Coulomb blockade and coherent electron transport in nanowires undergoing a superconductor-insulator transition

Andrey Rogachev

Department of Physics
University of Illinois at Urbana-Champaign
1110 W. Green St.,
Urbana IL 61801

To test the limits of superconductivity in one dimension we have fabricated a series of ultrathin homogeneous MoGe wires with diameters below ~10 nm using suspended carbon nanotube as templates. With decreasing diameter, nanowires display clear superconductor – insulator transition (SIT). In superconducting state, the nanowire resistance was found to follow the classical theory of thermally activated phase slips. In insulating state, zero-bias anomaly and temperature dependence of conductance are well described by the theory of weak Coulomb blockade of coherent single-electron transport. Within this interpretation a nanowire, which in our experiment is shorter than dephasing length, acts as a zero-dimensional coherent scatter. The capacitance extracted from theoretical fits quantitatively agrees with the capacitance between two electrodes connected to the opposite sides of the wire. Experiment suggests that the charge of the carriers changes from 1e for strongly insulating wires to 2e for weakly insulating wires that are close to the SIT.