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Spin Torques Arising from the Spin Hall Effect in Ferromagnets
JONATHAN GIBBONS, DAVID MACNEILL, Department of Physics, Cornell University, ROBERT BUHRMAN, School of Applied and Engineering Physics, Cornell University, DANIEL RALPH, Department of Physics, Cornell University — The anomalous Hall effect arising within a ferromagnet possessing strong spin-orbit interactions is expected to generate a spin current whose spin orientation can be manipulated by altering the magnetic state of the generating layer. This capability could provide a new level of functionality for controlling magnetic memory devices using spin-transfer torque. We report the generation of spin currents by the anomalous Hall effect from a Gadolinium-doped Iron layer, and verify that the in-plane spin polarization can indeed be controlled by varying the magnetization direction. We use a pinned ferromagnetic layer/spacer/free magnetic layer stack and an in-plane second harmonic detection method to obtain quantitative measurements of the spin transfer torque exerted by these spin currents. We will also discuss the conditions required to use the anomalous Hall effect to generate an out-of-plane anti-damping spin-orbit torque.

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