Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

On Current Carrying Capacity of Single Wall Semiconducting Carbon Nanotubes YIJIAN OUYANG, YOUNGKI YOON, JING GUO, Department of Electrical and Computer Engineering, University of Florida — The current carrying capacity of single wall semiconducting carbon nanotubes (CNTs) in the presence of phonon scattering and band-to-band tunneling is studied by self-consistently solving Poisson and Schrödinger equation using the non-equilibrium Green's function formalism. We show that the current delivery capacity of semiconducting CNTs strongly depends on the bias regime and is drastically different from metallic CNTs. A long metallic single wall CNT carries a saturation current of $\sim 25\mu$A due to optical phonon (OP) scattering. In contrast, a semiconducting CNT can deliver a current well above 25μA in ambipolar transport regime even when the channel length is much longer than the OP scattering mean free path (mfp). When the channel length is short (comparable to the OP scattering mfp), a semiconducting CNT biased in unipolar transport regime can deliver a current larger than 25μA. Biasing the CNT in ambipolar transport regime, however, further doubles the current. The different current carrying capacity in the ambipolar transport regime is due to nearly uncoupled dissipative transport through both the lowest conduction and valence subbands in the channel.

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Date submitted: 28 Nov 2005 Electronic form version 1.4