MAR15-2014-020077

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Single carbon-nanotube photonics and optoelectronics[1]

YUICHIRO K. KATO, The University of Tokyo

Single-walled carbon nanotubes have unique optical properties as a result of their one-dimensional structure. Not only do they exhibit strong polarization for both absorption and emission, large exciton binding energies allow for room-temperature excitonic luminescence. Furthermore, their emission is in the telecom-wavelengths and they can be directly synthesized on silicon substrates, providing new opportunities for nanoscale photonics and optoelectronics. Here we discuss the use of individual single-walled carbon nanotubes for generation, manipulation, and detection of light on a chip. Their emission properties can be controlled by coupling to silicon photonic structures such as photonic crystal microcavities [1] and microdisk resonators [2]. Simultaneous photoluminescence and photocurrent measurements show that excitons can dissociate spontaneously [3], enabling photodetection at low bias voltages despite the large binding energies. More recently, we have found that alternating gate-voltages can generate optical pulse trains from individual nanotubes [4]. Ultimately, these results may be combined to achieve further control over photons at the nanoscale.

[1] R. Miura, S. Imamura, R. Ohta, A. Ishii, X. Liu, T. Shimada, S. Iwamoto, Y. Arakawa, and Y. K. Kato, Nature Commun. 5, 5580 (2014).
[2] S. Imamura, R. Watahiki, R. Miura, T. Shimada, and Y. K. Kato, Appl. Phys. Lett. 102, 161102 (2013).
[3] Y. Kumamoto, M. Yoshida, A. Ishii, A. Yokoyama, T. Shimada, and Y. K. Kato, Phys. Rev. Lett., 112, 117401 (2014).
[4] M. Jiang, Y. Kumamoto, A. Ishii, M. Yoshida, T. Shimada, and Y. K. Kato, arXiv:1407.7086.

[1]Work supported by KAKENHI, The Canon Foundation, The Asahi Glass Foundation, and JSPS Open Partnership Joint Projects, as well as the Nanotechnology Platform and Photon Frontier Network Program of MEXT, Japan.