Institut des NanoSciences de Paris
Unité mixte de recherche 7588 - CNRS - UPMC

Proposition de stage 2012-2013

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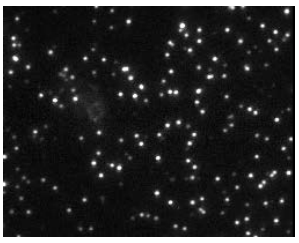
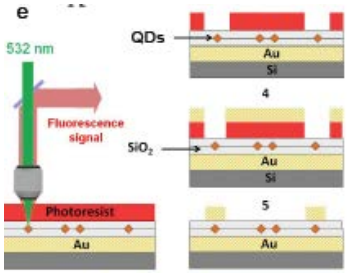
Coupling a single fluorescent nanocrystal to a micropillar

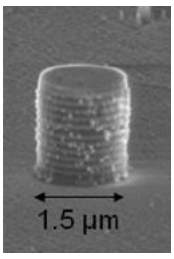
The internship will take place at the INSP, in a group which studies the effect of a **photonic or plasmonic structure** (photonic crystal, optical cavity, nano-antenna…) on the **fluorescence of a single nano-emitter**. The principle of these studies is that the fluorescence properties of a nano-emitter are not only a function of its intrinsic characteristics, but also of its environment and its density of available photonic states (Fermi's golden rule). The nano-emitters in consideration are **nanocrystals**, CdSe spheres of a few nm, obtained by chemical synthesis. These nanocrystals are very bright and versatile ; their emission wavelength is determined by their size (quantum confinement) and tunable over the whole visible spectrum. By fluorescence microscopy, it is possible to image single nanocrystals deposited on a substrate (fig. a).

A technical challenge in coupling a single nano-emitter to a specific nano-photonic environment is the need to **control the position and the emission wavelength of the emitter with respect to the photonic structure**, or vice versa. We are presently implementing, in collaboration with the Laboratoire de Photonique et Nanostructures (LPN), a **photolithography protocol** to fabricate a metallic disk nano-antenna on top of a nanocrystal : on a substrate, nanocrystals are deposited and covered by a photosensitive resist ; by fluorescence microscopy, the sample is mapped and a single nanocrystal is found ; then a stronger laser beam is sent into the microscope in order to expose a disk in the photoresist. The sample is then developed and gold is deposited in a micrometer-sized disk centered on the nanocrystal (fig. b).

The objective of the internship is to adapt this technique to **fabricate a dielectric micropillar centered on a single nano-crystal**. The fabrication steps will be : deposition of a Bragg mirror (layers of dielectric layers reflecting light by constructive interference), then nanocrystals, then a second Bragg mirror ; etching a micropillar by photolithography. Such a structure (preliminary realization shown in fig. b) constitutes an optical cavity as light is confined vertically by the Bragg mirrors and horizontally by total internal reflection. This internship will provide training for a broad range of techniques, especially clean room nanofabrication (deposition, etching - performed at the LPN) and fluorescence microscopy.

a) 

b) 

c) 

Ce stage pourra-t-il se poursuivre en thèse ? Oui
Si oui, financement envisagé : financement obtenu par l'ANR