Inter-shell hopping and resonant transport in double-wall carbon nanotube

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Electrical transport properties of individual double-wall carbon nanotube (DWNT) is studied. Negative differential conductance (NDC) was observed for the DWNT with a defected outer shell. Such NDC was explained in terms of the resonant tunneling through multiple quantum dots. Also observed is the Fano resonance for the low-resistance samples. The Fano resonance was manifested by asymmetric peaks in the gate modulation and also by the zero-bias peak in the differential conductance curve. We argue that the Fano resonance in DWNT arises from the interplay of inner and outer shells via the inter-shell hopping of electrons. Our interpretation is supported by two experimental observations. First, a longer period oscillation superimposed on conventional Coulomb blockade oscillation, which signals the presence of a side-coupled dot. Second, the magnetic-field-induced evolution of the Fano resonance profile, whose period is consistent with the Aharonov-Bohm type interference of inner and outer shells.

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