MAR08-2007-003326

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Imaging the Drift and Diffusion of Optically- and Electrically-Injected Spins in Semiconductors[1]

SCOTT CROOKER, National High Magnetic Field Laboratory, Los Alamos National Lab

We use methods for low-temperature scanning Kerr-rotation microscopy to directly image the drift, diffusion, and precession of spin-polarized electrons flowing laterally in GaAs. The 2-D images are used to explore spin generation and propagation resulting from both optically- as well as electrically-injected electron spins. The focused probe laser also allows to locally probe and spatially resolve the depolarization of an electron spin distribution by a small applied transverse magnetic field. The shape of these "local Hanle effect" curves reveals important spin transport properties including the spin lifetime, drift velocity, mobility, and diffusion length [1]. The data can be accurately modeled using numerical solutions to the spin-drift-diffusion equations. Spatially-dependent asymmetries in the local Hanle effect data directly reveal the presence of additional effective magnetic fields due to spin-orbit coupling, and the dependence of these spin-orbit fields on the in-plane electron momentum **k**. Using spin imaging and local Hanle effect measurements, we measure the drift and diffusion of electrically-injected spins in lateral spin transport devices having biased Fe/GaAs tunnel-barrier contacts [1], both within the charge current path as well as outside of the charge current path where only a pure spin current exists. A bias-dependent reversal of the injected spin polarization is directly observed, and we discuss how optical pumping methods can be used to measure (and tune) the spin dependent sensitivity of the epitaxial Fe/GaAs contacts when used as electrical spin detectors. [1] M. Furis *et al.*, New J. Phys. **9**, 347 (2007); X. Lou *et al.*, Nature Physics **3**, 197 (2007)

[1]In collaboration with D. L. Smith, M. Furis, X. Lou, C. Adelmann, E. S. Garlid, S. Flexner, K.S.M. Reddy, J. Zhang, C. J. Palmstrøm, and P. A. Crowell and supported by the Los Alamos LDRD and NSF MRSEC programs and ONR.