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Phonon scattering in Carbon Nanotube Field Effect Transistors – an NEGF Treatment.[1] SIYURANGA KOSWATTA, SAYED HASAN, MARK LUNDSTROM, Electrical and Computer Engineering, Purdue University, M.P. ANANTRAM, NASA Ames Research Center, DMITRI NIKONOV, Intel Corp. — We examine the influence of phonon scattering on DC current transport in carbon nanotube field-effect transistors using the non-equilibrium Green's function (NEGF) formalism. Both optical and acoustic phonon modes are considered, and electron-phonon interaction is modeled through a scattering self-energy. Intra-valley scattering due to longitudinal optical (LO) and radial breathing mode (RBM) phonons is examined. Zone-boundary phonon eigenmodes that mediate inter-valley scattering are found to be a mixture of fundamental polarizations such as LO/TA and to couple strongest to the electrons. The effect of phonon scattering on the current vs. voltage characteristic of a filed-effect transistor is found to have distinct gate voltage (Vg) dependence. High-energy optical phonons can significantly degrade the ON-current (large Vg) while their effect is negligible in the OFF-state (low Vg). On the other hand, low-energy phonons (acoustic and RBM) can considerably affect the current transport for all gate biases. Their influence is enhanced at low Vg due to the one-dimensional density of states.

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