CS15

Magnetic Vortex Excitations in Dipolar-coupled Magnetic Nanodots

Hyunsung Jung, Ki-Suk Lee, Young-Sang Yu, and Sang-Koog Kim*

Research Center for Spin Dynamics & Spin-Wave Devices and Nanospinics Laboratory, Department of Materials Science and Engineering, College of Engineering, Seoul National University, Seoul, South Korea

*Corresponding author: Sang-Koog Kim, e-mail: sangkoog@snu.ac.kr

Owing to advances in the fundamental understanding of magnetic vortex gyrotropic motions [1] and vortex-core reversals by oscillating fields [2] and spin-polarized currents [3], it becomes possible to make an array of nanodots' vortex states practically applicable to information storage devices [4]. To increase the storage density of such devices, the interdistance between dots should be decreased and in such cases dipolar interactions between different nanodots become dominating. Thus, it is necessary to understand the effect of dipolar interactions between neighboring dots on the vortex gyrotropic mode and vortex core reversal behaviors.

In the present work, by micromagnetic simulations using the OOMMF code [5] and analytical calculations [6], we have studied the dipolar interaction effect on the vortex gyrotropic motion, its core switching in coupled vortex states of two different Permally cylindrical nonodots (2R = 300 nm diameter, L = 20 nm thickness) separated by various distances (0, 3, 36, 75, 150, 300, 360, 450 nm). In the micromagnetic simulations, we started with a ground vortex state in two different dots where a vortex core was positioned at the center of each dot. Then, a vortex core was shifted from the center for only one dot (N1) by applying a local static magnetic field H =150 Oe along the +x direction. Upon turning the power off, the characteristic gyrotropic motion was observed. Due to the dipolar interaction of the one dot (N1) with the other dot (N2), the VC in dot N2 began to move in a spiral manner with increasing trajectory radius, even though the magnetic field was not applied to it. While the radius of the gyrotropic motion in dot N2 increased with time, that of the motion in dot N1 decreased. After a certain time, the radii of the orbital motions in dots N1 and N2 again increased and decreased, respectively. Such behavior can be understood with reference to the coupled system of the two different oscillators. In such dipolar coupled dots, the energy transfer between the two dots occurs during their gyrotropic motions. This result also influences vortex core switching occurring in a single dot. The present work offers a fundamental understanding of coupled gyrotropic motion and vortex core reversal behaviors in dipolar-coupled dots.

This work is supported by Creative Research Initiatives (ReC-SDSW) of MEST/KOSEF.

REFERENCES

[1] K. Y. Guslienko *et al*., J. Appl. Phys. 91, 8037 (2002); K.-S. Lee *et al.*, Appl. Phys. Lett. 91, 132511 (2007); K.-S. Lee *et al.*, Appl. Phys. Lett. 92, 192513 (2008).
[2] B. Van Waeyenberge *et al.*, Nature 444, 461 (2006); K.-S. Lee *et al.*, Phys. Rev. B 76, 174410 (2007).
[3] K. Yamada *et al*., Nature Mater. 6, 296 (2007); S.-K. Kim *et al.*, Appl. Phys. Lett. 91, 082506 (2007).
[4] S.-K. Kim *et al.*, Appl. Phys. Lett. 92, 022509 (2008).
[5] For details, see http://math.nist.gov/oommf.
[6] A.A. Thiele, Phys. Rev. Lett. 30, 230 (1973); D. L. Huber, Phys. Rev. B 26, 3758 (1982).

CT01

Synthesis and Evaluation of a Novel Film TiN-WC/TiN

Shi-Hong Zhang*, Jae-Hong Yoon, Tong-Yul Cho, and Yon-Kun Joo

School of Nano & Advanced Materials Engineering, Changwon National University, 9, Sarim-Dong, Changwon, Gyeongnam, 641-773, South Korea

*Telephone and Fax number: 82-55-2837532, Email address: zsh10110903@hotmail.com

By adjusting the power of WC target, TiN-WC films with different composition were prepared on AIP TiN coatings using the hybrid technique of arc ion plating and DC & RF magnetron sputtering. The TiN-WC films are composed with TiN, Ti and WC phases. The microstructure, mechanical properties and wear behaviors of the TiN-WC films were investigated by X-ray diffraction, field emission scanning electron microscope, indentation tester and reciprocating ball-on-disk UMT-2MT tribometer. The results indicated that TiN-WC films were composed of TiN, Ti and WC phases. And the (200) preferred orientation of WC phase was grown on AIP TiN interfilm. The TiN-WC films with thickness of 50~90 nm were formed and the films prepared using WC target of 500 W had thickest WC which is up to 90 nm. And compact and defects free interface among TiN-WC, AIP TiN and substrate was obtained. The largest hardness is up to 35 Gpa. Compared to AIP multilayer TiN films, the friction and wear resistance of TiN-WC films had an evident increase. However, the friction coefficient of TiN-WC3 films had a slight increase because of large WC particles formed on the surface. And the wear ratio of Ti-WC2 films was four times smaller than that of AIP multilayer TiN films. The wear mechanism of multilayer AIP TiN films and TiN-WC was changed from "severe wear" to "mild wear".