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Quantum capacitance and gate coupling in NT array field effect devices SLAVA V. ROTKIN, Lehigh University, JOHN A. ROGERS, Beckman Institute, UIUC — Modern electronics may essentially benefit on a new approach to fabricating nanotube field-effect thin film transistors (NT-TFT) that consist of parallel NT arrays with high uniformity of inter-tube spacing and orientation of neighbor NTs. The large density of NTs per channel area allows to improve such device characteristics as drain current and transconductance. Here we address theoretically the issue of a quantum capacitance as a unique feature of the single-wall NT material and its role in transport in the dense or sparse array NT-TFTs. We present a complete electrostatic model joined with the quantum theory of the NT response to investigate the capacitance coupling to the backgate and/or the top gate for the broad range of the TFT device geometry. We vary the NT density, uniformity of the array, dielectric substrate and the top-gate dielectric to study the factors possibly limiting performance of the NT-array TFT. We found that due to the effect of strong electrostatic coupling between neighbor NTs in the TFT channel the device characteristics, such as gate coupling and the conductance related to the latter, are robust even to significant deviations from an ideal geometry. This is discussed with respect to the problem of fabrication of devices with good uniformity at the system level despite of some disorder at the subsystem level of discrete elements. [Supported by NSF-0403489]

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