PA14

Dense Stripe Domains in a Nanocrystalline CoFeSiB Thin Film

Jungbum Yoon[1,2], Seung-young Park[1], Younghun Jo[1], Myung-Hwa Jung*[1], Chun-Yeol You[2], Taewan Kim[3], Jang Roh Rhee[4], and Young Keun Kim[5]

[1]Quantum Material Research Team, Korea Basic Science Institute, Daejeon 305-333, Korea
[2]Department of Physics, Inha University, Incheon 402-751, Korea
[3]Department of Advanced Materials Engineering, Sejong University, Seoul 143-747, Korea
[4]Department of Physics, Sookmyung Women's University, Seoul 140-742, Korea
[5]Department of Materials Science and Engineering, Korea University, Seoul 136-713, Korea

*Corresponding author: mhjung@kbsi.re.kr, Phone: +82 42 865 3495, Fax: +82 42 865 3499

We have investigated the magnetic properties of amorphous and nanocrystalline CoFeSiB thin films. The amorphous film shows a strong ferromagnetic signal, while the nanocrystalline film shows an antiferromagnetic character [1]. We have conjectured that the antiferromagnetic coupling is associated with the nanocrystalline structure. In order to check this, magnetic force microscopy (MFM) images has been carried out. The dense stripe domains [2] in the nanocrystalline thin film are observed by MFM, and related magnetic properties are characterizedas a result of the evolution of the stripe domains. The perpendicular component of magnetization in zero field is oriented periodically up and down out of the surface, which can be ascribed to the columnar growth of nanostructures, as reported in Fe-B/Co-Si-B multilayers [3]. With applying magnetic field, for longitudinal fieldthe stripe domain size is reduced, while for transverse field the domain structure is tilted to be zigzagged, although there is no magnetic anisotropy in the plane. With further increase of magnetic field above the saturation magnetic field H_s 2.5 kOe, the domain structure disappears.

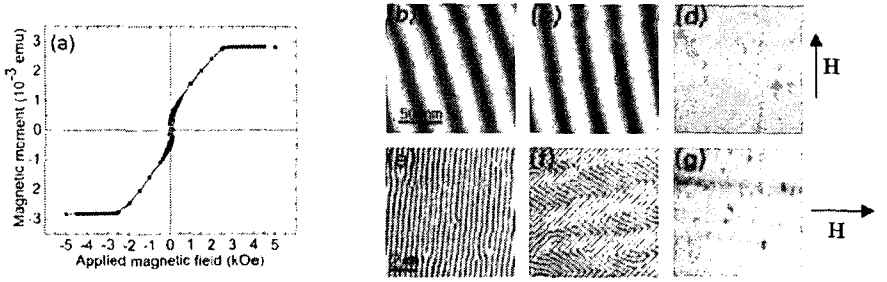

Fig. 1. (a) In-plane magnetization curve of nanocrystalline CoFeSiB thin film at 300 K. MFM images has been recorded under longitudinal applied field of (b) 0, (c) 1 and (d) 3 kOe, and transverse applied field of (e) 0, (f) 0.8 and (g) 3 kOe. The arrows indicate the direction of applied magnetic field.

REFERENCES

[1] Jungbum Yoon et al. Unpublished.
[2] Robert J. Spain, Appl. Phys. Lett. 3, 208 (1963).
[3] A. Asenjo, D. Garcia, J. M. Garcia, C. Prados, and Vazquez, Phys. Rev. B **62**, 6538 (2000).

PA15

Magnetization Reversal of Magnetic Nanostructures Fabricated by Atomic Force Microscope

Tatsuhiko Yokoyama[1], Hiroki Shibata[1], Noriyuki Ishii[1], Tsutomu Yamada[1], Jun-ichi Shirakashi[2] and Yasushi Takemura*[1]

[1]Department of Electrical and Computer Engineering, Yokohama National University, 79-5 Tokiwadai, Hodogaya, Yokohama, 240-8501, Japan
[2]Department of Electrical and Electronic Engineering , Tokyo University of Agriculture and Technology, 2-24-16 Nakacho, Koganei, Tokyo, 184-8588, Japan

*Corresponding author: takemura@ynu.ac.jp, Phone & Fax: +81-45-339-4151

Lithography techniques using scanning probe microscopes have attracted much interest as novel tools for fabricating electron devices with well-defined nanostructures. When a negative-biased voltage is applied to a conductive atomic force microscope (AFM) cantilever, a metal thin film is oxidized by an electrochemical reaction between the metal and water in air. We have demonstrated fabrication of magnetic nanostructures using this technique [1]. Recently, modification of magnetic domain structures in ferromagnetic nanostructures using AFM nano-oxidation technique has been performed [2]. In this paper, magnetization reversal of magnetic nanostructure is reported.

Co-based rectangular nanostructures were fabricated by using electron beam lithography and lift-off process. The size of the rectangles is 3.0 um length and 0.75-1.0 um width. AFM nano-oxidation was performed for the Co-based nanostructures as "writing" nano-wires of oxide across the width of rectangles. Figure 1 shows the magnetic force microscope (MFM) image of the Co-based rectangle of 17 nm thickness. A similar sample was prepared using a spin valve film consisting of CoFe/Cu/Co/NiO multilayer. Only the top layer of CoFe (15 nm thickness) was patterned by the AFM nanolithography. A current was applied in-plane direction along the stripe shape of the spin valve. The magnetization reversal of nano-structured region of CoFe was successfully observed in the MFM measurement. This switching was due to the induced magnetic field from the current. The threshold current for the magnetization reversal of around 80 mA.

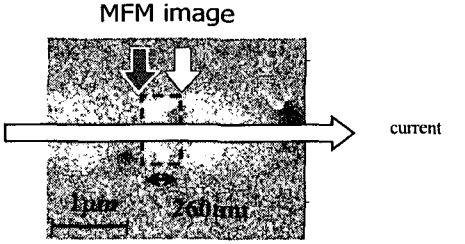

Fig. 1. MFM image of nanostructure defined by nano-oxide wire on Co thin films.

REFERENCES

[1] Y. Takemura and J. Shirakashi, AFM Lithography for Magnetic Nanostructures and Devices, J. Magn. Magn. Mater., 304, 19, 2006.
[2] G. Watanabe, S. Koizumi, K. Watanabe, T. Yamada, Y. Takemura and J. Shirakashi, Magnetoresistance of patterned NiFe thin films with modified structures by AFM nanolithography, J. Vac.Sci. Tech. B23, 2390, 2005.