DB04

Magnetic and microstructure analyses of FePt thin films sputtered onto flexible substrate

L.T. Nguyen*[1], N.P.Thuy[1], N.H.Duc[2] and J.C.Lodder[3]
[1]Faculty of Electronics and Telecommunications, College of Technology, Vietnam National University, Hanoi, Vietnam
[2]Faculty of Physics Engineering and Nano Technology, College of Technology, Vietnam National University, Hanoi, Vietnam
[3]Faculty of Electrical Engineering, Twente University, The Netherlands
*Corresponding author: longnt@vnu.edu.vn, Phone: +84 04 7547709, Fax: +84 04 754338

FePt thin films are attractive due to their hard magnetic properties which are potential for high density magnetic recording as well as micro magnets for micro system applications. Conventionally, FePt thin films are deposited onto rigid substrates such as sillion or glass. In this study, we investigate FePt thin films sputtered onto flexible substrate which can find their applications in flexible electronics devices. A series of FePt films were sputtered onto polyimide substrates by DC sputtering from a composite target with the atomic composition of $Fe_{50}Pt_{50}$. The sputter power was fixed at 50W while several parameters such as Ar pressure, film thickness were varied. Moreover, FePt thin films were also deposited on Ag underlayer using polyimide substrate. The as-deposited samples were annealed in vacuum with the base pressure of 1×10^{-6} mbar, the heating rate of 1 C/1s and the annealing temperatures ranging from 300 C to 450 C. Microstructure analyses are carried out using Xray Diffraction (XRD), Atomic Force Microscopy (AFM) and Transmission Electron Microscopy (TEM) techniques. Magnetic properties were investigated using Vibrating sample magnetometer (VSM) with the field up to 2.4 Tesla and Magnetic Force Microscopy (MFM). It is observed that different factors such as Ar pressure, film thickness have been found to have a strong influence to the formation of fct hard magnetic phase. Increasing Ar pressure can promote the formation of fct FePt thin films sputtered on Polyimide phase. However, when the Ar pressure is too high the crystallinity of the films is degraded and the fct phase can not be formed. Thus the optimum pressure in our system is around 2×10^{-2} mbar. The thickness of the film also influences the ordering process: the transformation from fcc to fct structure take place easier in thicker films. When the thickness of FePt is reduced to 10 nm, annealing temperature of 400 C is not sufficient to allow the formation of fct phase. In addition, the effect of Ag underlayer has been studied. Although Ag films sputtered at room temperature have (111) texture and consequently, (001) texture of FePt layer has not been promoted, it is obvious that the degree of ordering can be strongly enhanced by introduction of Ag underlayer. Ag underlayer can also provide pinning sites which increase the coercivity and reduce the inter-grain exchange coupling. Detailed estimation of the ordering parameters and the effective anisotropy constant in our films has also been given. From these values, a strong correlation between structure properties and magnetic behavior has been revealed.

REFERENCES
[1] D. Weller, A. Moser, L. Folk, M. E. Best, W. Lee, M. F. Toney, M. Schwickert, J. U. Thiele and M. F. Doerner, IEEE. Trans. Magn **36**, 10 (2000).
[2] L. T. Nguyen, A. Lisfi and J. C. Lodder, J. Appl. Phys, **95**, 7492 (2004).

DB05

Magnetic Domain Structure of High Temperature Sm(Co,Fe,Cu,Zr)z Magnets Detected by Magnetic Force Microscopy

Z.H. Guo*[1], A.L. Xia[2], Y.K. Fang[1], B.S. Han[2], and W. Li[1]
[1] Division of Functional Materials, Central Iron & Steel Research Institute, Beijing 100081, China
[2] State Key Laboratory of Magnetism, Institute of Physics, Chinese Academy of Sciences, Beijing 100080, China
*Corresponding author: zhguo@vip.sina.com, Phone: +86 10 62184522, Fax: +86 10 62182610

Recently, Sm(Co,Fe,Cu,Zr)z magnets have been receiving considerable attention due to the needs for high-temperature applications[1]. Magnetic microstructure is very important to understand the coercivity mechanism of Sm(Co,Fe,Cu,Zr)z magnets. With a lateral resolution of 10~50nm, magnetic force microscopy (MFM)has been proved to be a powerful tool for detecting the magnetic microstructures of permanent magnetic materials[2]. In this paper, the magnetic microstructures of Sm(Co,Fe,Cu,Zr)z magnets were investigated by MFM.

Sintered magnets with nominal composition of Sm(CobalFe0.07Cu0.088Zr0.025)7.5 were prepared by arc melting under Ar atmosphere, followed by conventional powder metallurgy processing. The magnetic tips used were high coercivity Fe-Pt point tips. For a downward magnetized MFM tip, upward and downward stray fields emerged from specimen surface are illustrated in "bright" and "dark" colours in magnetic force images, respectively. The typical magnetic force images are shown in Fig. 1. Detecting from the direction perpendicular to c-axis, as shown in Fig.1(a), corrugation and spike domain patterns are characteristic. Because easy axes of grains are normal to the surface of specimen, in order to reduce demagnetized energy, branching, tilting, curving of domain walls and refinement of domains toward the surface occur gradually, which causes the domain patterns in surface layer vary gradually from simple to complicated, leading to the appearance of corrugation and spike domains. Detecting from the direction parallel to c-axis, plate-like domains are typical, as shown in Fig. 1(b), in which the bottom side is set as the aligning field direction, so that the magnetization directions in the adjacent plate domains are actually towards right and left orderly. In addition, comparing with high coercivity Fe-Pt point tips, it is found that the Co-Cr thin-film tips are not suitable for detecting the magnetic microstructures of strong permanent magnets.

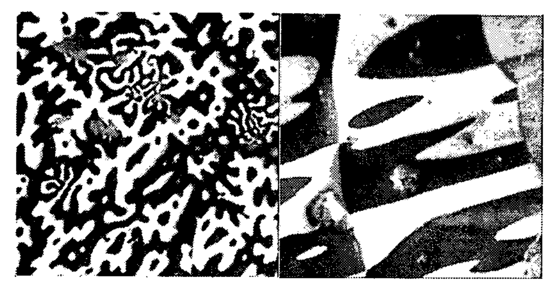

Fig. 1. Typical MFM images of Sm(Co,Fe,Cu,Zr)z magnets, perpendicular to c-axis (a) and parallel to c-axis (b). (scan size: 40 μm×40μm)

REFERENCES
[1] G.C. Hadjipanayis *et al*, IEEE Trans. Magn. **36**, 3382 (2000).
[2] J. B. Yang *et al*, Appl. Phys. Lett. **71**, 3290 (1997)