CSU PHYSICS COLLOQUIUM

"Direct electrical detection of spin-momentum locking in topological insulators"

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Naval Research Laboratory

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Virtual via Zoom (see announcement for link)

Abstract

Topological materials constitute a new quantum phase of matter distinct from the classic dichotomy of simple metals and semiconductors. The existence of this class of material was predicted from the study of electronic band topology, a branch of mathematics that describes properties that only change step-wise. In this talk, I will first give an overview of the research at Naval Research Lab on topological materials, and discuss our work on topological insulators (TI) with an insulating bulk and time reversal symmetry protected surface states that exhibit spin-momentum locking—the spin lies in-plane and is locked at right angle to carrier momentum. This enables the direct control and conversion between charge and spin, where an unpolarized charge current produces a spin accumulation, and conversely the electrical injection of spin polarized electrons generate a charge accumulation. Using ferromagnet/tunnel barrier contacts to detect/inject spin, we probe these phenomena in topological insulators Bi_2Se_3, Bi_2Te_3, and Sb_2Te_3, and compare them to a trivial two-dimensional electron gas on an InAs(001) surface. We have also developed a model to derive the signs of the spin signals expected for the TI surface states, which reveals the critical role of parameters such as spin-dependent interface resistances. I will also briefly discuss our latest effort on developing bulk insulating Bi_2Se_3 for spin orbit torque switching of ferromagnets.

Biography

Connie H. Li is a staff research scientist in the Magnetoelectronic Materials & Devices Section in the Materials Science & Technology Division at the Naval Research Laboratory (NRL) in Washington, DC. She received her B.S. and Ph.D. in 1998 and 2002 from UCLA, working on compound semiconductor surface reactions at an atomic scale in MOCVD, during which she was supported by an NSF Graduate Fellowship. She was a National Research Council Postdoctoral Research Associate at NRL from 2002- 2004, and became a research staff member in 2004. Her current research involves spin-dependent transport and magneto-optical studies in ferromagnet/semiconductor heterostructures, 2D transition metal dichalcogenides, and topological insulators for spintronic applications.