Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Giant Spin Hall Effect in Perpendicularly Magnetized Ta/CoFeB/MgO Structure and Temperature Dependence[1] QIANG HAO, GANG XIAO, Brown University — The Giant Spin Hall Effect (GSHE) in non-magnetic metals with strong spin-orbit coupling (SOC) has been found in various solids like Pt, beta-Ta, and beta-W. The spin current from GSHE solids yields a spin-transfer torque (STT) inside an adjacent ferromagnetic layer with perpendicular magnetic anisotropy (PMA) to effect a magnetization switching. The combination of PMA with STT-induced switching has the advantage of low power consumption, high reliability and durability and data non-volatility over earlier generations of MRAM. Here we first studied the post-annealing effect on achieving PMA in Ta/CoFeB/MgO multilayers. We achieved so far the lowest critical current density of 2.3 MA/cm^2 for the STT-induced switching in the presence of 5mT magnetic field as compared to earlier PMA structures. Using a macrospin model, we are able to obtain the Spin Hall Angle of 0.11 in Ta and anisotropy field of 260mT at room temperature, and both values increase with reducing temperature. We also found a scaling law between Ta resistivity and Spin Hall angle in a quadratic relation. Our results are important for magnetic memory and spin-logic applications through optimizing the engineering of such multilayer structures with PMA.

[1]This work was supported by Nanoelectronics Research Initiative (NRI) through the Institute for Nanoelectronics Discovery and Exploration (INDEX) and by National Science Foundation through Grant No. DMR-1307056.

Qiang Hao
Brown University

Date submitted: 24 Dec 2014 Electronic form version 1.4