THE INFLUENCE OF NiFe THICKNESS OF TOP-ELECTRODE ON EXCHANGE COUPLING PARAMETERS OF $IrMn_3$ BASED MTJ

T. Stobiecki[1,2], Cheol Gi Kim[1], Chong-Oh Kim[1], Yongkang Hu[1], J. Wrona[2], J. Kanak[2], M. Tsunoda[3], M. Takahashi[3]

[1]Chungnam National University, Department of Materials Engineering, Daejon, 305-764, Korea; [2]University of Mining and Metallurgy, Department of Electronics, 30-059 Krakow, Poland; [3]Tohoku University, Department of Electronic Engineering, Sendai 980-8579, Japan

Recent works of $IrMn_3$ based MTJ's have focused mainly on enhancement of TMR ratio, by modifying the preparation conditions of tunnel barrier [1], or local electrical properties [2]. There are only a few reports which discuss interlayer exchange coupling between two ferromagnetic electrodes [3]. In this work particular attention will be paid to the evolution of the interlayer exchange coupling with the thickness of NiFe and annealing in junctions with the structure: of Ta(50Å)/Cu(100Å)/Ta(50Å)/NiFe(20Å)/Cu(50Å)/IrMn(100Å) /CoFe(25Å)/Al-O/CoFe(25Å)/**NiFe(t)**/Ta(50□), where **t** = 0Å, 100Å, 300Å, 600Å and 1000Å. We obtained decrease of minor loop shifting field (H_{ua}) and coercivity (H_c) for free layer with increasing NiFe thickness in as-deposited and annealed samples. For example the unidirectional anisotropy field H_{ua}= 8 [Oe] and H_c= 14[Oe] for as-deposited junction with t = 100Å. After annealing at 300^0 C in external field 1 [kOe], we obtained following values: TMR = 40%, H_{ua}= 11.5 [Oe], H_c= 11.6 [Oe] for free layer and exchange biased field of pinned layer, H_{EB} = 1440 [Oe] which corresponds to exchange biased energy E_{EB} = 0.52 erg/cm^2. The variations of H_c and H_{ua} correlate with the size of NiFe grains determined from GID-XRD measurements. The analysis of the surface roughness, determined from AFM measurements, of bottom CoFe electrode layer and the distribution of H_{ua} (obtained from micro-MOKE, M-H loop tracer) across the junction, suggests that variation of the interlayer exchange coupling field of the free layer is well described by dipole interactions in the form of so-called Néel "orange peel" coupling.

[1] M.Tsunoda et al. Appl. Phys. Lett. **80** (2002), 3135
[2] Y.Ando et al. J. Magn. Magn. Mat. **226-230** (2001), 924
[3] K.Li et al. J. Magn. Magn. Mat. **241** (2002), 89