Highlights

Transport properties in aggregates of Nb nanowires templated by carbon nanotube films

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Films of multiwall carbon nanotubes (CNTs), arranged on Si/SiO_2 substrates, are used as templates for Nb films with thickness in the range 3-50 nm deposited by sputtering. The resulting aggregates show normal state and superconducting properties similar to those observed in networks of superconducting nanowires (SNW) obtained by other methods. Decreasing the Nb thickness a superconductor-insulator transition is observed. Moreover, thermally activated phase slips in thicker samples, evolving in quantum phase slips in thinner nanowires, are observed in the superconducting state. The experimental results indicate that the template method based on CNTs is a promising alternative to the nanolithography techniques for obtaining SNWs.
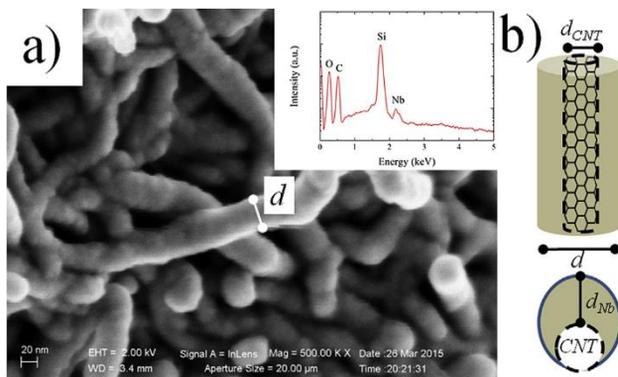
Figure 1. a) SEM image of the sample CNTNb30. The dot-ended line white line indicates the average diameter of a SNW. Inset: Energy Dispersive Spectrum of the same sample. b) Schematic of a SNW built using a CNT as a template (upper panel) and its cross section (lower panel); d_{Nb}, d_{CNT} and d represent the Nb thickness, the CNT diameter and the diameter of the whole structure, respectively.
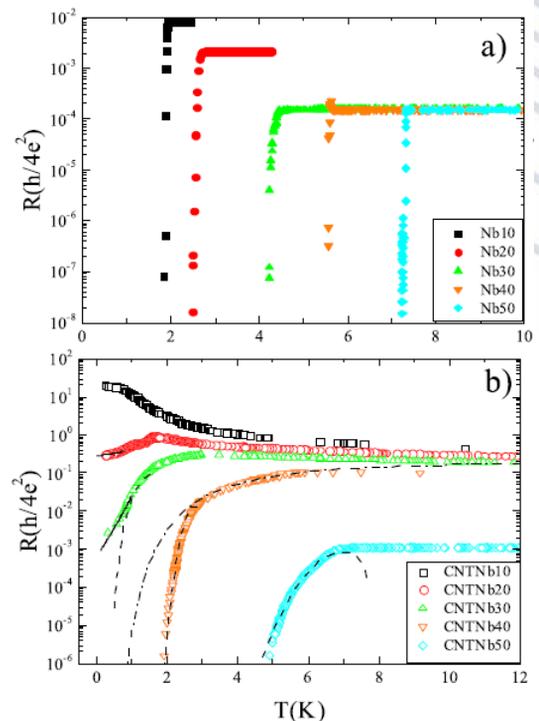

Figure 2. Resistance in units of quantum resistance for (a) the Nb reference samples and (b) the SNW aggregates. The lines in the right panel are fits to the data using the TAPS model (dashed lines), QPS model (solid lines) and Ambegaokar-Halperin (AH) model (dot-dashed line for CNTNb40).