Study of 0-π phase transition in hybrid superconductor-InSb nanowire quantum dot devices

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Hybrid InSb nanowire-superconductor devices are promising candidates for investigating Majorana modes in solid-state devices and future technologies of topological quantum manipulation Here, we reports on the realization of high-performance hybrid superconductor-quantum dot devices based on individual InSb nanowires grown by molecular-beam epitaxy. We demonstrate proximity-induced supercurrent together with clear signatures of multiple Andreev reflections, indicating phase-coherent transport within junction.[1] Furthermore, in a closed quantum dot regime, we observed two types of subgap resonance states within the superconducting gap, which can be attributed to gate-tunable Andreev bound states with different Kondo temperatures. The presence of the gate-tunable 0 and π junction allow us to investigate the fundamental 0 π transition. Detailed magnetic field and temperature evolution of level spectroscopy demonstrate different behavior of two types of the Andreev bound states. Our results exhibit that the InSb nanowires can provide a promising platform for exploring phase coherence transport and the effect of spin-orbit coupling in semiconductor nanowire-superconductor hybrid device.

[1]S. Li et al., Sci. Rep. **6,** 24822 (2016); S. Li et al., Phys. Rev. B **95,** 014515(2017).