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Title:Optoelectronic properties of single-wall carbon nanotubes
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Abstract:Single-wall carbon nanotubes (SWCNTs), with their uniquely simple crystal structures and chirality-dependent electronic and vibrational states, provide an ideal laboratory for the exploration of novel 1D physics, as well as quantum engineered architectures for applications in optoelectronics. This article provides an overview of recent progress in optical studies of SWCNTs. In particular, recent progress in post-growth separation methods allows different species of SWCNTs to be sorted out in bulk quantities according to their diameters, chiralities, and electronic types, enabling studies of (n,m)-dependent properties using standard macroscopic characterization measurements. Here, a review is presented of recent optical studies of samples enriched in 'armchair' (n = m) species, which are truly metallic nanotubes but show excitonic interband absorption. Furthermore, it is shown that intense ultrashort optical pulses can induce ultrafast bandgap oscillations in SWCNTs, via the generation of coherent phonons, which in turn modulate the transmission of a delayed probe pulse. Combined with pulse-shaping techniques, coherent phonon spectroscopy provides a powerful method for studying exciton-phonon coupling in SWCNTs in a chirality-selective manner. Finally, some of the basic properties of highly aligned SWCNT films are highlighted, which are particularly well-suited for optoelectronic applications including terahertz polarizers with nearly perfect extinction ratios and broadband photodetectors.

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Quantum theory

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