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Enhanced spin Hall ratios by Al and Hf impurities in Pt thin films¹ MINH-HAI NGUYEN, MENGAN ZHAO, DANIEL C. RALPH, ROBERT A. BUHRMAN, Cornell Univ — The spin Hall effect (SHE) in Pt has been reported to be strong and hence promising for spintronic applications. In the intrinsic SHE mechanism, which has been shown to be dominant in Pt, the spin Hall conductivity σ_{SH} is constant, dependent only on the band structure of the spin Hall material. The spin Hall ratio $\theta_{SH} = \sigma_{SH} \cdot \rho$, on the other hand, should be proportional to the electrical resistivity ρ of the spin Hall layer. This suggests the possibility of enhancing the spin Hall ratio by introducing additional diffusive scattering to increase the electrical resistivity of the spin Hall layer. Our previous work has shown that this could be done by increasing the surface scattering by growing thinner Pt films in contact with higher resistivity materials such as Ta. In this talk, we discuss another approach: to introduce impurities of metals with negligible spin orbit torque into the Pt film. Our PtAl and PtHf alloy samples exhibit strong enhancement of the spin Hall torque efficiency with impurity concentration due to increased electrical resistivity.

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Minh-Hai Nguyen
Cornell Univ

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