Effect of Disorder on Spin-Injection in Semiconductors from Ferromagnets

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Abstract

We investigate the problem of spin-injection from a ferromagnetic metal into a semiconductor. Near 100% polarization is predicted for an ideal Fe(100)-semiconductor interface since states of only one symmetry $\Delta_1$ which exist only in the majority channel can propagate through the Schottky barrier. In the presence of interface disorder some of the minority blocked states are scattered into the $\Delta_1$ state, reducing the polarization.

Conclusions

• In absence of disorder transmission is 100% spin-polarized due to symmetry of states at $k||=0$.
• Majority transmission which occurs via $\Delta_1$ state is not affected by disorder.
• Minority transmission increases with disorder decreasing polarization of injected current.
• Effect (decrease in polarization) is greatest for disorder in the Fe, decreasing as disordered layer is moved towards the semiconductor.
• Disorder was modeled using a uniform distribution of on-site energies of width 0.05Ry (upper graphs) or using substitutional disorder (lower graphs).

Without disorder, $k_\uparrow$ is conserved. Only up spin electrons can penetrate the Schottky barrier.

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