Superconductor – Insulator Transition in One-Dimensional Nanowires.

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Abstract:

To test the limits of superconductivity in one dimension we have fabricated a series of ultrathin homogeneous Nb and MoGe wires with diameters below ~10 nm using suspended carbon nanotubes as templates. With decreasing diameters, nanowires display clear superconductor to insulator transition. On the superconducting side, the resistance of the nanowires drops exponentially with decreasing temperature in an agreement with the theory of thermally activated phase slips. This behavior also persists in wide range of magnetic fields. The magnetic field dependence of the critical temperature is in good quantitative agreement with the theory of pair-breaking perturbations Main characteristics of the insulating wires, the rising *R(T)* dependence and zero-bias resistance peak, can be well described by the theory of weak Coulomb blockade. Within this interpretation, a nanowire (which in our experiment is shorter than dephasing length) acts as a rigid coherent scatterer and combined system of nanowire and electrodes acts effectively as a capacitor. The experiment strongly suggests that the charging energy has global origin, i.e. is determined by the size and geometry of electrodes.

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