Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage

Date de la proposition : 27/10/16

Responsables du stage / *internship supervisors*:

Noms / *name*: Barisien, Legrand — Prénoms/ *first name* : Thierry, Laurent

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Courriel / *mail*:
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Nom du Laboratoire / *laboratory name*: Institut des NanoSciences de Paris (INSP)

Code d'identification :UMR 7588 — Organisme : INSP

Site Internet / *web site*: http://www.insp.jussieu.fr

Adresse / *address:* 4, place Jussieu, 75005 Paris

Lieu du stage / *Internship place*: campus Jussieu, T 22-32 2ème étage.

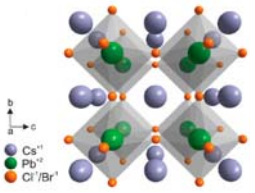
Internship title:

Optical spectroscopic properties of a new generation of nanocrystals: towards single objects investigation

Summary

Colloidal semiconductor nanocrystals, typically 2-20 nm large, are systems where quantum confinement effect induces size-tunable emission wavelengths, discrete "atomic like" energy spectrum and enhances the probability of emission or absorption of photons. They are being intensively studied as future optoelectronic materials but also for bio-imaging and bio-diagnostic applications. Some of them are already used as the new generation of phosphors in industrial applications and are integrated in display. They have many advantages. Aside from having outstanding physical properties for example their bright emission properties, they are produced with low-cost chemicals methods and can be obtained as dispersed objects in films of transparent matrices and eventually easily incorporated into various devices.

Among these nanocrystals a new class has emerged since two years, namely, nanocrystals of caesium lead halide perovskites ($CsPbX_3$, X = Cl, Br, I) (see figure). The internship will be focused on the optical spectroscopies on this new class of nanocrystal quantum dots. We aim at studying the emission properties of a *single* nanocrystal, free from inhomogeneous effects. This will be done on spin-coated films where the nanocrystals will be sufficiently dispersed in a transparent matrix in order to be addressed individually with a micro-photoluminescence set-up. The confinement will be varied with the size and/or composition of the synthetized nanocrystals in the laboratory.



A part of the internship will be devoted to the elaboration of films with dispersed nanocrystals. The emission properties of these new materials will be investigated by continuous-wave and time-resolved spectroscopies. Dynamics of the emission and so lifetimes will be explored from low to room temperature. The response in emission following two-photons absorption will also be investigated; this is of major importance in two fields: bio-imaging first where absorption and scattering phenomena should be minimized but also more fundamental explorations (coherent control for instance) requiring excitation of a single crystal at resonance but probing of relaxation (luminescence) at a separate wavelength.

The proposed studies are rather of fundamental nature; they allow gaining insights into the mechanisms that determine the intrinsic basic properties of confined systems. As already mentioned, colloidal nanocrystals are of interest in several fields like for instance in optoelectronics but also in photovoltaics where high conversion efficiency is required, or in biomedical photonics.

Techniques in use: Micro-photoluminescence, time-resolved luminescence, low temperatures studies using cryogenic setup, absorption spectroscopy, spin-coating

Applicant skills: Taste for experimental work, good knowledge of light-condensed matter interaction

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***: Ecole Doctorale Physique en IdF 564**

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

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