DC01

Design and fabrication of high resolution tips for magnetic force microscopy

H. Saito*[1], G. Egawa[1], T. Washiya[1], S. Ishio[1], W. Pei[2], J. Yuan[2], A. Ito[3], H. Kawamura[3]
[1] Faculty of Resource Science and Engineering, Akita University, Akita 010-8502, Japan
[2] Venture Buisiness Laboratory, Akita University, Akita 010-8502, Japan
[3] Nitto Optical Co. Ltd., Misato, Akita 019-1403, Japan
*Corresponding author: hsaito@ipc.akita-u.ac.jp, Phone: +81 18 889 2455, Fax: +81 18 837 0409

Magnetic force microscopy (MFM) is a powerful tool to investigate microscopic magnetic domain structures for high density magnetic recording media and nanoscale magnetic materials [1-3]. In recent years, a spatial resolution of less than 10 nm is strongly required due to the development of magnetic storage technology. MFM tip is the key to improve the resolution. High resolution MFM tips need a small effective magnetic volume and large coercivity against stray magnetic fieldsfrom the sample because the high magnetic charge-density at a small tip-end can improve MFM resolution.

To develop high resolution MFM tips, we have clarified MFM transfer function [4] and estimated the resolution limit by calculating the signal of various MFM tips in consideration of the thermodynamic noise of a MFM cantilever. It was found that sharp MFM tips, such as the tips with ellipsoidal and spheroidal tip-end, are expected to have higher resolution less than 10 nm at room temperature [5-6]. For further improvement of MFM resolution to overcomethe limit of the saturation magnetization of hard magnetic materials, the tip using an exchange-spring magnet has been proposed [7] and FePt/FeCo/FePt exchange spring trilayer with very thin FeCo layer ware fabricatedfor this application [8].

Based on the simulation results for MFM tip design, we have developed high-coercivity FePt tips with 10nm resolution by depositing FePt thin film on Si cantilever. The tips enable to observe clearer magnetic images for high density magnetic recording media than commercial CoCr tips. Highcoercivity above 10kOe was obtained for the FePt tips having SiO_2 underlayer on Si cantilever. The underlayer can prevent the FePt film to be alloyed with Si cantilever during the heat treatment for L10 ordering of FePt film. FePt tip is a base system to fabricate sharp-end tips and exchange-spring magnet tips for further improvement of resolution. Higher resolution is expected for the tips with one-side deposition of FePt film on sharp-end Si cantilever and the tips using an exchange spring magnet.

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DC02

Planar Hall Resistance Sensor for Biochip Application

C. G. Kim*[1], N. T. Thanh[1,2], C. O. Kim[1]
[1] Department ofMaterials Science and Engineering, Chungnam National University, 220 Gung-Dong, Yu-Seong Gu, Daejeon, 305-764, Korea
[2] College of Technology, Vietnam National University, 144 Xuan Thuy - Cau Giay - HaNoi, Vietnam
*Corresponding author: cgkim@cnu.ac.kr, Phone: +82 42 821 6632, Fax: +82 42 822 3206

In this work, we introduce a new type of using planar Hall effect in spin valve structure for biochip application due to advantage of increasing sensor sensitivity. The sensor for single Dynabeads® M-280 Streptavidin detection has been accomplished with the pattern size of $3\times3\mu m^2$ by using NiFe(6.0 nm)/Cu(3.5 nm)/NiFe(3.0 nm)/IrMn(10.0 nm) spin valve. Furthermore, it is also developed to integrated arrays by including 24 sensor patterns. A comparison of our sensor performance with the other groups, connecting with the advantages of more stable and a high signal to noise of PHE sensor's behaviors, have proved a possibility to the biomolecule recognition. It is also feasible to provide a vehicle for studying other molecular interaction, particular single DNA molecule interaction and for detection of the binding of streptavidin functionalized magnetic beads to sensor bound biotin. Due to the simple fabrication scheme, this Planar Hall effect based sensor can be easily integrated into other systems for applications.

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