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Contactless Probing of the Carrier Transport in Carbon Nanotubes Using Dielectric Force Microscopy YIZE LI, JUN GE, JIA LIU, JIE ZHANG, WEI LU, LIWEI CHEN, Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences — We have developed a scanning probe microscopy (SPM) based technique which is named as dielectric force microscopy (DFM) to manipulate and probe the majority carriers in 1-dimensional nanoelectronic materials. We have demonstrated its success in distinguishing semiconducting single-walled carbon nanotubes (SWNTs) from metallic ones, locating semiconducting-metallic junction in SWNTs, determining the majority carrier types in SWNTs and ZnO nanowires, and detecting the electronic doping of SWNTs by gaseous ammonia. To achieve a quantitative measure of the intrinsic carrier transport, we have performed DFM measurement on individual SWNTs, fabricated field effect transistor devices with the individual SWNT serving as the channel, and carried out electrical transport experiment. The results from DFM and transport measurements are quantitatively correlated in an almost perfect fashion allowing the extraction of intrinsic carrier transport properties especially carrier mobility from DFM data without making metal contacts. Furthermore, we have successfully detected the location and behavior of local transport barriers in SWNTs utilizing the nanometer scale resolution feature of DFM.

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