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Spin accumulation in forward-biased MnAs/GaAs Schottky diodes¹

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The injection of electrons from ferromagnetic metals into semiconductors has recently received much attention in the field of spintronics since these systems have the potential to serve as room-temperature sources of spin polarization. To date, most research in this vein has focused on electron currents flowing through a tunnel barrier from the ferromagnet to the semiconductor. For example, spin injection has been observed for tunneling through Schottky and aluminum oxide tunneling barriers as well as in more complicated structures such as magnetic tunnel transistors. All of these schemes share the common feature that spin-polarized electrons are injected from ferromagnet to semiconductor. Here we describe experiments demonstrating a new means for the all-electrical generation of spin polarization in ferromagnet/semiconductor epilayers, in which an electron current flows from the semiconductor to the ferromagnet³. In contrast to the more conventional route of spin injection, we observe spin accumulation at the metal/semiconductor interface of these forward-biased ferromagnetic Schottky diodes. Spatiotemporal Kerr microscopy is used to image the electron spin and the resulting dynamic nuclear polarization that arises from the non-equilibrium carrier polarization. A simple model can be used to describe the spin accumulation effect in terms of spin-dependent interface transmission and reflection coefficients and to estimate its magnitude.

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³J. Stephens et al. Phys. Rev. Lett. 93, 097602 (2004)