Enhancement of carbon nanotube photoluminescence by photonic crystal nanocavities

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Single-walled carbon nanotubes are bright nanoscale emitters, whereas photonic crystal nanocavities offer the possibility for efficient optical coupling at the nanoscale because of their small mode volumes and high quality factors. Here we report on the enhancement of photoluminescence from single-walled carbon nanotubes by silicon photonic crystal nanocavities [1]. L3 cavities in hexagonal lattice photonic crystals are fabricated from silicon-on-insulator substrates, and micelle-encapsulated carbon nanotubes are dispersed on the devices. Photoluminescence spectroscopy and imaging reveal sharp peaks at wavelengths much longer than silicon photoluminescence that are localized at the cavity location, and we attribute the peaks to carbon nanotube emission coupled to the cavity modes. The cavity modes can be tuned throughout the emission wavelength of carbon nanotubes by changing the photonic crystal lattice constant, demonstrating the ability to enhance photoluminescence from a variety of chiralities.

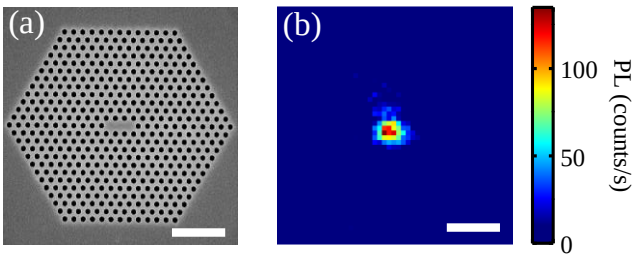

Fig. 1. (a) Scanning electron micrograph of a photonic crystal microcavity. (b) A photoluminescence image of the device shown in (a), taken at a detection wavelength of 1395 nm. Scale bars are 2 μm.

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[1] R. Watahiki, T. Shimada, P. Zhao, S. Chiashi, S. Iwamoto, Y. Arakawa, S. Maruyama, and Y. K. Kato, Appl. Phys. Lett. **101**, 141124 (2012).