D-04

CoCrPt-Oxide계 수직기록매체의 결정립크기 및 결정립분리에 미치는 인자
(Factors controling the grain size and grain isolation of CoCrPt-Oxide perpendicular recording media)

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1. Introduction

Larger perpendicular anisotropy(Ku), enhancement of grain isolation, and small and uniform grain size are critical issues for perpendicular magnetic recording(PMR) to achieve high recording density beyond 200 Gbit/in^2. CoCrPtO PMR media have relatively large Ku and well isolated grains because those have low Cr and high Pt content and thick oxide grain boundaries. In case of CoCrPtO media, the grain isolation by oxide can be manipulated through the control of oxygen partial pressure during the sputtering. However, it has been reported that the coercivity(Hc) and grain isolation of CoCrPtO layers can also be affected by soft magnetic underlayer(SUL) conditions[1]. In the present work, we investigated factors controling the grain size and isolation of CoCrPt-Oxide media by changing the sputtering pressure of SULs and Ru underlayers.

2. Experiments

The films structure of CoCrPtO(20 nm)/Ru(20 nm)/Ta(5 nm)/ CoZrNb(200 nm) was used. Sputtering pressure for the SULs was varied from 1.5 mtorr to 40 mtorr to modify residual stress and surface morphology while the sputtering conditions for CoCrPtO(20 nm)/Ru(20 nm)/Ta(5 nm) layers were fixed. On the other hand, sputtering pressure of Ru underlayers was also modified to investigate the effect of Ru underlayers. Residual stress was measured by a curvature method. Surface morphology was investigated by AFM and TEM. Magnetic hysteresis loops of CoCrPtO layers were measured by a polar KERR hysteresis loop tracer.

3. Results and discussion

Fig.1 shows Kerr hysteresis loops of CoCrPtO layers grown on top of the SULs which were deposited at the different sputtering pressure. As the sputtering pressure of the SULs increases, Hc increases drastically up to 10 mtorr and decrease gradually beyond the pressure. The increase of the Hc are due to the enhancement of grain isolation which are confirmed by TEM images. The residual stress induced on the SULs and the Hc of CoCrPtO layers grown on the SULs are plotted together in Fig.2. The behavior of the residual stress are in good agreement with that of the Hc. The Hc of the CoCrPtO layers grown on tensile stressed SULs show higer values than that on the compressive stressed SUL. The CoZrNb SUL deposited at 3 mtorr has compressive stress and very flat surface. Ru underlayer(UL) grown on the SUL follows the surface roughness of the SUL. On the other hand, the CoZrNb SUL deposited at 10 mtorr has tensile stress and very rough surface. Ru UL grown on the SUL also follows the surface morphology of the SUL. The CoCrPtO layers grown the rougher Ru ULs have thicker oxide boundaries than the fatter Ru ULs because the valley of Ru UL with higher chemical potentials more favorable site for oxide formation. These results indicate that the grain isolation are correlated with the surface topology of the SUL which may be associated with residual stress. Up to now, direct relationship between surface topology and residual stress are not known although it is reported that the surface evolves and roughens as it is driven by the relaxation of strain energy[2]. In this work, the effect of Ru

underlayers also were investigated. Magnetic properties, microstructure and chemical analysis to explain and find out the factors about the results will be discussed later in detail through the VSM, TEM and XPS

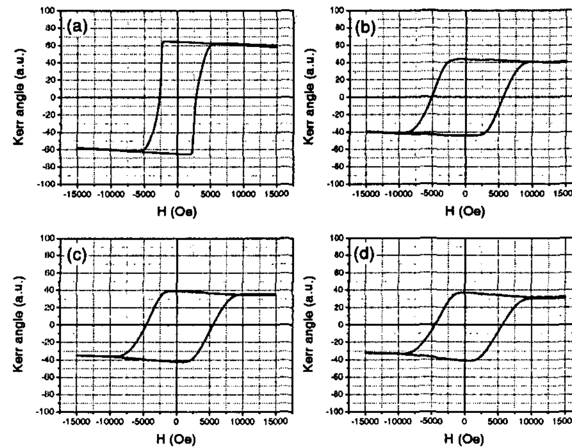

Fig. 1 Hysteresis loops of CoCrPtO(20 nm)/ Ru(20 nm)/ Ta(5 nm)/ CoZrNb(200 nm) with variation of sputtering pressure of CoZrNb SUL((a) 3 mtorr, (b) 10 mtorr, (c) 20 mtorr, (d) 40 mtorr)

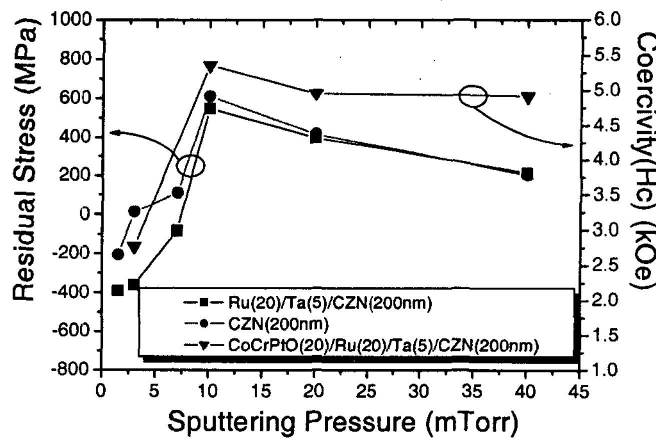

Fig. 2 Residual stress and coercivity of Ru(20 m)/ Ta(5 nm)/ CoZrNb(200 nm) and CoZrNb(200 nm) with variation of sputtering pressure of CoZrNb SUL

References

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