CHEMICAL COMPOSITION OF SPUTTERED CoCr FOR PERPENDICULAR RECORDING

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INTRODUCTION: For high density perpendicular recording media, sputtered CoCr films are considered one of the most expected materials for applications. To understand this complex system recently a lot of effort has been put into the study of the surface magnetic behaviour. A lack of sufficient data about the chemical state of the surface makes it very difficult to interpret the results obtained by these experiments. In this paper we publish the results obtained by performing AES on CoCr samples with different thicknesses and to correlate magnetic and chemical data. Also XPS measurements were performed.

EXPERIMENTS: All the samples were prepared by RF-sputtering. Six kinds of CoCr films were prepared under the condition of the previous report [1]. XRFs was adopted to determine the average film composition and thickness. The film thicknesses at AES measurements were normalized by comparison with XRFs results. The AES sputtering rate was determined from this result. The AES analyses were performed in a PHI-600. Standard measurement conditions were: primary beam energy: 3keV, beam current: 100nA, excitation beam area: approximately $0.2\mu m^2$, measuring area: approximately $10\mu m^2$ (scanning mode). In order to clean the films and appreciate depth profiling, Ar ion bombardment was carried out. A 3.5keV ion beam was adopted for the sputtering with an emission current of 2.5mA for an area of $2 \times 2mm^2$. To determine the magnetic state of the films we measured the perpendicular hysteresis curves by VSM and M.O. Kerr tracer [1].

RESULTS: Fig.1 shows the average Auger peak to peak intensity of Co, Cr and O from a series of six CoCr films with different thicknesses along the depth direction from the surface. When we consider the surface region, there are many considerable factors, for example physical adsorption layers (CO, $CuHnOx$ etc.), chemisorption layers (soon change into oxide or hydroxide) and oxidized Co and Cr. From this figure, the thickness of the adsorption layers are considered not to depend on the sample thicknesses. Most of the surface of every sample is considered to be physically adsorbed, therefore the first sputtered layer is regarded as an adsorbed layer (left of the dashed line). Adsorbed molecules are mainly CO and $CuHnOx$ from the inside of the AES system. By the electron bombardment and/or the Ar collision in a vacuum (4×10^{-8} while Ar sputtering, to 2×10^{-9} Torr), these layers were easily removed from the surfaces of the films. Then we considered that these adsorbed initial layers are removed by the first Ar sputtering even though they might re-adsorb the sputtered atoms which are taken to be mainly C, H and O. The Co peak increases monotonously and around a depth of 50 Å it reaches to a constant value. Meanwhile the Cr peak has its threshold around a depth of 20 Å. In Fig.2 the Cr(489eV)/Co(775eV) peak ratio is given as a function of the depth from the surface. The same tendency is found for all the six samples. The Co/Cr peak ratio shows the Cr concentration near the surface. This means

Cr is more concentrated than Co in the top layer. The segregated Cr state is being studied. This is also suggested in ref. [2] with the as-grown surface of the bulk casting CoCr samples by the results of XPS. Fig.3 shows the Auger peak intensity of O at the top layer for six different samples. The O takes a critical value of around 100nm thickness. These results coincide with those of the VSM coercivity (from the total value of the film) and the surface coercivity (M.O. Kerr) [1]. Further results will be discussed with the analyses of XPS in relation to the magnetic properties at the surface.

REFERENCES:

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