Semiconductor Spintronics

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Abstract: Spintronics is an interdisciplinary field in which the central idea is the manipulation of spin degrees of freedom in solid state systems. The motivation to examine semiconductor spintronics is stimulated by recent materials advances in magnetic semiconductors and the prospect of device applications, either not feasible or ineffective with conventional electronics. Near term applications include, for example, nonvolatile magnetic random access memory and spin-controlled logic, while in the long term a realization of a spin-based quantum computer is sought. However, in contrast to the well-established modeling of semiconductor charge-based devices, modeling efforts in semiconductor spintronics have only begun. In this talk we focus on our proposal for the spin-polarized [1] and magnetic p-n junctions [2,3]. We generalize the drift-diffusion equations and the appropriate numerical algorithms to the case of spin-polarized transport in semiconductors. In particular, we predict the amplification of spin density [1] and the spin-voltaic effect [2,3], where due to injected nonequilibrium spin, a charge current can flow even at no applied bias. [1] I. Zutic, J. Fabian, S. Das Sarma, Phys. Rev. B 64, 121201 (2001). [2] I. Zutic, J. Fabian, S. Das Sarma, Phys. Rev. Lett. 88, 066603 (2002). [3] I. Zutic, J. Fabian, S. Das Sarma, Appl. Phys. Lett. 82, 221 (2003).