C9

광자기 디스크의 기록 및 자기적 특성에 산소가 미치는 영향

전남대학교 금속공학과 최 건

EFFECT OF OXYGEN ON THE MAGNETIC AND RECORDING CHARACTERISTICS OF MAGNETO-OPTICAL DISK

Dept. of Metallurgical Eng., Chonnam National Univ., G. Choe

Introduction

The environmental stability of amorphous rare earth-transition metal films is a key issue for their use in magneto-optical media. Although several methods such as using additives[1,2] or protective layers[3,4] have been developed for reducing the rate of film degradation, there still is a concern about the incorporation of oxygen in MO films, since oxygen in the MO disk is known to degrade the magnetic perpendicular anisotropy and the disk performance. In this study, the effects of different partial pressures of oxygen during sputtering on the magnetic and recording characteristics of MO disks were investigated.

Experiments

Different flows of oxygen were deliberately introduced into the MO sputtering chamber to have a variety of partial pressures of oxygen during sputtering. Using a residual gas analyzer to monitor the oxygen peak before, during, and after sputtering, the reacted oxygen amount was estimated. The oxygen content in the MO film was analyzed by secondary ion mass spectroscopy (SIMS) and Auger electron spectroscopy (AES). The magnetic and magneto-optical properties such as coercivity, perpendicular anisotropy, and Kerr rotation angle were measured using a vibrating sample magnetometer, a torque magnetometer, and a Kerr loop tracer. Dynamic characterization of the MO disks were performed at a carrier frequency of 4.93 MHz and a linear velocity of 7.5 m/sec.

Results

Most of the oxygen introduced into the chamber is reacted during sputtering as shown in Fig.1. The deposition rate, however, remains constant until the partial pressure of oxygen is more than $9.0\mathrm{x}10^{-5}$ torr when the oxidation of the target starts to occur. As the partial pressure of oxygen increases, the oxygen content of the MO film increases also. This oxygen appears to be bound as Tb-O, effectively decreasing the magnetically active Tb content of the film. The coercivity decreases (Fig.2) but the squareness of the B-H loop is still excellent and the Kerr rotation angle increases slightly due to the more iron rich composition. The perpendicular anisotropy decreases with increasing oxygen pressure, but not significantly, as shown in Fig.3. The CNR performance, including the write power sensitivity and bias field sensitivity is acceptable for disks sputtered with oxygen partial pressure up to $9.0\mathrm{x}10^{-5}$ torr. The write power sensitivity does not change significantly up to $1.5\mathrm{x}10^{-4}$ of oxygen pressure(Fig.4) when threshold decreases due to high demagnetization(Fig.7) and possibly due to a more porous film microstructure resulting from Tb oxidation. However, the disks sputtered with oxygen show better external bias field sensitivity with higher thresholds than the disk sputtered without oxygen (Fig.5). This change in write power threshold with oxygen is more significant for the disk sputtered with the higher oxygen content MO target. Disks sputtered at lower deposition rates are more easily oxidized and degraded than disks sputtered at higher deposition rates. The oxygen in the film appears to be stably bound as terbium oxide and no significant degradation of coercivity is observed during an accelerated aging test (Fig.6).

[1] M.Kobayashi, M.Asano, Y.Maeuo, K.Oishi and K.Kawamura, Appl.Phys.Lett. 50, 1694(1987)

[2] T.K.Hatwar and D.Majumdar, IEEE Trans. on Mag. MAG-24,2449 (1988)

[3] M.Asano, M.Kobayashi, Y.Maeno, K.Oishi and K.Kawamura, IEEE Trans. on Mag. MAG-23, 2620 (1987)

[4] M.Miyazaki, I. Shibata, S.Okada, K.Ito and S.Ogawa, J.Appl.Phys. 59, 213 (1986)

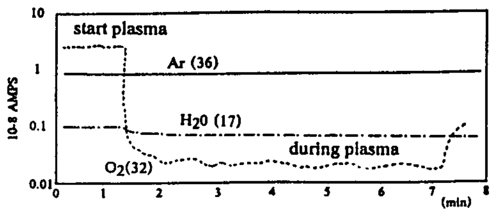


Fig.1: Isitu profile of residual gases during sputtering: oxygen partial pressure before sputtering is 9×10^{-5} torr.

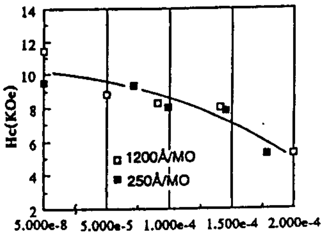
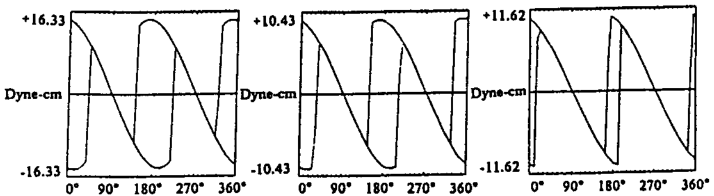


Fig.2: Change in magnetic coercivity with oxygen partial pressure.



(a) $K_u = 3.34\times10^6$ erg/cm^3 (b) $K_u = 2.57\times10^6$ erg/cm^3 (c) $K_u = 1.97\times10^6$ erg/cm^3

Fig.3: Change in Torque curves with oxygen partial pressure: (a) 5.0×10^{-8} torr, (b) 1.5×10^{-4} torr and (c) 2.1×10^{-4} torr.

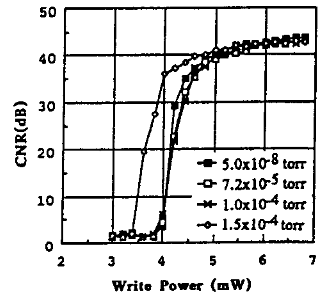


Fig.4: Write power sensitivity of MO disks sputtered with different oxygen partial pressures.

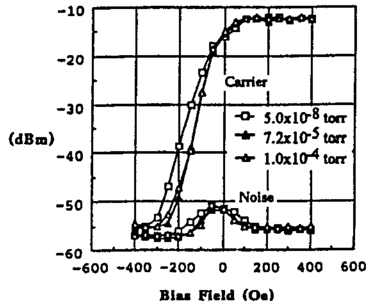


Fig.5: Write bias field sensitivity of MO disks sputtered with different oxygen partial pressures.

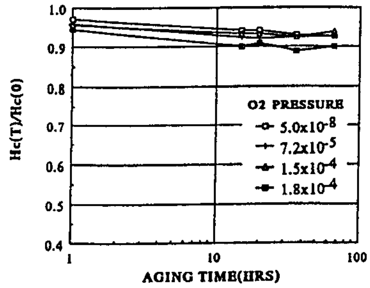


Fig.6: Change in coercivity with aging time at 100°C air.

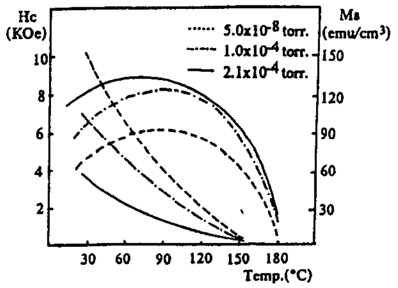


Fig.7: Dependence of Hc and Ms on temperature for the samples sputtered with different oxygen pressure.