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Title:Terahertz dynamics of quantum-confined electrons in carbon nanomaterials
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Abstract:Low-dimensional carbon nanostructures, such as single-wall carbon nanotubes (SWCNTs) and graphene, offer new opportunities for terahertz science and technology. Being zero-gap systems with a linear, photon-like energy dispersion, metallic SWCNTs and graphene exhibit a variety of extraordinary properties. Their DC and linear electrical properties have been extensively studied in the last decade, but their unusual finite-frequency, nonlinear, and/or non-equilibrium properties are largely unexplored, although they are predicted to be useful for new terahertz device applications. Terahertz dynamic conductivity measurements allow us to probe the dynamics of such photon-like electrons, or massless Dirac fermions. Here, we use terahertz time-domain spectroscopy and Fourier transform infrared spectroscopy to investigate terahertz conductivities of one-dimensional and two-dimensional electrons, respectively, in films of highly aligned SWCNTs and gated largearea graphene. In SWCNTs, we observe extremely anisotropic terahertz conductivities, promising for terahertz polarizer applications. In graphene, we demonstrate that terahertz and infrared properties sensitively change with the Fermi energy, which can be controlled by electrical gating and thermal annealing. © Springer Science+Business Media, LLC 2012.
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