MAR17-2016-020478

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

Spin transport in antiferromagnetic heterostructures[1]

KAI CHEN, Univ of Arizona

Recently, it has been demonstrated that antiferromagnetic (AF) insulators are capable of conducting spin current injected by spin pumping and spin Seebeck effect from an adjacent ferromagnetic layer [1]. More importantly, the insertion of thin NiO film between YIG and Pt layer enhances the spin pumping/Seebeck current in the Pt layer. Motivated by such findings, we proposed a theoretical model where the spin current in antiferromagnetic insulators is carried by incoherent thermal magnons. In equilibrium, spin up and spin down magnons in AF materials are equally occupied. While non-equilibrium spin accumulation can be built up when AF magnons from one branch are selectively excited by spin accumulation from an adjacent layer. Then a spin current traverses the AFI layer via magnon spin diffusion. Utilizing spin convertance at interfaces and spin diffusion in each layer, we calculate spin Seebeck current across various layered structures at different temperatures. We find the presence of a NiO film blocks the spin current at low temperature while enhances the spin current at high temperature. The enhancement factor reaches maximum value near the magnetic transition temperature of NiO. The calculated temperature dependence quantitatively agrees with experiments [2]. In contrary, other models in which the spin current is carried by coherent magnons or spin supercurrent predict temperature insensitive spin conductivity of an AF insulator. Furthermore, we investigate the interplay between AF order dynamics and the magnon excitations based on the conversion between incoherent and coherent AF magnons. I am grateful for W. Lin and C.-L. Chien from Johns Hopkins University for their contributions to this work. [1] H. Wang *et al.*, Phys. Rev. Lett. **113**,097202 (2014); W. Lin *et al.*, Phys. Rev. Lett. **116**, 186601 (2016). [2] K. Chen *et al.*, Phys. Rev. B **94**, 054413 (2016).

[1]My work was supported by National Science Foundation under grant No. ECCS-1404542.