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[Co_xFe_{1-x}/Pt] 다층박막에서 결정구조와 자기적 특성연구

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Crystalline Structure and Magnetic Characteristics in [Co_xFe_{1-x}/Pt] Multilayers

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1. Introduction

Co/Pt multilayers with large perpendicular magnetic anisotropy (PMA) and enhanced Kerr rotation have received much attention in both basic research and application in high-density magnetic and magneto-optical (MO) recording. Compared with the RE-TM alloys currently used in commercial MO disks, the Co/Pt multilayers are attractive for their superior corrosion resistance and large Kerr rotations at short wavelength[1,2].

Due to the increasing demand of huge capacity storage devices and with the longitudinal recording media nearing an end due to the super-paramagnetic effect arising from thermal instability of recorded bits, perpendicular magnetic media with high magnetic anisotropy is very promising to solve such issues. $L1_0$ ordered FePt with face-centered tetragonal structure attracted much attention due to its high magneto-crystalline anisotropy constant, K_u = 7×10^7 erg/㎤. However, high temperature of 600 ℃ and above is required for phase transformation from soft magnetic face centered cubic (fcc) to hard magnetic face centered tetragonal (fct) phase either during deposition or post-deposition annealing[3].

Hence it is important to understand how atomic composition affects the magnetic and structural properties of alloy $Co_{1-x}Fe_x$/Pt multilayers, which is the purpose of the present work.

2. Experiments

Films with the structure of glass/Ta/Pt/[$Co_{1-x}Fe_x$/Pt] multilayers were produced by ion beam sputtering in a home-made UHV-IBD (ion beam deposition) sputtering system. Typical chamber base pressure is better than 6.0×10^{-9} Torr. Ar gas with 99.99% purity was used as working gas pressure with 3.0×10^{-4} Torr. The Ta underlayer and Pt thickness were fixed at 20 Å and 5 Å, respectively. The $Co_{1-x}Fe_x$ layer and Pt layer thicknesses were 5 Å and 10 Å, respectively. The atomic compositions of $Co_{1-x}Fe_x$ layer were x = 0, 0.1, 0.25, and 1, which are determined by four targets with Co, $Co_{90}Fe_{10}$, $Co_{75}Fe_{25}$, and Fe. The substrate of Corning glass (7905) was set to room temperature with as-grown state. The magnetic properties were analysed using the extraordinary Hall-voltage amplitude (EHA) and the structural properties the X-ray diffractometer (XRD) using Cu-K_α radiation.

3. Results and discussion

Fig. 1 (a) shows the XRD spectra of the [Co(t_{Co})/Pt(10 Å)]$_5$ multilayers, As t_{Co} increases, the

fundamental peak of the multilayer (indicated as Pt(111) peak (2Θ = 40°) in Fig. 1(a)) decreases dominantly. In addition to, the XRD spectra don't show clear satellite peaks like Co/Pt(111) (located at between 2Θ = 41° and 42°.

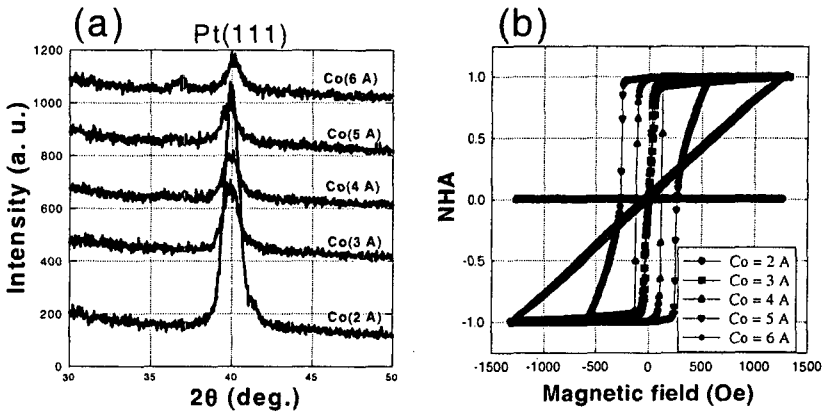

Fig. 1. (a) X-ray diffraction spectra and (b) NHA hysteresis loops of $[Co(t_{co})/Pt(10\ Å)]_5$ multilayers.

Fig. 1 (b) shows the NHA (normalized Hall-voltage amplitude) curves obtained by measurement EHA of Ta(20 Å)/Pt(5 Å)/$[Co(t_{co})/Pt(8\ Å)]_5$ multilayers as a function of thickness of Co layer. As Co layer thickness increases up to 5 Å, the perpendicular coercive field H_c increases 250 Oe. However, when Co layer thickness is 6 Å, PMA changes to in-plane magnetic anisotropy.

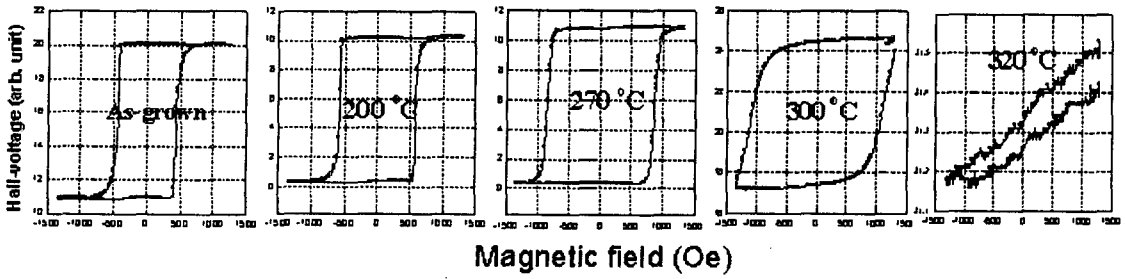

Fig. 2. EHA curves of Ta(20 Å)/Pt(5 Å)/$[Co(5\ Å)/Pt(6\ Å)]_5$ multilayer as a function of the annealing temperature.

Fig. 2 shows the EHA curves of Ta(20 Å)/Pt(5 Å)/$[Co(5\ Å)/Pt(6\ Å)]_5$ multilayer as a function of the annealing temperature. As increasing an annealing temperature up to 300 ℃, the sample was slightly changed from PMA to in-plane and the magnetic property was vanished above 320 ℃ due to inter-diffusion between Co and Pt layer interface.

We will compare and discuss the experimental results of the other atomic compositions (x = 0.1, 0.25, and 1) of $Co_{1-x}Fe_x$ layers.

References

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