MAR12-2011-004969

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Electrical spin injection from an organic-based ferrimagnet in a hybrid organic/inorganic heterostructure[1]

EZEKIEL JOHNSTON-HALPERIN, Department of Physics, The Ohio State University

The development of organic-based magnets with room temperature magnetic ordering and semiconducting functionality promises to broaden the field of semiconductor spintronics, providing a route to all-organic spintronic devices and hybrid organic/inorganic structures capable of exploiting the multifunctionality and ease of production in organic systems as well as the well established spintronic functionality of inorganic materials. Our work demonstrates the successful extraction of spin polarized current from the organic-based room temperature ferrimagnetic semiconductor $V[TCNE]_x$ ($x \sim 2$, TCNE: tetracyanoethylene; $T_C > 400$ K, $E_G \sim 0.5$ eV, $\sigma \sim 10^{-2}$ S/cm) and its subsequent injection into a GaAs/AlGaAs light-emitting diode (LED) [1]. The spin current is detected by monitoring the polarization state of the photons emitted from the LED structure and tracks the magnetization of $V[TCNE]_{x\sim 2}$, is weakly temperature dependent, and exhibits heavy hole / light hole asymmetry. This result opens the door to a new class of active, hybrid spintronic devices with multifunctional behavior defined by the optical, electronic and chemical sensitivity of the organic layer. In addition, spin transport in these hybrid structures provides the opportunity to leverage well-characterized inorganic materials as a probe of spin physics in organic and molecular systems and to explore the impact of the hybrid interface on spin injection efficiency. Initial studies exploring the impact of surface passivation of the inorganic layer with self-assembled monolayers of various chemistries will be presented, and additional experimental probes of the interfacial exchange interaction will be discussed.

[1] "Electrical Spin Injection from an Organic-Based Ferrimagnet in a Hybrid Organic-Inorganic Heterostructure," Lei Fang, K. Deniz Bozdag, Chia-Yi Chen, P.A. Truitt, A.J. Epstein and E. Johnston-Halperin, *Phys. Rev. Lett.* **106**, 156602 (2011).

[1]Funding for this research was provided by the Center for Emergent Materials at the Ohio State University, a NSF MRSEC (Award Number DMR-0820414).