Extended Abstracts of the 2009 International Conference on Solid State Devices and Materials, Sendai, 2009, pp917-917

Giant, level-dependent electron g-factors and Kondo physics in few-electron InSb nanowire quantum dots

Hongqi Xu

Division of Solid State Physics, Lund University, Box 118, S-221 00 Lund, Sweden
Electronic mail: Hongqi.Xu@ftf.lth.se

I report our recent study of spin physics and Kondo phenomena in quantum dots fabricated from semiconductor InSb nanowires. Spin states, effective g-factors, and spin-orbit interaction strength were measured for the fabricated quantum dots in the few-electron regime. The measurements showed that the quantum levels of the InSb quantum dots have giant g-factors, with absolute values up to ~70, the largest value ever reported for semiconductor quantum dots. We also observed that the values of these g-factors are quantum-level dependent and can differ strongly between different quantum levels. The presence of giant g-factors indicated that considerable contributions from the orbital motion of electrons were preserved in the measured InSb nanowire quantum dots, while the level-to-level fluctuations aroused from spin-orbit interaction. We have deduced a value of 280 μeV for the strength of spin-orbit interaction from an avoided level crossing between the ground state and an excited state of an InSb nanowire quantum dot. We have also studied strong correlation phenomena in the InSb nanowire quantum dots and observed both the odd-number and the even-number electron Kondo. We have also observed a new Kondo-like correlation-induced phenomenon, namely the conductance blockade at the degeneracy of two orbital states with the same spin. We attribute this conductance blockade to the effect of electron interference between two equivalent, strongly correlated, many-body states in the quantum dot.

I acknowledge collaborations with Henrik A. Nilsson, Philippe Caroff, Marcus Larsson, Claes Thelander, Jakob B. Wagner, Lars-Erik Wernersson, and Lars Samuelson.