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Disentangling the spin torques in a ferromagnet/semiconductor bilayer TIMOTHY D. SKINNER, London Centre for Nanotechnology, University College London, KAMIL OLEJNIK, Institute of Physics, ASCR, LUCY K. CUNNINGHAM, University of Cambridge, HIDEKAZU KUREBAYASHI, London Centre for Nanotechnology, University College London, RICHARD P. CAMPION, BRYAN L. GALLAGHER, University of Nottingham, TOMAS JUNGWIRTH, Institute of Physics, ASCR, ANDREW J. FERGUSON, University of Cambridge — Current-induced spin torques measured in ferromagnet/paramagnetic metal bilayers can originate from the spin-Hall effect (SHE) and inverse spin galvanic effect (ISGE). Distinguishing the two effects has proved difficult as they can both possess the same symmetries, but it is essential for our basic physical understanding of the spin torques at the ferromagnet/paramagnet interface to experimentally disentangle the SHE and ISGE contributions. In our approach, we look to zinc-blende crystals (such as III-V semiconductors), where the ISGE has a symmetry which depends on the crystal orientation. The field-like [1] and antidamping [2] torques, arising from the ISGE in the magnetic III-V semiconductor (Ga,Mn)As, are well understood because of low-temperature spin-torque ferromagnetic resonance (ST-FMR) measurements. Through new ST-FMR measurements, we show that in a room-temperature ferromagnetic metal/paramagnetic semiconductor bilayer, the SHE and ISGE coexist and can be unambiguously separated and quantified by their symmetries.

[1] D. Fang et al., Nature Nanotechnol. 6, 413417 (2011
[2] H. Kurebayashi, Jairo Sinova, D. Fang, A.C. Irvine, T.D. Skinner et al., Nature Nanotechnol. 9, 211-217 (2014)

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