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The Enhancement of spin Hall torque efficiency and Reduction of Gilbert damping in spin Hall metal/normal metal/ferromagnetic trilayers[1] MINH-HAI NGUYEN, CHI-FENG PAI[2], DANIEL C. RALPH, ROBERT A. BUHRMAN, Cornell Univ — The spin Hall effect (SHE) in ferromagnet/heavy metal bilayer structures has been demonstrated to be a powerful means for producing pure spin currents and for exerting spin-orbit damping-like and field-like torques on the ferromagnetic layer. Large spin Hall (SH) angles have been reported for Pt, beta-Ta and beta-W films and have been utilized to achieve magnetic switching of in-plane and out-of-plane magnetized nanomagnets, spin torque auto-oscillators, and the control of high velocity domain wall motion. For many of the proposed applications of the SHE it is also important to achieve an effective Gilbert damping parameter that is as low as possible. In general the spin orbit torques and the effective damping are predicted to depend directly on the spin-mixing conductance of the SH metal/ferromagnet interface. This opens up the possibility of tuning these properties with the insertion of a very thin layer of another metal between the SH metal and the ferromagnet. Here we will report on experiments with such trilayer structures in which we have observed both a large enhancement of the spin Hall torque efficiency and a significant reduction in the effective Gilbert damping. Our results indicate that there is considerable opportunity to optimize the effectiveness and energy efficiency of the damping-like torque through engineering of such trilayer structures.

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