the local magnetic variation that generally exists in real films has a critical effect on magnetization reversal mechanism, which has a decisive role in the magnetic domain recording process [2]. In this work, we have investigated the local magnetic variation in CoCrPt alloy films with perpendicular anisotropy and clarify the influence of the microstructral properties on the local magnetic variation.

2. EXPERIMENT

Serial samples of 500-Å Si_3N_4/400-Å $(Co_{72}Cr_{18})_{100-x}Pt_x$/1100-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 6 to 28. The film growth orientation, film surface morphology, and microstructures were characterized using a high-angle x-ray diffractormeter (XRD), scanning electron microscope (SEM), and transmission electron microscope (TEM), respectively. The local coercivity distribution was investigated using the magneto-optical microscope magnetometer (MOMM) system. Additionally, the spatial coercivity distribution was obtained by mapping the colors onto the map.

3. RESULTS AND DISCUSSION

In Fig. 1, we plot the local coercivity distribution density for the alloy films with Pt concentration of (a) 6 and (d) 28 at. %. It is clearly seen from the figure that the local coercivity distribution is distinctively deviated from a Gaussian distribution with increasing the Pt concentration: the local coercivity distribution for the sample with x=6 at.% could be well-fitted by a Gaussian distribution function, whereas the samples with x = 28 at.% is observed to deviate from a Gaussian distribution. As the Pt concentration increases, full-width-half-maximum (FWHM) of the local coercivity distribution and an average of the local coercivity monotonically increase from 0.17 kOe to 0.34 kOe and from 0.43 kOe to 1.3 kOe, respectively. To understand the local coercivity distribution and average local coercivity dependent on the Pt concentration, we have investigated the grain size and grain size distribution in CoCrPt alloy films via TEM images. Fig. 4, illustrate the grain size distribution for the samples. The grain size distribution of sample with the Pt concentration of 6 at.% is observed to be Gaussian shape, whereas the sample with the Pt concentration of 28 at.% show non-Gaussian shape. Most interestingly, one can notice that the grain size distribution for each sample shows similar variation with that of the local coercivity in Fig.1. This observation directly demonstrates the close correlation between local coercivity distribution and grain size distribution.

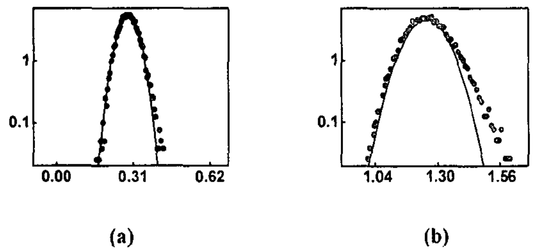

Fig.1. Distribution density of the local coercivity of the 500-Å Si_3N_4/ 400-Å $(Co_{72}Cr_{18})_{100-x}Pt_x$/ 1100-Å Ti alloy films with (a) x=6 at.%, (b) x=28 at.%.

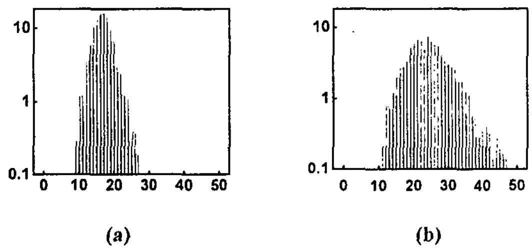

Fig.2. Distribution density of the grain size of the 500-Å Si_3N_4/400-Å $(Co_{72}Cr_{18})_{100-x}Pt_x$/1100-Å Ti alloy films with (a) x=6, (b) x=28 at. %.

4. CONCLUSIONS

We have found that the local coercivity distribution takes crossover from a Gaussian to a non-Gaussian distribution with increasing Pt concentration. The transition of local coercivity distribution and the average local coercivity were closely correlated with the grain size distribution and its average size, respectively.

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