Igor Zutic: Spin-polarized transport in semiconductor junctions: From superconductors to magnetic bipolar transistors

The physics of semiconductor junctions makes it possible to study the interplay of magnetism, superconductivity, and nonequilibrium spin. The motivation for examining these structures ranges from fundamental issues involving spin degrees of freedom to a wide range of spintronic applications [1]. This lecture will focus on two topics. We first discuss spin-polarized transport in junctions with superconductors which were recently used for a measurement of the spin polarization in a novel class of ferromagnetic semiconductors. We next develop a theory of spin transport in inhomogeneously doped magnetic semiconductors. Using this theory we predict that a nonequilibrium spin leads to the spin-voltaic effect [2], a spin-analog of the photo-voltaic effect. The direction of the charge current, which can even flow at no applied bias, can be switched
by reversal of the equilibrium magnetization or by reversal of the polarization of the injected spin. We discuss some implications of the spin-voltaic effect in magnetic bipolar transistors [3], active spintronic devices which could provide spin-switching and spin-controlled amplification.

[1] I. Zutic, J. Fabian, and S. Das Sarma, Rev. Mod. Phys. 76, 323 (2004).
[2] I. Zutic, J. Fabian, and S. Das Sarma, Phys. Rev. Lett. 88, 066603 (2002).
[3] J. Fabian and I. Zutic, Phys. Rev. B 69, 115314 (2004); cond-mat/0409196.