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Graphene and nanotubes on the polar insulator: Near-field thermal conductance across the interface SLAVA V. ROTKIN, Lehigh University, ALEXEY G. PETROV, Ioffe Institute — Our ability to apply carbon-based materials for electronic devices requires detailed knowledge of their electronic properties as well as thermal ones in the real environment (rather than in vacuum). We present a microscopic theory of the electromagnetic coupling of the charge carriers in graphene and single-wall carbon nanotube to the surface electromagnetic modes of the SiO2 substrate, which allows a new interpretation of experimental data. Such coupling changes the physics of both inelastic hot charge carrier scattering in carbon-based electronic devices and thermal conductance across the interface with the substrate. Our modeling predicts that the near-field scattering by the surface modes results in (A) a dominating inelastic scattering channel (with a typical 30 nm m.f.p.) [Nano Lett 9, 1850, (2009)] and (B) the most significant interface thermal conductance mechanism (0.1 W/m^2K) [SPIE Proc. 7399, 7399-0F (2009)]. Both effects have to be taken into account to study the high-electric field transport and to compute the Joule losses and channel steady-state temperature. This talk focuses on the novel thermal coupling mechanism which is a QED (near-field) counterpart of the Kapitza conductance. We discuss possibilities to tweak it for graphene and nanotube materials on the polar substrates.

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