Spin Transport and Scattering in Ferromagnetic Semiconductor Heterostructures

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A fundamental understanding of the transport and scattering of spin-polarized carriers in semiconductors is central to the development of semiconductor spintronics. We describe recent work that probes the spin-dependent transport of holes in heterostructures derived from the ferromagnetic semiconductor (Ga,Mn)As. In tensile-strained (Ga,Mn)As/(In,Ga)As heterostructures with perpendicular magnetic anisotropy, we observe a longitudinal magnetoresistance that is **antisymmetric** in magnetic field and attributed to slowly propagating magnetic domain walls [1]. This is confirmed both by a simple calculation and by measuring patterned submicron channels designed to trap single domain walls. In (Ga,Mn)As/p-GaAs/(Ga,Mn)As trilayer heterostructures, we demonstrate an all-semiconductor spin-valve effect, despite short spin-diffusion and elastic scattering lengths in the spacer layer [2]. Magnetoresistance (MR) measurements carried out in the current-in-plane geometry reveal positive MR peaks when the two ferromagnetic layers are magnetized orthogonal to each other. Measurements with different post-growth annealing conditions and spacer layer thickness show that the positive MR originates in a noncollinear spin valve effect due to spin-dependent scattering at interfaces.


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