

MAR17-2016-000895

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Magnon-mediated current drag across a magnetic insulator¹

JING SHI, University of California - Riverside

Electric current transmission can occur in a magnetic insulator via spin current inter-conversions at heavy metal/magnetic insulator interfaces. In magnetic insulators, spin current is carried by spin wave excitations or their quanta, magnons. This marvelous phenomenon was first theoretically predicted and dubbed as the magnon-mediated current drag in 2012 by Zhang et al. (1, 2). Following a breakthrough in materials growth, i.e. yttrium iron garnet films or YIG ranging from 30 to 80 nm in thickness sandwiched between two heavy metal films (3), we successfully showed the nonlocal DC current transmission in such sandwich structures via spin current rather than charge current (4). To exclude the leakage effect, the experiments are conducted at temperatures below 250 K where the resistance between the metal layers exceeds 20 Gohms. In addition, by replacing the top Pt electrode with beta-Ta which is known to reverse the sign in the spin Hall angle, we found that the nonlocal signal reverses the polarity, which is a direct demonstration of the spin current nature. Furthermore, the temperature dependence of the nonlocal signal confirms the role of magnons in this effect.

1. S. S.-L. Zhang & S. Zhang, Magnon Mediated Electric Current Drag across a Ferromagnetic Insulator Layer. *Phys. Rev. Lett.* 109, 096603 (2012).
2. S. S.-L. Zhang & S. Zhang, Spin convertance at magnetic interfaces. *Phys. Rev. B* 86, 214424 (2012).
3. Mohammed Aldosary, Junxue Li, Chi Tang, Yadong Xu, Jian-Guo Zheng, Krassimir N. Bozhilov, and Jing Shi, Platinum/yttrium iron garnet inverted structures for spin current transport, *Appl. Phys. Lett.* 108, 242401 (2016); DOI: 10.1063/1.4953454.
4. J.X. Li, Y.D. Xu, M. Aldosary, C. Tang, Z.S. Lin, S.F. Zhang, R. Lake, and Jing Shi, Observation of magnon-mediated current drag in Pt/yttrium iron garnet/Pt(Ta) trilayer. *Nat. Comm.* 7, 10858 (2016); DOI: 10.1038/ncomms10858.

¹The work was supported as part of the SHINES, an Energy Frontier Research Center funded by the US Department of Energy, Office of Science, Basic Energy Sciences under Award No. SC0012670.