Electroluminescence From Carbon Nanotubes With Quantum Defects

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Individual single-walled carbon nanotubes with covalent sidewall defects have emerged as a new class of photon sources whose photoluminescence spectra can be tailored by the carbon nanotube chirality and the attached functional group/molecule. Here we present electroluminescence spectroscopy data from single-tube devices based on (7, 5) carbon nanotubes, functionalized with dichlorobenzene molecules, and wired to graphene electrodes [1]. We observe electrically generated, defect-induced emissions that are controllable by electrostatic gating and strongly red-shifted compared to emissions from pristine nanotubes [2]. The defect-induced emissions are assigned to excitonic and trionic recombination processes by correlating electroluminescence excitation maps with electrical transport and photoluminescence data. At cryogenic conditions, additional, gate-dependent emission lines are assigned to phonon-assisted hot-exciton electroluminescence from quasi-levels. We will report on single-photon defect-state emission observed in second-order correlation function measurements from a Hanbury Brown and Twiss experiment, and discuss the dependence of the intensity correlation measurement on electrical power and emission wavelength, and the challenges of performing such measurements [3]. If time allows, we will also report on the integration of electroluminescent semiconducting carbon nanotubes into hybrid 2D-3D photonic circuits [4].

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