Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Date de la proposition : 14 octobre 2015

Responsable du stage / *internship supervisor*:

Nom / *name*:	COOLEN	Prénom/ *first name* :	Laurent
Tél :	01 44 27 78 31	Fax :	
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Nom du Laboratoire / *laboratory name*:

Code d'identification : UMR 7588 — Organisme: Institut de NanoSciences de Paris(INSP)

Site Internet / *web site*: http://www.insp.jussieu.fr/-Nanophotonique-et-optique,158-.html

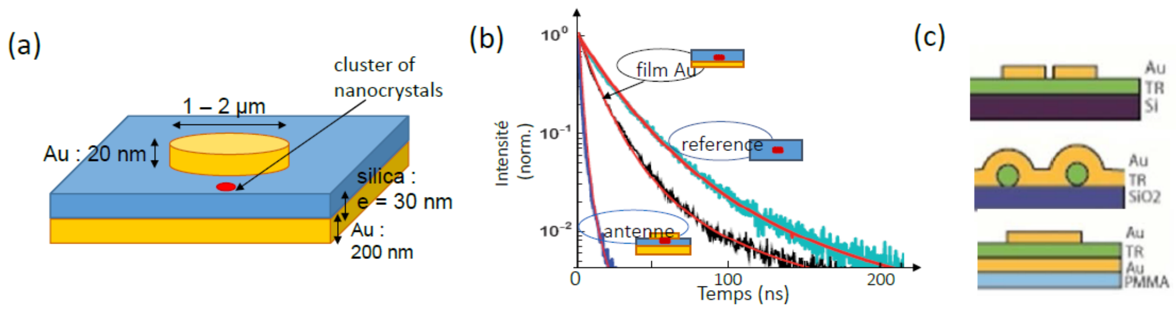
Adresse / *address:* 4 place Jussieu, boîte courrier 840 75252 PARIS cedex 05

Lieu du stage / *internship place*: campus Jussieu, couloir 22-32, 5e étage

Coupling an optical nano-antenna to the fluorescence of rare-earth ions

The group « Nanophotonics and quantum optics » at INSP studies how light emission from a nano-emitter depends not only on the emitter itself, but also on its optical environment (as stated by Fermi's "golden rule" which relates the rate of light emission to the density of available photonic states). Various types of structures are studied (photonic crystal, nano-cavity…), among which metallic nano-antennas concentrate the electric field in extremely small volumes, thus enhancing considerably the density of states, over a broad spectral range. Various antenna geometries have been demonstrated. For instance, our group has studied the coupling of fluorescent semiconductor nanocrystals to "patch" antennas (fig. a) consisting in a sandwich of a gold layer and a gold disk separated by a silica spacer where the emitter is located. We have shown that the nanocrystals decay rate (fig. b) was increased significantly by the antenna (by a factor 2 to 80 depending on the emitting dipole orientation) [1]. However, a large portion of the electromagnetic energy is lost as ohmic dissipation inside the metallic structure instead of leading to light radiation. Theory shows that the emitters which would benefit the most from coupling to a nano-antenna, in terms of emission intensity, are emitters which already have important intrinsic losses so that the ohmic losses are not detrimental and the enhancement of the light emission is the main effect.

The purpose of the internship is to begin studying the coupling of rare-earth (europium) ions to a nano-antenna (as part of a collaboration with Ph. Goldner and A. Ferrier at IRCP – Chimie Paris who synthesize Eu-doped nanocrystals and thin layers and study the quantum coherence of the Eu-ions emission). As these emitters have low efficiency (but very long coherence times which could be used for quantum information), important emission improvement can be expected when inserted in an antenna. The intership work will consist in fabricating antennas of various geometries (fig. c) and characterizing the optical properties of the obtained structures by photoluminescence microscopy.



(a) Schematic of a "patch" antenna. (b) Emission decay curves of nanocrystals clusters inside an antenna, on a gold film and in a reference homogeneous medium. (c) Proposed geometries for the insertion of rare-earth (TR)-doped nanocrystals or thin layers inside nano-antennas.

[1] C. Belacel et al., Nano Lett. 13, 1516 (2013)

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : Yes**

Si oui, financement de thèse envisagé/ *financial support for the PhD*: **Application to grant from the Ecole doctorale**

Lumière, Matière, Interactions	X	Lasers, Optique, Matière	X