

Spin States, Spin Correlations, Supercurrent, and Multiple Andreev Reflections in InSb Nanowire Quantum Devices

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Bulk InSb is one of the most promising materials for applications in spintronics and quantum information processing, due to the fact that it has the smallest electron effective mass $m_e^* = 0.015 m_e$ and the largest electron magnetic moment $|g^*| = 51$ among all III-V semiconductors. Here, we report on transport measurements of InSb quantum dots and superconductor/InSb/superconductor hybrid devices made from InSb nanowires. Spin states, effective g-factors, and spin-orbit interaction energy are measured for the InSb quantum dots. We have also studied strong correlation phenomena and observed a new spin-correlation-induced phenomenon in the devices, namely the conductance blockade at the degeneracy of two orbital states with the same spin. We attribute this conductance blockade to the effect of interference between two equivalent, strongly correlated, many-body states in the dots. In superconductor/InSb nanowire/superconductor hybrid devices, we have observed supercurrent and multiple Andreev reflections, and have found that the fluctuations in the supercurrent are correlated to the conductance fluctuations of the corresponding InSb nanowires in the normal state. We have also observed multiple Andreev reflections and interplay between the Kondo correlation and proximity effect in the Coulomb blockade regime.