Ultrafast Exciton Dynamics in Semiconducting Carbon Nanotubes Probed by Terahertz Emission and Photocurrent Spectroscopy

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Excitons dominate optical properties of single-wall carbon nanotubes (SWCNTs) with enormous binding energies and oscillator strengths. Here, we demonstrate that excitons also dominate terahertz (THz) dynamics in SWCNTs.[1] We performed simultaneous THz emission and photocurrent measurements on a device consisting of aligned (6,5) SWCNTs (Fig. 1a), which were fully reproduced by theoretical simulations based on far-from-equilibrium Boltzmann transport equations (Fig. 1b). In particular, we were able to clarify the crucial roles of exciton autoionization (in THz emission) and impact generation (in nonlinear photocurrent). These results help understand the complex quasiparticle dynamics under an electric field in 1D materials for future device applications.

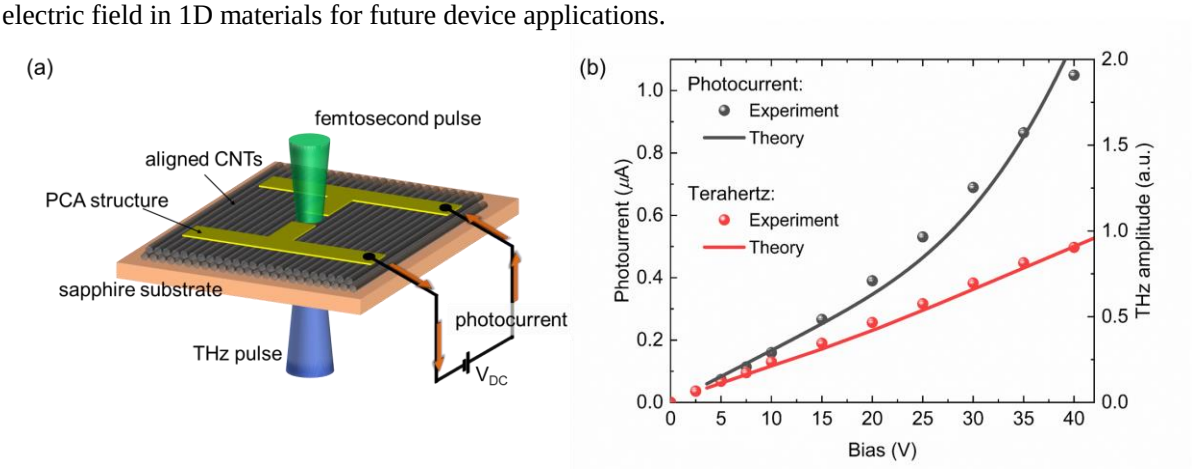

Figure 1 (a) Device and experiment design. (b) THz and photocurrent vs bias (experiment and simulation).

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Reference:

(1) F. R. G. Bagsican *et al*. Terahertz Excitonics in Carbon Nanotubes: Exciton Autoionization and Multiplication. *Nano Lett.* **2020**, *20* (5), 3098–3105.