Optical properties of core-shell systems based on carbon nanotubes

Lucile Orcin-Chaix, Yannick Chassagneux, Christophe Voisin, Stéphane Campidelli, Jean-sébastien Lauret

Optical properties of core-shell systems based on carbon nanotubes

Lucile Orcin-Chaix[1,2], Yannick Chassagneux[3], Christophe Voisin[3], Stéphane Campidelli[2], Jean-Sébastien Lauret[1]

[1] *Laboratoire Aimé Cotton,CNRS, Univ. Paris-Sud, ENS Paris-Saclay, Université Paris Saclay, 91405 Orsay Cedex, FRANCE*
[2] *LICSEN, NIMBE, CEA, CNRS, Université Paris-Saclay, CEA Saclay, 91191 Gif-sur-Yvette Cedex, FRANCE*
[3] *Laboratoire Pierre Aigrain, Ecole Normale Supérieure, CNRS, Université Pierre et Marie Curie, Université Paris Diderot, PSL, Sorbonne Paris Cité, Sorbonne Université, 24, rue Lhomond, 75005 Paris, FRANCE*

Single-walled carbon nanotubes exhibit unique physical properties and in particular, single-photon emission at room temperature has been recently reported ([1], [2]). This has been achieved by surface chemistry that creates point-like defects that localize the nanotube's exciton. The design of these defects allows creating potential well with deepness far above kT leading to the antibunching at room T. The last achievement reports $g^2(0)<0.01$ at room T and in the telecom wavelength bands ([2]).

Concomitantly, first Cavity Quantum Electrodynamics experiments have been carried out using nanotubes as the quantum emitter. These experiments exhibit Purcell effect and cavity feeding ([3],[4]).

In order to integrate nanotubes in devices, efforts have to be made on the material side. Nanotubes are only made of surface atoms, the consequence is an uncontrolled sensitivity to their local environment. Our main problem is blinking and spectral diffusion processes at low temperature. The important influence of the environment does not allow us to do lithography that is needed to build real photonics devices.

Our strategy is to protect carbon nanotubes from the environment to have a more stable emission and a suitable material for real devices. To do that, we synthesize core/shell nanostructures: the nanotube is the active core, while a polymer acts as protective shell. Here, we will discuss our preliminary results about the influence of the shell on the emission properties of single nanotubes investigated by microphotoluminescence experiments at low temperature.

[1] X. Ma, *et al.*, Nature Nanotechnology, **10(8)**, 671-675 (2015).
[2] X. He, *et al.*, Nature Photonics **11**, 577-582, pp 200-205 (2017).
[3] A. Jeantet, *et al.*, Physical Review Letters, **116(24)**, 247402 (2016)
[4] A. Jeantet, *et al.*, Nano Lett., **17(7)**, pp 4184-4188 (2017)