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Spin-Torque Ferromagnetic Resonance in PMA Thin Film Structures LUIS VILELA-LEÃO, CHI-FENG PAI, YONGXI OU, YUN LI, DANIEL RALPH, ROBERT BUHRMAN, Cornell Univ — Thin film systems with strong perpendicular magnetic anisotropy (PMA) are important for many spintronic device applications. For example for magnetic memory, strong PMA can enable ultra-high density storage, in combination with enhanced non-volatility and low write energy. Recently, some interesting phenomena, including the spin Hall effect and spin orbit fields, have been reported in normal metal/ferromagnetic (NM/FM) structures with PMA. These effects, which arise from spin-orbit coupling in the structure, convert charge current into torques (a field-like torque and/or a damping-like torque) on the magnetization of the FM that can be strong enough to switch the magnetization, generate persistent magnetic oscillation, and efficiently move domain walls. Here we show that spin-torque ferromagnetic resonance (ST-FMR) can be effectively employed to characterize the anisotropy, the spin-orbit torques, and the magnetic damping of a PMA structure. We will report on ST-FMR results from several PMA systems, including W/Hf(t)/CoFeB/MgO and W/CoFeB where we have found large values for both the first order and second order terms of the magnetic anisotropy and where we have measured intrinsic and extrinsic contributions to the effective magnetic damping.

Chi-Feng Pai
Cornell Univ

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