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Optoelectronic Characterization of Nafion-gated Nanotube FETs

HAPPINESS MUNEDZIMWE, Lehigh University, IBE Dept., 200 West Packer Ave, Bethlehem, PA 18015, SLAVA V. ROTKIN, Lehigh University, Physics Dept., 16 Memorial Dr. East, Bethlehem, PA 18015 — Optoelectronic probing is a routine way of characterizing standard semiconductor devices. For Carbon Nanotubes Field Effect Transistors (CNT FETs) made on silicon, however, it is a challenge to distinguish between intrinsic and ambient/substrate effects. Photo voltages at the Si-SiO2 interface often dominate the characterization. Back gated FETs systems also exhibit very high gating voltages. Ionomeric substrates allow higher gating efficiencies and at lower voltages. We report significant transconductance and photo modulation at gate voltages peaking around 5V with Nafion-117 ionomer as substrate which is ten times less than for typical Si systems. We use a generic back-gated FET geometry for characterizing gating performance and the trapping processes at the Nafion –CNT layer interface. Typical signal rise and decay times are of the orders 10 s and 100 s respectively, consistent with charge trapping inside the ionomeric polymer. The close similarity between electrostatic gating and photo-gating signal profiles makes the latter a plausible explanation for photo-conductance characterization mechanism in our samples.

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