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Imaging Spin Injection and Accumulation in Lateral Ferromagnet/Semiconductor Devices[1]

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We have directly imaged electrical spin injection and accumulation in the GaAs channel of a lateral spin transport device.[†] The ferromagnetic source and drain tunnel-barrier contacts at each end of the channel are epitaxial Fe Schottky barriers separated by a distance of 300 μm, which is much longer than the spin diffusion length. Emission of majority-spin electrons from the Fe source contact is observed using scanning Kerr microscopy. A majority spin polarization in the channel is also detected near the drain electrode, and we show that this accumulation is due to a spin current flowing away from the drain, against the unpolarized incident electron current. This result implies that the transmission of electrons through the forward-biased Schottky barrier is spin-sensitive. This is confirmed by demonstrating that the electrical conductance of the device can be modulated by controlling the spin orientation of optically injected electrons flowing through the drain. These experiments are conducted in a geometry sensitive only to spin precession and allow for detailed modeling of spin transport in the channel. We show how this approach can be used to detect the spin accumulation at the drain electrode using purely electrical means. [†]S. A. Crooker *et al.*, Science **309**, 2191 (2005).

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