Fabrication and photoluminescence characterization of carbon nanotube dual-gate devices

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Photoluminescence from carbon nanotubes subjected to a DC gate voltage is quenched due to induced carrier accumulation [1], whereas applying a square-wave gate voltage to nanotubes causes luminescence recovery as a result of carriers being swept into contact electrodes [2]. Here we characterize photoluminescence of carbon nanotubes in dual-gate devices which allow for simultaneous and independent application of a DC gate voltage and a square-wave gate voltage. The devices are fabricated from silicon-on-insulator substrates, where trenches isolate two regions of the top silicon layer for use as the dual gates. We then perform thermal oxidation to form a gate dielectric, and air-suspended carbon nanotubes are grown over the trench between the dual gates. Photoluminescence measurements are used to identify the chirality of the as-grown individual nanotubes, and we examine the response of the nanotube emission to various combinations of the dual-gate voltages.

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