

Electron Spectroscopy Studies on Magneto-Optical Media and Plastic Substrate Interface

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Abstract--The depth-profiles of amorphous TbFeCo films sputtered onto polycarbonate substrate were studied by X-ray photoelectron spectroscopy. Oxidized metals, oxides and hydroxides for example, and adsorbed impurities were found to exist mainly in the vicinity of the film surface and film/substrate interface.

Introduction

The quality of magneto-optical memory devices currently being studied is determined exclusively by the chemical composition of film/substrate interface on which the laser beam is focused. This study inquires into the characteristics of TbFeCo/polycarbonate interface by observing the depth-profile of the XPS spectra.

Experimentals

Amorphous Tb₂₇Fe₅₁Co₂₂ film (1000 Å in thickness) have been prepared by RF-sputtering onto water-cooled and rotating

polycarbonate (PC) substrates (1.2 mm in thickness). Magneto-optical properties of the discs were as follows; $\theta_k = 0.29^\circ$, $H_c = 3$ kOe, Curie temperature, $T_c = 180^\circ\text{C}$. Photoelectron spectra were measured by ESCA LAB5 at the pressure of $\sim 10^{-8}$ Pa with a power of 200 W (10 kV at 20 mA). The radiation source was Mg-K α (1253.6 eV). Ar⁺ ion etching for depth-profile observation was done at an Ar pressure of 2×10^{-4} Pa with an ion beam voltage of 5 kV. The binding energy was corrected by reference to the Cls peak 284.4 eV for neutral carbon atoms.

Results

The depth-profile for a amorphous Tb₂₇Fe₅₁Co₂₂ alloy film by observation with XPS is illustrated in Fig. 1. The interface between the TbFeCo and PC is observed after 70-80 min of Ar⁺ ion etching. The peak intensity of the oxygen and the Tb exhibit the maximum near the interfacial layer. This correlation suggests that oxygen is predominantly bound to Tb at the interface. Measurements of the Co2p signals indicate, however, that Co is scarcely oxidized at various depths of the film.

The O1s spectra for the TbFeCo film are shown in Fig. 2 as a function of etching time. The peak at 530 eV is assigned to

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the oxygen of metal oxide, while that of 532 eV is also attributable to adsorbed species, for instance H_2O , O_2 , and CO_2 , evolved from the polymer surface during sputtering deposition. The peak intensity ratio of O1s (532 eV) to O1s (530 eV) drastically changes near the film surface and the TbFeCo/PC interface. It is maximum at the outmost surface and decreases in the inner layer. After about 70 minutes of etching, the interface layer appears and the peak ratio becomes minimum. Passing through this point, it increases again. The O1s spectra in the vicinity of interfacial layer is not due to the oxygen atoms in the PC, even though the polymer is decomposed by the high energy Ar^+ ion bombardment.

The contribution of O1s peak intensity from the oxygen atoms in the PC can definitely be neglected. These results indicate that metal hydroxide, metal carbonate or absorbed impurities exist at both the magnetic film surface and the outmost layer of the TbFeCo/PC interface, whereas metal oxide exists primarily in the inner layer of the magnetic film.

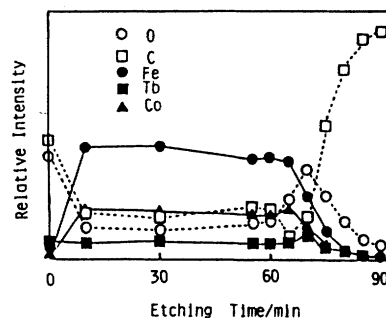


Fig. 1. TbFeCo film depth direction profile.

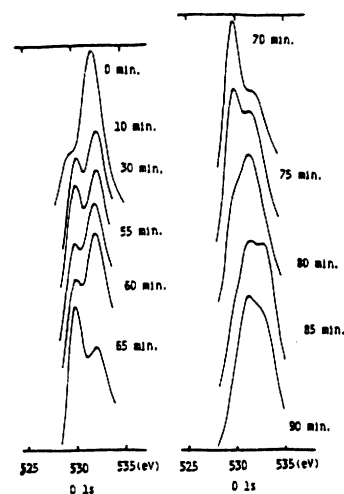


Fig. 2. O1s signals versus etching times.