대향타겟식 스퍼터를 이용한 박막의 제작

Preparation of Thin Film using Facing Target Sputtering

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Introduction

It is well known that the Co-Cr film is a candidate for the perpendicular magnetic recording media. The Co-Cr film has been worked out by several researchers. In particular, there has been several reports about initial layer influences on the magnetic properties and the structure of Co-Cr film.[1][2]

However, It has not been studied yet the magnetic properties of intial layer without etching. In general, it is said that the magnetic properties are related to crystal sturctures.

In this study, we prepared the Co-Cr monolayer film and investigate the magnetic properties of Co-Cr initial layer and propose a way of estimation of the Co-Cr crystallinity in the Co-Cr monolayer film using Kerr effect.

Experimental Procedure

The specimen $Co_{83}Cr_{17}$ films were deposited on glass substrates at room temperature using facing targets sputtering(FTS) apparatus and the fundamentals of standard FTS system is schematically shown in Fig. 1

Their thickness was fixed at 200nm, of which the value was most acceptable for perpendicular magnetic media. Ar gas pressure P_{Ar} was varied in the range from 0.3 to 10 mTorr. The crystallographical characteristics such as relative diffraction intensity $I_{(002)}$, interplanar distance $d_{(002)}$ and dispersion angle of c-axis $\Delta\theta_{50}$ were evaluated on X-ray diffraction diagrams. On the other hands, the magnetic characteristics such as saturation magnetization M_s and perpendicular coercivity $H_{c\perp}(W)$ of the whole films were determined using vibrating sample magnetometer(VSM).

Kerr hysteresis loops were observed at the wavelengh of 830 nm from the both sides of substrate and film, where penetration depth of incident light was estimated to be about 15nm. So, covercivities of the loops on the side of substrate and film, $H_{c\perp}(I)$ and $H_{c\perp}$ (S) were defined as those of initial growth and surface layers, respectively.

Result and Discussion

Fig. 2 shows the dependence of perpendicular coercivity for initial layer, whole film and surface layer, $H_{c\perp}(I)$, $H_{c\perp}(W)$ and $H_{c\perp}(S)$, respectively, on Ar pressure P_{Ar}. $H_{c\perp}(W)$ was much higher than $H_{c\perp}(I)$, while $H_{c\perp}(S)$ was silghtly higher than $H_{c\perp}(W)$.

Saturation magnetization M_s decreased at P_{Ar} higher than 3mTorr as shown in Fig. 3. The decrease of M_s was attributed to many voids at the grain boundary.

Fig. 4 shows the dependence of Kerr rotation angle of initial growth and surface layer, $\theta_k(I)$ and $\theta_k(S)$, respectively, on Ar presure. $\theta_k(S)$ decreased with increase of P_{Ar}, while $\theta_k(I)$ was almost constant at various P_{Ar}. These results indicate that $\theta_k(S)$ depended on M_s, while $\theta_k(I)$ was independent of M_s. This may be due to surface layer includes many voids around the grain boundary, while voids in the initial growth layer was few at higher P_{Ar}.

Reference

[1] S. Iwasaki and Y. Nakamura, IEEE Trans. Magn. MAG-13, 1272 (1977)

[2] C. Byun, J. H. Judy, J. Appl. Phys., Vol. 57, 1. 3997 (1985)

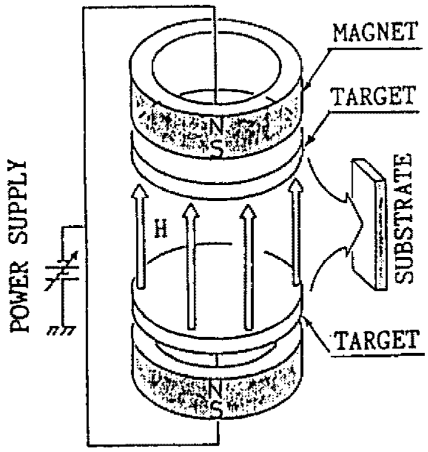

Fig. 1 Schematic diagram of facing target sputtering(FTS) system

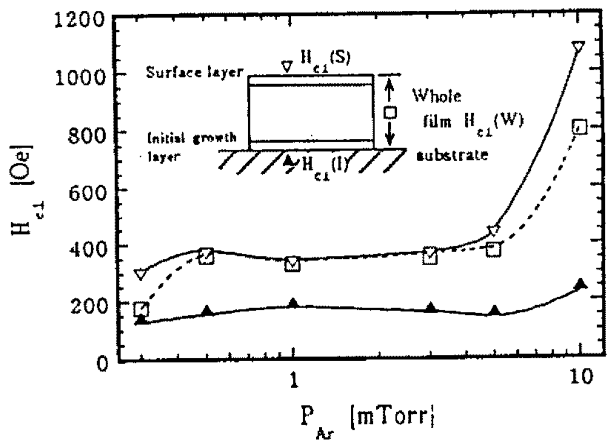

Fig. 2 Dependence of perpendicular coercivity $H_{c\perp}$ on Ar pressure P_{Ar}

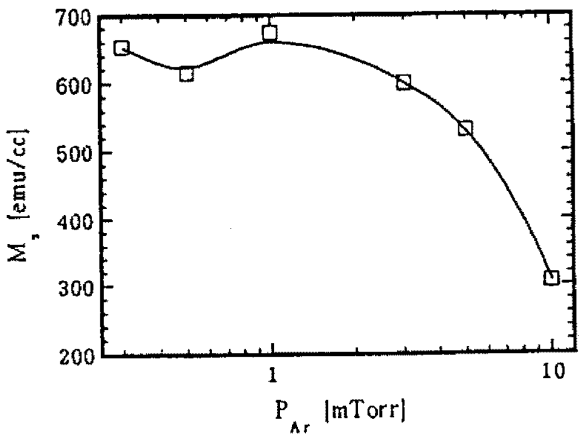

Fig. 3 Dependence of saturation magnetizatin M_s on Ar pressure P_{Ar}

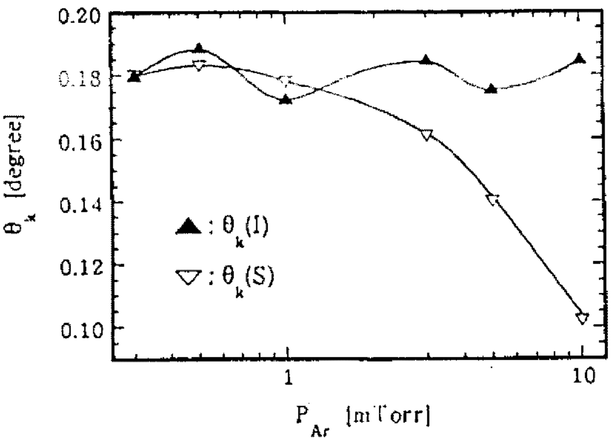

Fig. 4 Dependence of Kerr rotation angle θ_k on Ar pressure P_{Ar}