Tunneling magnetoresistence characteristics of CoFeB/MgO/Py magnetic tunnel junctions

Kyoung-Min Lee[1,2*], Jun Woo Choi[1], Chaun Jang[1], Junghyun Sok[2], and Byoung-Chul Min[1]

[1] Spin Convergence Research Center, Korea Institute of Science and Technology, Seoul 136-791, Republic of Korea

[2] Department of Nano Engineering, University of Seoul, Seoul 130-743, Republic of Korea

Recently there has been great interest in the development of magnetic vortex nano-oscillator based on spin-torque induced magnetic vortex gyrations [1-3]. In the magnetic vortex nano-oscillator, a large perpendicular magnetic field is typically required for operation of the nano-oscillator, since a sustained magnetic vortex gyration motion occurs only when the vortex core magnetization and the polarizer magnetization directions are parallel. Therefore a perpendicular magnetic anisotropy (PMA) polarizer is needed for the vortex oscillation to occur with a small or zero external magnetic field.

In this work, we fabricated magnetic tunnel junctions with 'perpendicular polarizer/MgO/vortex' configuration for its potential application in magnetic vortex nano-oscillators. Magnetic tunnel junction (MTJ) structures of CoFeB(1.2nm)/MgO/Py(25-35nm) were used, where the 1.2 nm thick CoFeB layer and 25 (or 35nm) Py layer would act as the polarizer layer and magnetic vortex layer, respectively. Magnetic hysteresis loop measurements of the 25 and 35nm thick Py layers confirmed that the Py layers have a magnetic vortex structure. The as-grown amorphous CoFeB layer has in-plane magnetic anisotropy, while the 300°C annealed CoFeB layer shows perpendicular magnetic anisotropy. The tunneling magneto-resistance ratios (TMR) of the MTJ samples were measured with the external magnetic field applied in-plane and out-of-plane. The TMR ratio was ~ 4 %. There is clear difference in the TMR curves of as-grown (in-plane CoFeB) and annealed (perpendicular CoFeB) samples. We also report preliminary results on the magnetic vortex oscillation behavior with a perpendicular polarizer.

[1] A. Dussaux's, et al. *Nature Comm.* **1** (2010) pp. 8

[2] Yan Liy, et al. *J. Appl. Phys.* **112** (2012) pp. 093905

[3] F. Abreu Araujo, et al. *Appl. Phys. Lett.* **102** (2013) pp.222402