UB08

Coercivity Enhancement of FePt (001) Thin Films via Ag Additive

S. C. Fong*[1,2], D. H. Wei[1], C. C. Yu[3], K. L. You[1], F. T. Yuan[1],
H. W. Chang[1], Y. Liou[1], T. S. Chin[2], and Y. D. Yao[4]

[1] Institute of Physics, Academia Sinica, Taipei 115, Taiwan, R.O.C.
[2] Dep. of Materials Sci. and Eng., National Tsing-Hua University, Hsinchu 300, Taiwan, R.O.C.
[3] Department of Applied Physics, National Kaohsiung University, Kaohsiung 811, Taiwan, R.O.C.
[4] Department of Materials Engineering, Tatung University, Taipei 104, Taiwan, R.O.C.

*Corresponding author: d907531(@alumni.nthu.edu.tw, Phone: +886-2-27896717, Fax: +886-2-27834187

FePt ordered phase is one of the most potential candidates for future magnetic recording due to its large magnetocrystalline anisotropy constant (~7×10^7 erg/cm^3). This high magnetic anisotropy could thermally stable and exhibit perfect ferromagnetic properties even grains size down to 5 nm and possibly achieve up to 1 T bit/in.^{2} recording densities [1]. In this article, we fabricated *in-situ* ordered [Fe (1 nm)/Pt (1 nm)]$_{10}$ multilayers at 500 °C on MgO (001) substrates and to study the beneficial effects of symmetric Ag additive layers on the magnetic properties and magnetization reversal of FePt films. Ultrathin Ag additive layers, 0.5 nm each, were symmetrically introduced into [Fe/Pt] bilayers by a Knudsen cell. Two layers (Ag_{2P}) located atop of the 3rd and 7th [Fe/Pt] bilayers, respectively. Five layers (Ag_{5P}) located atop of every two [Fe/Pt] bilayers, respectively. For comparison, we introduced only one Ag layer atop of the 5th [Fe/Pt] bilayer with a thickness the same as total thickness of two (1 nm) and five (2.5 nm) layers, respectively. The out-of-plane coercivity values of the FePt films without and with Ag_{2P} are about 4400 and 6310 Oe, respectively. With Ag_{2P} introduced into FePt films, the coercivity is 40% larger than those without Ag. However, the coercivity of the films with a single 1 nm Ag layer is 4900 Oe, which is only 12% larger than those films without Ag. The highest coercivity is 75% larger than pure FePt films via introducing Ag_{5P} as shown in Fig. 1. It is worthwhile to note that the coercivity of FePt films with symmetric Ag layers is always larger than those films with a single Ag layer of the same total thickness. The more effective enhancement in coercivity with symmetric Ag layers is due to the relative uniformly distributed defects than that of a single Ag layer induced pinning effects to impede domain wall movement. From the measurement of angular dependence coercivity shows a tendency of the domain-wall motion shift towards rotation of reverse-domain type upon the introduction of Ag layers into FePt films as seen in Fig. 2. This implies that the grains of the FePt are less magnetically coupled and the reversal of magnetization is more independent via Ag additive. The separated magnetic domains caused by the Ag additive as observed from the MFM images, which may inhibit the domain-wall extension, thus effectively enhances the coercivity of the FePt films.

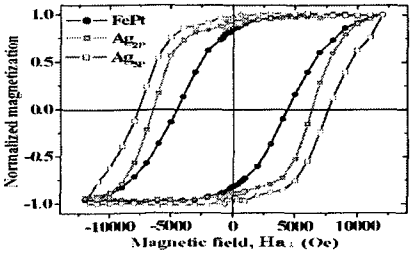

Fig. 1. Perpendicular magnetization curves for the FePt, Ag_{2P}, and Ag_{5P} films.

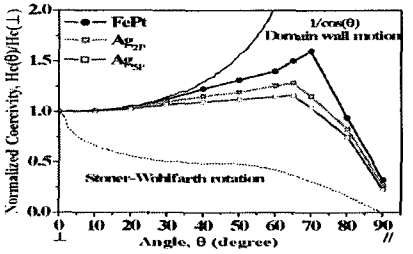

Fig. 2. Angular dependence coercivity profiles for the FePt, Ag_{2P}, and Ag_{5P} films.

REFERENCES

[1] Z. L. Zhao, J. S. Chen, J. Ding, J. B. Yi, B. H. Liu, and J. P. Wang, Appl. Phys. Lett. **88**, 052503 (2006).

UB09

Electrochemical Preparation of Co_3Pt Nanowires

Ji Hyun Min[1], Jun-Hua Wu[2], Ji Ung Cho[1], Ju Hun Lee[1], Young-Dong Ko[3],
Seung Pil Ko[1], Hong-Ling Liu[4], Jin-Seok Chung[3], and Young Keun Kim*[1]

[1] Department of Materials Science and Engineering, Korea University, Seoul 136-713, Korea
[2] Research Institute of Engineering and Technology, Korea University, Seoul 136-713, Korea
[3] AMCRCD and Department of Physics, Soongsil University, Seoul 156-743, Korea
[4] Institute for Nano Science, Korea University, Seoul 136-713, Korea

*Corresponding author: ykim97(@korea.ac.kr, Phone: +82 2 3290 3281, Fax: +82 2 928 3584

The synthesis and study of nanowires is of interest for underlying physics and potential applications in nanoscale devices. Compared to other magnetic metallic compositions, Co-Pt alloy nanowires have been explored for applications in sensors and high density recording media due to their highly perpendicular anisotropic properties, in particular the composition of Co_3Pt that belongs to the category of the highest magnetic anisotropy materials [1,2]. In this paper, we engineer Co-Pt alloy nanowires in the form of Co_3Pt phase in AAO nanotemplates by DC electrodeposition and investigate correspondingly the structural and magnetic properties of the magnetic nanowire arrays as a function of Co concentration. The Co-Pt alloy nanowires were DC electrodeposited in anodic aluminium oxide (AAO) nanotemplates from a single bath which contains $CoSO_4{\cdot}7H_2O$ and $PtCl_4$. The morphology examination by SEM and TEM shows well-aligned, robust, individual Co-Pt alloy nanowires, while HRTEM reveals the lattices of the atomic arrangement in the nanowires. The uniformity of the alloy composition was performed by elemental linescan and mapping, which proves the homogenous distribution of the two elements, Co and Pt, throughout the nanowires. The structure of the Co-Pt alloy nanowire arrays in high Co concentration were analysed by XRD for the cases of (A) $Co_{67}P_{33}$, (B) $Co_{84}Pt_{16}$, and (C) $Co_{92}Pt_8$, with the peaks in the spectra assigned to face-centered-cubic (fcc) Co_3Pt phase ($L1_2$), which are further corroborated by SAED study and the appearance of more peaks in XRD diffraction patterns after heat treatment. In the magnetic measurements, Co-rich nanowires display a well-defined ferromagnetic behaviour, in contrast to near superparamagnetic response of the Pt-rich nanowires, unanimously showing the perpendicular anisotropy. The effect of annealing on the microstructure and magnetic properties of the nanowires were investigated by thermal treatment of the nanowires at 600~650°C in vacuum, leading to improvements in the crystallinity and magnetic performance of the nanowires. In short, the fabrication of Co-Pt nanowire arrays with fcc-Co_3Pt phase was accomplished by DC electrodeposition in the AAO nanotemplates.

This work was supported by the Korea Research Foundation grants KRF-2004-005-D00057 and KRF-2005-210-D00023, by grant A050750 of the Korea Health 21 R&D Project, Ministry of Health & Welfare, and by grant M10500000105-05J0000-10510 from the National Research Laboratory Program of the Korea Science and Engineering Foundation.

REFERENCES

[1] D. Weller, A. Moser, L. Folks, M. E. Best, Wen Lee, M. F. Toney, M. Schwickert, J.-U. Thiele, M. F. Doerner, IEEE Transactions on Magnetics, 36 (2000) 10.

[2] Ji Hyun Min, Boo Hyun An, Ji Ung Cho, Hye Min Ji, Soo Jung No, Young Keun Kim, Hong-Ling Liu, Jun Hua Wu, J. Appl. Phys., accepted.