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Transport Magnetic Proximity Effects in Platinum

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Platinum (Pt) metal, being non-magnetic and having a strong spin-orbit coupling interaction, has been central in detecting pure spin current and establishing most of the recent spin-based phenomena. Thus, it is important to ascertain the transport and magnetic characteristics of thin Pt films in contact with a ferromagnet. In this work, we use both electric and thermal means to conclusively show the transport magnetic proximity effects (MPE) of thin Pt film in contact with ferromagnetic insulator YIG. At thicknesses comparable to, and less than, the spin diffusion length, the strong ferromagnetic characteristics in Pt films on YIG are indistinguishable from those of ferromagnetic permalloy on YIG. [1] The MPE occurs at the interface and decreases exponentially away from the interface, concentrating in only a few monolayers. As a result, the pure spin current detected by a thin Pt is tainted with a spin polarized current. The pure spin current phenomena, such as the inverse spin Hall effect and the spin Seebeck effect, have been contaminated with the anomalous Hall effect and the anomalous Nernst effect respectively. These results raise serious questions about the suitability, and the validity, of using Pt in establishing pure spin current phenomena; on the other hand, a much stronger spin-based effect can be induced by the MPE at the interface. This research is in collaboration with X. Fin, Y. P. Chen, J. Wu, and J. Q. Xiao (University of Delaware), T. Y. Chen (Arizona State University) and D. Qu, W. G. Wang, and C. L. Chien (The Johns Hopkins University).

[1] S. Y. Huang *et al.,* Phys. Rev. Letts. **109**, 107204 (2012).