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Switching of three-terminal MTJ devices by the giant spin Hall effect of Pt alloys MINH-HAI NGUYEN, SHENGJIE SHI, SRIHARSHA ARADHYA, ROBERT BUHRMAN, Cornell Univ — Since the discovery of the large spin Hall ratios of Pt, beta-Ta and beta-W, the spin Hall effect (SHE) in normal metallic systems has attracted a great deal of attention due to the broad scientific interest in spin-orbit torques. In addition the high efficiency by which the SHE in such metals can convert an electrical current to a transverse spin current can enable a wide range of spintronics applications, including the fast, reliable, low energy switching of three-terminal nanoscale magnetic tunnel junction (MTJ) devices that has been recently demonstrated [1]. The performance of such three-terminal SHE devices is determined by the spin Hall ratio and resistivity of the channel material, as well as by the demagnetization field and magnetic damping of the free ferromagnetic layer. Our earlier work [2] has shown that the spin Hall ratio of Pt can be enhanced when it is alloyed with Hf, due to the intrinsic nature of the SHE in Pt. In this talk, we will discuss the low switching current, nanosecond pulse switching speed and low write error rates of the three-terminal MTJ devices made with PtHf nano-channels. Our results suggest that further improvement of the three-terminal MTJ structure is possible by engineering the bulk and interfacial properties of the spin Hall channel.
[1] Aradhya et al. Nano Letters 10, 5987 (2016)
[2] Nguyen et al. APL 108, 242407 (2016)

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