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Cavity-controlled, electrically-induced infrared emission from a single single-wall carbon nanotube FENGNIAN XIA, MATHIAS STEINER, YU-MING LIN, PHAEDON AVOURIS, IBM Watson Research Center — Single-wall carbon nanotube (SWCNT) is attracting significant attention from the photonics community recently due to its unique optical properties and potential applications in optical communications, optical interconnects, and, in particular, nanophotonics. Tunable and truly nanometer-scale (diameters of 0.5 to 2nm) light emitters can possibly be realized using individual semiconducting nanotubes. However, optical cavities are needed to control the emission wavelength, direction, and emission rate of these broadband, nanoscale emitters. Here, we report the monolithic integration of an electrically-excited light emitter based on a single (SWCNT) with a planar photonic $\lambda/2$-cavity. Emission properties were dominated by the cavity characteristics almost regardless of the free-space emission. The broad, free-space emission spectrum of a single SWCNT with a FWHM of 300 to 500nm was transformed to cavity controlled emission with a FWHM of $\sim$40nm. We also modeled the device as a broadband emitter in a planar cavity. Good agreement between the simulated and experimental results was achieved. In our configuration, the maximum enhancement in emission rate is estimated to be 4.4. We consider this result to be an important first step in the development of truly nanometer-scale photonic devices based on SWCNTs.

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