Hole transport in an InSb nanowire quantum dot with superconductor contacts

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An InSb quantum dot with superconductor contacts is fabricated from an InSb nanowire grown by MOVPE.[1] Due to the narrow band gap (E_g ~0.17eV) of InSb, the quantum dot can be tuned to the hole transport regime by applying negative voltages to the back gate even though the grown InSb nanowire is originally n-type. In low temperature measurements, abnormal Coulomb staircases are observed in the I-V curves. Every Coulomb step is accompanied by a sharp peak at its edge. This peak can be attributed to the singularity of the BCS density of states (DOS) in the superconductor leads and the conductance shows a maximum when the hole level of the quantum dot is aligned with the DOS singularity in the leads. The hole states in the InSb quantum dot have also been characterized by the magnetotransport and temperature dependent transport measurements. It is found that at slightly higher temperatures, an extra conductance peak is visible. This extra peak can be attribute to the thermal excitation of quasiparticles in the leads and the thermal population of an excited hole state in the dot.

[1]H. A. Nilsson, O. Karlström, M. Larsson, P. Caroff, J. N. Pedersen, L. Samuelson, A. Wacker, L.-E. Wernersson, and H. Q. Xu, Phys. Rev. Lett. 104, 186804 (2010).