MAR08-2007-006537

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Spin Dependent Transport in Si/SiGe Few-Electron Quantum Dots

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Si/SiGe quantum dots are of interest for quantum information processing due in large part to the existence of spin zero isotopes of both Si and Ge. We present the results of transport measurements and integrated charge sensing in silicon double and single quantum dots.[1,2] We observe two effects arising from spin dependent transport in a double quantum dot. First, and as expected, for one direction of current flow we observe spin blockade – the canonical example of spin-to-charge conversion in transport. In addition, when current flow is reversed, we observe a second effect: strong tails of current extend from the sharp triangular regions in which current conventionally is observed. The presence of these tails is explained by a combination of long spin relaxation times and preferential loading of an excited spin state. We also present charge-sensing measurements of single and double quantum dots using an integrated quantum point contact. The charge sensor signal from single electron tunneling is well correlated with conventional transport through the system. When the tunnel barriers are large and transport through the dot is not measurable, charge sensing remains a viable means to track charge transitions and is used to confirm individual-electron occupation in a single quantum dot. Work performed in collaboration with Nakul Shaji, Madhu Thalakulam, Levente J. Klein, H. Luo, Hua Qin, R. H. Blick, D. E. Savage, M. G. Lagally, A. J. Rimberg, R. Joynt, M. Friesen, S. N. Coppersmith, M. A. Eriksson. Work supported by ARO, LPS, NSF and DOE. (1) Shaji, N. *et al.* e-print arXiv:0708.0794 (2) Simmons, C. B. *et al.* Appl. Phys. Lett. **91**, 213103 (2007).