A POLYMER ANTENNA FOR THE REALISATION OF A BRIGHT AND DIRECTIONAL SINGLE PHOTON SOURCE

Researchers from GEMaC and LPQM (ENS Paris-Saclay) have developed a photonic cavity incorporating a light nanoemitter for efficient quantum light emission.

Obtaining a bright single photon source is crucial for applications in quantum information processing. A common approach is to couple a single emitter to a plasmonic or dielectric resonator. This can increase the rate of photons emitted and collected or reduce the spectral width of the source. While it has been demonstrated that a single-photon source can be cast into a pillar-type photonic cavity, controlling the position of the nanoemitter in the structure is often complex and requires delicate methods.

In this work, the researchers used the direct laser writing (DLW) ultra-low photon absorption (LOPA) method to reproducibly and controllably incorporate an individual

emitter (a CdSe/CdS semiconductor nanocrystal) into a submicrometer polymer pillar. Numerical simulations show that the emitter must be placed near the tip of the pillar to achieve directional emission towards the detection system (located in the extension of the pillar foot). In this case, a collection rate of the emitted photons close to 90% is achieved, which is confirmed by the experimental results. At room temperature, a single-photon source emitting 2.5 million photons per second is thus created.
This work, carried out in collaboration between GEMaC and the LuMIn laboratory of ENS Paris-Saclay, is part of the ICQOQS Flagship.

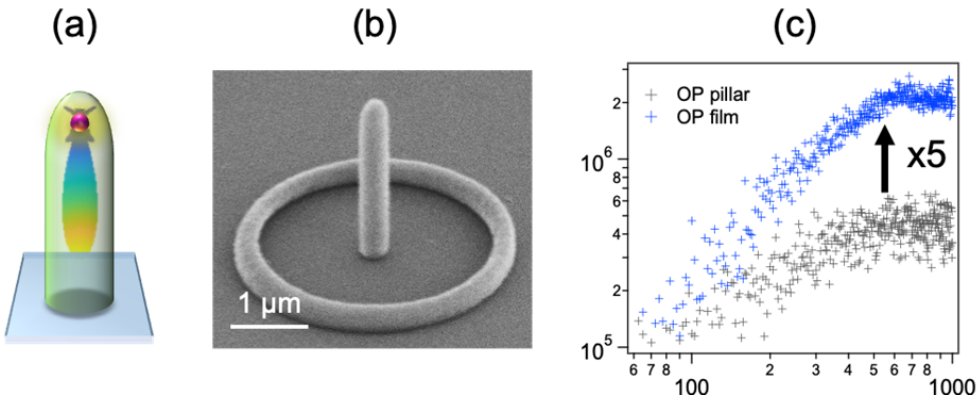

Figure 1 (a) Single photon source radiation pattern modelling for an individual emitter embedded near the top of a dielectric sub-micro pillar. (b) Scanning electron microscope image of a polymer pillar containing a CdSe/CdS nanocrystal. (c) Evolution of the number of single photons emitted as a function of the excitation laser power for two cases: emitter in a planar polymer film (black crosses) and emitter in a polymer pillar (blue crosses).

Read more:
"High directional radiation of single photon emission in dielectric antenna"
T. H. Au, S. Buil, X. Quélin, J.-P. Hermier, N. D. Lai
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Contact : Jean-Pierre Hermier

Link to NanoSaclay Highlights