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Transport Study of Carbon Nanotube Networks with Different Ratios of Semiconducting and Metallic Nanotubes XUAN WANG, ERIK HÁROZ, QI ZHANG, JUNICHIRO KONO, Rice University — An important goal of current nanotechnology research is to obtain a quantitative understanding of how electrons drift and tunnel through junctions of nanostructures and how the overall electrical conductivity of networks of nanostructures is determined. Here, we present a comprehensive study of DC transport properties of macroscopic single-wall carbon nanotube (SWCNT) networks with different ratios of metallic and semiconducting nanotubes. The temperature-dependent resistivity shows that when the length of SWCNT is orders of magnitude smaller than the dimensions of the network, the resistance mainly comes from inter-tube junctions. However, the transport mechanism changes from fluctuation-induced tunneling in metallic-enriched networks to variable range hopping in semiconductor-enriched networks. The magneto resistance (MR) of these two networks also show distinct features. In a metallic enriched network, MR is negative up to 10 Tesla below 70 K which can be explained based on weak localization theory. One the other hand, in a semiconductor-enriched network, MR is mostly positive up to 10 Tesla below 10 K, which can be explained based on the shrinking of electron wave function due to the magnetic field.

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