G-04

ELECTRON BEAM IRRADIATION EFFECT ON EXCHANGE COUPLING IN FM/AFM/FM TRILAYER

K. E. Lee[1], H. K. Yun[1], D. Y. Kim[2], C. O. Kim[1] and C. G. Kim[1*]
[1] Department of Materials Science& Engineering, Chungnam national University, Daejeon 305-764 Korea
[2] ReCAMM, Chungnam National University, Daejeon 305-764 Korea

NiFe/FeMn/NiFe trilayer structure is the basic spin valve structure, where the magnetizations of two-FM layers are pinned by antiferromagnetic layer. A systematic investigation of the exchange bias variations of bottom and top NiFe layers has been done as functions of thickness of bottom NiFe layers and different conditions of electron beam irradiation.

The trilayer thin films were prepared by RF magnetron sputtering. The base pressure of vacuum was hold below 2.0×10^{-7} Torr, and then Ar gas of high purity (99.999%) was introduced into the chamber through a mass flow controller at 3.0 mTorr. During sputtering process a uniform magnetic filed of 100 Oe was applied parallel to plane of substrate. To further enhance the magnetic properties of the samples, and especially the exchange bias of pinned layer, the samples were annealed at 200 ℃, 1 hour under field of 1 kOe. The electron beam of 2 MeV was irradiated in dose range of 10^{13}~10^{16} electrons/cm^2. The saturation magnetization, coercivity and anisotropy field were measured using VSM (vibrating sample magnetometer) with a magnetic filed applied parallel to the film plane.

As the thickness of the bottom NiFe layer increases to 4, 12, 20 nm, the exchange bias of bottom layer in as-deposited samples decreases to 160, 77, 68 Oe, corresponding to interfacial coupling energy of 0.04, 0.06, 0.08 erg/cm^2, respectively. After the heat treatment, the exchange bias of the bottom NiFe layer is generally decreased down to 105, 50, 68 Oe, corresponding to interfacial energy of 0.02, 0.04, 0.07 erg/cm^2. But the interfacial energy of top layer (5 nm thickness) increases from 0.01 to 0.02, from 0.02 to 0.04, from 0.02 to 0.04 erg/cm^2 for bottom layer thickness of 4, 12, 20 nm, respectively, after annealing.

After electron beam irradiation, interfacial coupling energy for both bottom and top layers monotonously decreases with dose. It is quite different behavior from that of Ar ion irradiation. In this paper, we will present the electron beam irradiation effects on interfacial coupling energy for as-deposited and annealed samples.

[1] B. Dieny, V. S. Speriosu, S. S. P. Parkin, B. A. Gurney, D. R. Wilhoit, and D. Mauri, Phys. Rev. B. 43, 1297(1991).
[2] V. K. Sankaranarayanan, S. M. Yoon, D. Y. Kim, C. O. Kim and C. G. Kim. J. App. Phys. V.96, 7428(2004).