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Spin Transport and Scattering in Ferromagnetic Semiconductor Heterostructures[1]

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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.

[1] G. Xiang, A. W. Holleitner, B. L. Sheu, F. M. Mendoza, O. Maksimov, M. B. Stone, P. Schiffer, D. D. Awschalom, N. Samarth, Phys. Rev. B **71**, 241307(R) (2005).
[2] G. Xiang, M. Zhu, B. L. Sheu, P. Schiffer, N. Samarth, cond-mat/0607580.

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