RA14

Deviation from Langevin Function in Real Magnetic Nanoparticle Systems

N.H. Hai *[1], L.H. Hoang[2], N.H. Luong[1], N. Chau[1]
[1]Center for Materials Science, Hanoi University of Science, Vietnam National University, Hanoi, 334 Nguyen Trai, Thanh Xuan, Hanoi, Vietnam
[2]Faculty of Physics, Hanoi University of Education, 136 Xuan Thuy, Cau Giay, Hanoi, Vietnam
*Corresponding author: nhhai@vnu.edu.vn, Phone: +84 4 558 2216, Fax: +84 4 858 9496

The fact that magnetization of magnetic fluids does not exactly follow the Langevin function is not clearly understood. The reasons may come from: polydispersity of particle size; magnetic anisotropy of materials; texture of the system; and dipolar interaction between nanoparticles. In this report, we take into account of anisotropy, polydispersity of particle size, texture, and the dipolar interaction factors to the total energy then derived magnetization as a function of magnetic field. Calculation is compared to magnetization curve of cobalt ferrite $Co_{1-x}Fe_xO.Fe_2O_3$ systems. The magnetic systems consist of cobalt ferrite nanoparticles distributed in a nonmagnetic solid media. The dispersity of particle size is determined by Transmission Electron Microscopy. The magnetic anisotropy is changed with the content of cobalt in cobalt ferrites. The texture of the systems is obtained by cooling the systems from the temperature higher than melting temperature of the solid media T_m to the temperature lower T_m (room temperature) under a magnetic field. The dipolar interaction between nanoparticles varies with the number of nanoparticles in a unit volume of media. Results show that, for magnetic systems with randomly oriented nanoparticles, magnetization is determined by polydisperse of particle size and dipolar interaction. For textured magnetic systems, contribution of anisotropy to the diversity must be taken into account. Calculation is used to explain magnetization in real magnetic nanoparticle systems.

RB01

Switching Behaviors of Magnetic Tunnel Junction with Mono-pinned Layer and Synthetic Antiferromagnet Structure Pinned Layer

K. M. Wu[1], C. H. Huang[1], M. J. Kao[2], M. J. Tsai[2], J. C. Wu[1], and L. Horng*[,1]
[1]Department of Physics and Taiwan SPIN Research Center, National Changhua University of Education, Changhua, Taiwan
[2]Industrial Technology Research Institute, Hsinchu, Taiwan
*Corresponding author: ncpwu@yahoo.com.tw, Phone: +886-4-7232105 ext3340, Fax: +886-4-7211153

With magnetic tunnel junction (MTJ) elements size decreasing, the stray field from pinned layer induces more influence on switching of free layer in a conventional MTJ with mono-pinned layer. The stray field influences on free layer of MTJs with mono-CoFeB and synthetic antiferromagnet (SAF) structure as pinned layer have been studied through analyzing magnetoresistance measurements. MTJ with structure of SiO_2/ bottom electrode (20)/ PtMn (15)/ Pinned-Layer/ Al (0.7)-oxide/ $Co_{60}Fe_{20}B_{20}$(2)/ capping layer (48) (all unit in nanometer) were grown by UHV DC sputtering system and the thickness was checked by transmission electron microscope (TEM). The Pinned-Layer has two different compositions: one is only CoFeB (3) single layer, and the other is $Co_{50}Fe_{50}$ (1)/ CoFeB (2)/ Ru (0.8)/ CoFeB (3), respectively. The sheet film was then patterned into elliptic shape with long/short axis of 4/2 micrometers adopting conventional lithography and inductively coupled plasma reactive ion etching technologies (ICP-RIE). SAF structure of CoFe (1)/ CoFeB (2)/ Ru (0.8)/ CoFeB (3) inducing to an almost zero net magnetization due to enclosed magnetic flux at the edge of two ferromagnetic layers was confirmed through hysteresis loops measured by alternate gradient magnetometer (AGM, MicroMag 2900). Stray field, caused by different pinned layer, results in observantly different pinning field on free layer. The free layer shows a little complex switching in mono-pinned layer MTJs and presents almost single domain reverse in SAF-pinned layer MTJs. The evidently smaller coercivity (Hc) of free layer was observed in SAF-pinned layer MTJs than in mono-pinned layer MTJs.

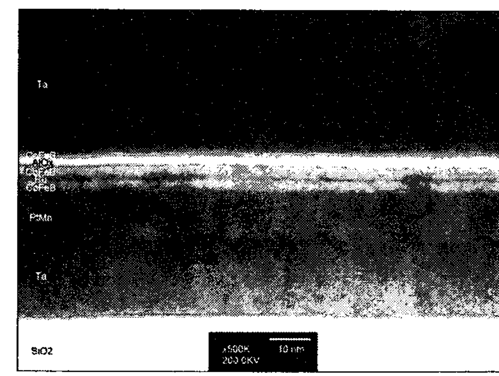

Fig. 1. TEM image of SAF-pinned layer MTJ