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The single-wall carbon nanotubes are currently studied and developed because of their unique physical properties. 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 to create 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. In particular, Purcell effect and cavity feeding has been recently reported ([3],[4]).

In order to integrate nanotubes in devices, efforts have to be made on the material side. Nanotubes being essentially made of surface atoms their electronic and optical properties are influenced by their local environment. For instance, blinking and spectral diffusion processes are observed in low temperature experiments. Moreover, nanotubes are fragile objects that are degraded by standard lithography processes needed to build real photonics devices.

Our strategy is to 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.

References

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

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