MAR14-2013-020333

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Exchange Coupling with Exponential Decay in $Y_3Fe_5O_{12}$/Barrier/Pt Heterostructures[1]

YONG PU[2], The Ohio State University

Understanding the mechanism of spin pumping is essential for advancing this exciting field and realizing potential applications of pure spin currents. It is believed that exchange interaction between the ferromagnet and nonmagnetic material is responsible for this phenomenon. We have grown high-crystalline quality $Y_3Fe_5O_{12}$ epitaxial thin films by off-axis sputtering and observed millivoltlevel inverse spin Hall effect (ISHE) voltages in $Y_3Fe_5O_{12}$/Pt bilayer excited by an FMR cavity. By inserting an insulating barrier between $Y_3Fe_5O_{12}$ and Pt, we detect an exponential decay of the ISHE voltages over three orders of magnitude for four different barrier materials, including $SrTiO_3$, Sr_2GaTaO_6, Sr_2CrNbO_6, and Si. Exponential decay lengths of 0.16, 0.19, and 0.23 nm are extracted for Sr_2GaTaO_6, $SrTiO_3$, and Sr_2CrNbO_6 with band gaps of 2.36, 3.40, and 4.91 eV, respectively. The exponential dependence of spin pumping on barrier thicknesses can be explained by quantum tunneling of the conduction electrons in Pt through the barrier and coupling with the precessing magnetization of $Y_3Fe_5O_{12}$ through exchange interaction to acquire spin polarization.

[1]Supported by NSF MRSEC and DOE

[2]Co-authors: H. L. Wang, C. H. Du, R. Adur, A. J. Berger, A. Hauser, R. E. A. Williams, D. W. McComb, E. Johnston-Halperin, P. C. Hammel, F. Y. Yang