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Electrical Measurement of the Direct Spin Hall Effect in Fe/GaAs Heterostructures E.S. GARLID, University of Minnesota, Q. HU, University of California, Santa Barbara, M.K. CHAN, University of Minnesota, C.J. PALMSTRØM, University of California, Santa Barbara, P.A. CROWELL, University of Minnesota — A handful of recent experiments, all of which have used optical techniques, have investigated the spin Hall effect in semiconductors. We report on an all-electrical measurement showing evidence of the spin Hall effect in epitaxial (100) Fe/GaAs heterostructures with a channel doping (Si) of $n = 5\times10^{16}$ cm^{-3} and highly doped Schottky tunnel barriers ($n^+ = 5 \times 10^{18}$ cm^{-3}). Multiple devices were fabricated on a single chip with the distance of the ferromagnetic (FM) electrodes from the channel edge varying between 2 and 10 μm. Devices were first characterized by performing non-local spin valve and Hanle measurements. Hall measurements were then performed with an unpolarized current flowing down the GaAs channel parallel to the magnetic easy axis of the FM electrodes. A magnetic field was applied along the FM hard axis to induce precession of the out-of-plane spins at the channel edges into the FM easy axis. We investigate the bias and temperature dependence of the resulting Hanle signal, and find that it is consistent with an extrinsic spin Hall effect. The data suggests that ionized impurity scattering is the dominant contribution to the spin Hall conductivity in these samples. Supported by ONR and NSF.

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