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Remote phonon scattering in NT field effect transistors ALEXEY G. PETROV, Ioffe Institute, SLAVA V. ROTKIN, Lehigh University — We developed a theory of the remote phonon (RP) scattering for the hot charge carriers in nanotube (NT) field effect devices that use polar dielectric substrates, such as SiO2 or high-kappa materials [JETP Lett 84, 156, 2006]. We calculated the effect of this novel scattering mechanism on the NT conductivity. We stress that in contrast to any other scattering mechanisms studied earlier the RP scattering allows to transfer the excess energy of the hot carriers directly to the substrate (not through the NT lattice). The macroscopic substrate has no limitation of a finite thermal capacity as a single NT has. Therefore, our RP scattering mechanism is advantageous for the high power NT devices, especially when aggressively scaling down the size and scaling up the operational frequency. We obtained a scattering time within a self-consistent quantum mechanical approach for inter- and intra-subband transitions in semiconductor and metallic NTs. The intra-subband transitions with forward scattering are shown to prevail over the inter-subband transitions as well as the backward scattering. We obtained the polaronic effects by solving for the electron energy and life-time self-consistently. We found the upper limit of the spacing between the NT and the polar dielectric for the RP scattering to become ineffective, which is approximately 40 nm for the quartz substrate.

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