MAR12-2011-006248

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

Probing and manipulating magnetization at the nanoscale

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Combining semiconductors with magnetism in hetero- and nano-structured geometries provides a powerful means of exploring the interplay between spin-dependent transport and nanoscale magnetism. We describe two recent studies in this context. First, we use spin-dependent transport in ferromagnetic semiconductor thin films to provide a new window into nanoscale magnetism [1]: here, we exploit the large anomalous Hall effect in a ferromagnetic semiconductor as a nanoscale probe of the reversible elastic behavior of magnetic domain walls and gain insight into regimes of domain wall behavior inaccessible to more conventional optical techniques. Next, we describe novel ways to create self-assembled hybrid semiconductor/ferromagnet core-shell nanowires [2] and show how magnetoresistance measurements in single nanowires, coupled with micromagnetic simulations, can provide detailed insights into the magnetization reversal process in nanoscale ferromagnets [3]. The work described here was carried out in collaboration with Andrew Balk, Jing Liang, Nicholas Dellas, Mark Nowakowski, David Rench, Mark Wilson, Roman Engel-Herbert, Suzanne Mohney, Peter Schiffer and David Awschalom. This work is supported by ONR, NSF and the NSF-MRSEC program.

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[2] N. J. Dellas et al., Appl. Phys. Lett. **97**, 072505 (2010).
[3] J. Liang *et al.*, in preparation.