CA05

Relationship between Lattice Parameters and Magnetic Anisotropy

Sang Hwan Park[1], Seon Ock Kim[1], and Taek Dong Lee[1]*
[1]Department of Materials Science and Engineering, Korea Advanced Institute of Science and Technology, 373-1 Guseung-Dong, Yuseong-Gu, Daejeon, 305-701, Korea
*Corresponding author: Taek Dong Lee, e-mail: tdlee@kaist.ac.kr

In a stacked medium composed of CoPt-TiO_2 and CoCrPt-SiO_2, Ku and Hc depends on the stacking order of the two layers. CoPt-TiO_2 bottom stack results in much higher Hc and Ku than those of reversed stack [1]. By controlling the thickness ratio between CoPt-TiO_2 bottom and CoCrPt-SiO_2 top stack, higher H_c than that of CoPt-TiO_2 single layer could be achieved. Magnetization reversal mode for both stacking order is close to the theoretical coherent spin rotation according to the angular dependence of Hc, therefore, such difference in magnetic properties would be attributed to crystallographic differences. In this work, a relationship between lattice parameter deformation and magnetic anisotropy was investigated based on the analyses of HRTEM and XRD for the stacked media. The lattice parameter "c" and "a" of hexagonal structure of each magnetic layer were obtained by directly measuring the inter-atomic and inter-layer lengths in HRTEM images. Ta/Ru/CoPt-TiO_2 (8nm)/ CoCrPt-SiO_2 (8 nm) and Ta/Ru/CoCrPt-SiO_2 (8 nm)/CoPt-TiO_2 (8 nm) were chosen for cross-sectional HRTEM analyses because these films showed the largest difference in K_u. In CoPt-TiO_2 (8nm)/CoCrPt-SiO_2 (8nm) stack, it was observed that the bottom CoPt-TiO_2 has both hcp and fcc phases while only hcp structure is observed in the top CoCrPt-SiO_2 layer. 2.3% trigonal deformation (reduction in d_{111}) and 2.6% hexagonal deformation (reduction in d_{0002}) were observed at fcc and hcp phases in CoPt grains, respectively. CoCrPt grown on hexagonal-deformed hcp CoPt grain also undergoes hexagonal deformation. In CoCrPt-SiO_2 (8nm)/CoPt-TiO_2 (8nm) stack, no deformation was observed. High K_u and H_c properties in CoPt-TiO_2 (8nm)/CoCrPt-SiO_2 (8nm) stack media may be, in part, caused by the hexagonal deformation at the bottom CoPt-TiO_2 and top CoCrPt-SiO_2 hcp phases. However, it is difficult to discuss about the effect of trigonal deformation of fcc CoPt-TiO_2 layer on the high K_u property.

Recording layer	*Hc (kOe)*	*Phase analysis*		*Lattice deformation*
CoPt-TiO_2 single (16 nm)	5.8	hcp		no deformation
CoCrPt-SiO_2 single (16 nm)	4.3	hcp + fcc		no deformation
CoPt-TiO_2 (8 nm)/CoCrPt-SiO_2 (8 nm)	6.2	top	hcp	hexagonal deformation
		bottom	hcp + fcc	hexagonal deformation + trigonal deformation
CoCrPt-SiO_2 (8 nm)/CoPt-TiO_2 (8 nm)	4.3	top	hcp	no deformation
		bottom	hcp + fcc	

REFERENCES
[1] S. H. Park *et al*, J. Appl. Phys. 103, 07F528 (2008).

CA06

Effect of Carbon Mixing on The Perpendicular Magnetization of FePt Thin Film on Pt/MgO(p) Underlayer

S.H. Lee, W.H. Lee, and J.K. Park*
Korea Advanced Institute of Science and Technology, 373-1 Guseong-dong, Yuseong-gu, 305-701 Daejeon, Korea
*Corresponding author: J.K. Park, e-mail: jkpark@webmail.kaist.ac.kr

The increasing carbon content has been reported to enhance the perpendicular magnetization of FePt:C thin film deposited on MgO single crystal despite a decreasing tendency of its Ku [1-3]. The purpose of the present research was to study this seemingly unusual effect of carbon on the perpendicular magnetization of FePt:C film which was deposited on our newly developed underlayer of Pt/MgO(p) thin film on glass substrate. FePt thin film was deposited by DC- magnetron co-sputtering on our newly developed underlayer of Pt/MgO(p) thin film on glass substrate, which was held at 700 C. Carbon layer was DC-magnetron sputtered alternatively with FePt layer in a multilayer form of $(FePt/C)_n$ (n = 4-8). The volume fraction of carbon was varied by changing the thickness of intercalated carbon layer at a fixed thickness (3 nm) of FePt film layer. VSM was used to measure the magnetic hysteresis curve. The texture and microstructure of thin film were characterized using x-ray diffraction and HRTEM. The micromagnetics simulation was carried out using OOMMF to investigate the effect of texture on the perpendicular coercivity of the thin film. The results showed that the addition of carbon significantly increased the perpendicular magnetization of FePt thin film on Pt/MgO(s) underlayer. The perpendicular magnetization was maximized at about 22 vol.% of carbon. And the microstructure observation showed that this was a critical composition at which thin amorphous carbon films start to completely enclose individual FePt grain and to separate FePt grain from one another. The result therefore suggested that the maximum perpendicular magnetization occurred due to a maximum relaxation of coherent strain for epitaxial growth and that the epitaxial growth for perpendicular magnetization was maximized in that particular microstrucure. The perpendicular coercivity reached 6800 Oe, in-plane coercivity being 980 Oe. The results of macromagnetics simulation showed that the improvement of perpendicular magnetization can greatly increase the perpendicular coercivity of FePt:C thin film suggesting that perpendicular coercivity can increase, at the same ordering state, as a result of the improvement of perpendicular magnetization.

REFERENCES
[1] A. Perumal, H.-S. Ko, and S.-C. Shin, IEEE Trans. Magn. 39, 2320 (2003).
[2] A. Perumal, H.-S. Ko, and S.-C. Shin, Appl. Phys. Lett. 83, 3326 (2003).
[3] S.H. Lee, M.C. Kim, and J.K. Park, Digest for Intermag. Conf., Madrid, Spain, 2008.