Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Spin Torque Ferromagnetic Resonance Induced by the Spin Hall Effect LUQIAO LIU, TAKAHIRO MORIYAMA, DAN RALPH, ROBERT BUHRMAN, CORNELL UNIVERSITY TEAM — We demonstrate that the spin Hall effect in a thin film with strong spin-orbit scattering can excite magnetic precession in an adjacent ferromagnetic film. The flow of alternating current through a Pt/NiFe bilayer generates an oscillating transverse spin current in the Pt, and the resultant transfer of spin angular momentum to the NiFe induces ferromagnetic resonance (FMR) dynamics. The Oersted field from the current also generates an FMR signal but with a different symmetry. The ratio of these two signals allows a quantitative determination of the spin current. As an independent check, we also apply a DC charge current to the Pt/NiFe bilayer while measuring the FMR signal. The effective damping of the NiFe layer can be increased or decreased depending on the relative angle between the magnetic moment and the injected spin. The amplitude of spin current extracted from this measurement agrees quite well with that obtained from the FMR lineshape. The self-calibration nature of this new technique makes it an excellent solution for a quantitative measurement of the SHE in a ferromagnetic/non-magnetic metal bilayer.

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Date submitted: 19 Nov 2010 Electronic form version 1.4