Challenges and Achievements on the Transport Measurements of Carbon Nanotubes

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Abstract
Carbon nanotubes are excellent realizations of one-dimensional quantum wires with intriguing electrical and physical properties. In particular, semiconducting nanotubes possess great potential in nanoelectronic applications owing to their high current-carrying capability and quasi-ballistic transport behaviors even at room temperature. However, traditional measurement techniques used to characterize the transport parameters in bulk materials may not be applicable to nanotube devices because of the unconventional 1D geometry and the tiny size of the system. For example, the perturbation of metal contacts to the nanotube prohibits the meaningful interpretation of nanotube resistivity in a regular four-probe measurement setup. The determination of transport parameters, such as carrier mobility and carrier density, is essential for both fundamental studies and applications of carbon nanotubes. Thus, the enormous interest in carbon nanotubes has spurred the advancement and development of a number of novel measurement techniques and strategies for nanoscale electronic devices. In this talk, I will first discuss the challenges in performing transport measurements on carbon nanotube devices, as well as the issues and complications when interpreting the experimental results. The device variability due to the nanotube diameter distribution will be discussed in conjunction with TEM characterizations. I will then present recent progress in the measurement techniques for nanoscale devices in order to extract intrinsic transport parameters of carbon nanotubes. The applicability and the limitations of these techniques will also be discussed.