Spin Pumping Through a Topological Insulator Studied by Ferromagnetic Resonance

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Topological insulators (TIs) have received widespread attention due to their large spin-orbit coupling and dissipationless, counter-propagating conduction channels in the surface state. So far, there has been only limited experimental research focused on the development of TI-FM heterostructures and similar TI devices, both for spin transport and proximity-enhancement studies [1,2]. In this work, we demonstrate the incorporation of a TI into a pseudo-spin valve heterostructure and study the time- and layer-resolved magnetodynamics [3].We use vector-network analyzer FMR and time-resolved x-ray magnetic circular dichroism [4] to demonstrate that TIs function as efficient spin sinks, while also allowing a limited dynamic coupling between ferromagnetic layers. These results shed new light on the spin dynamics of this novel materials class, and suggest future directions for the development of room temperature TI-based spintronics.

[1] A. A. Baker, A. I. Figueroa, K. Kummer, L. J. Collins-McIntyre, T. Hesjedal, and G. van der Laan, Enhanced Curie Temperature of Cr-doped Bi2Se3 Thin Films Through the Magnetic Proximity Effect, Phys. Rev. B, in press (2015).

[2] L. R. Shelford, T. Hesjedal, L. Collins-McIntyre, S. S. Dhesi, F. Maccherozzi, and G. van der Laan, Electronic Structure of Fe and Co Magnetic Adatoms on Bi2Ti3 Surfaces, UPhys. Rev. BU 86, 081304(R) (2012).

[3] A. A. Baker, A. I. Figueroa, L. J. Collins-McIntyre, G. van der Laan, and T. Hesjedal, Room-temperature spin transport in topological insulators, Scientific Reports 5, 7907 (2015).

[4] G.B.G. Stenning, L.R. Shelford, S.A. Cavill, F. Hoffmann, M. Haertinger, T. Hesjedal, G. Woltersdorf, G.J. Bowden, S.A. Gregory, L.C. Maple, C.H. Back, P.A.J. de Groot, and G. van der Laan, Magnetization Dynamics in an Exchange-Coupled NiFe/CoFe Bilayer, New J. Phys. 17, 013019 (2015).

BIO: Thorsten Hesjedal is an Associate Professor of Materials Design for Experimental Condensed Matter Physics. He graduated with a Ph.D. in Physics from the Humboldt University in Berlin, Germany. Before coming to Oxford, Dr. Hesjedal was an Associate Professor at the University of Waterloo (Ontario, Canada) and a Visiting Associate Professor at Stanford University. Dr. Hesjedal has research facilities located in the Clarendon Laboratory and in the Research Centre at Harwell on the Rutherford Appleton Laboratory site.

Dr. Hesjedal’s research focuses on the growth of quantum materials in the form of thin films and of nanostructures using molecular beam epitaxy (MBE), UHV sputtering, and chemical vapor deposition; their structural, magnetic, and electrical characterization; as well as exploratory device studies. Materials of interest include; Topological insulators – heterostructures, magnetic doping, intercalation, phase-change memory; Oxides – MBE growth, electronic studies, doping, strain engineering; Magnetic heterostructures - thin film growth, nanofabrication, devices; Silicon/germanium – thin film growth, strain engineering; Lanthanides - heterostructures, RE doping, exchange spring.