Internship offered in M2
2018-2019

Responsible for internship

Name: Laurent COOLEN

Location:
4 place Jussieu, 75005 Paris
Tour 22-32, 5e étage

Group: Nanostructures and Optics

E-mail: laurent.coolen@insp.jussieu.fr

Tel: +33 (0)1 44 27 78 31

Group website: http://www.insp.jussieu.fr/-Nanostructures-et-optique-.html

Internship topic: **Optical properties of self-assembled fluorescent nanoplatelets**

The group « Nanostructures and optics » at INSP works on the optical properties of photonic or plasmonic nanostructures and their coupling to fluorescent emitters, which can be used to enhance light absorption and emission, with potential applications in lighting, displays, bio-imaging, quantum cryptography or photovoltaics. Semiconductor nanostructures, such as spherical nanocrystals or planar nanoplatelets, obtained by chemical reactions in solution, are bright stable fluorescent emitters. Their wavelength tunability and versatile manipulation makes them promising materials for a wide range of applications in opto-electronics.

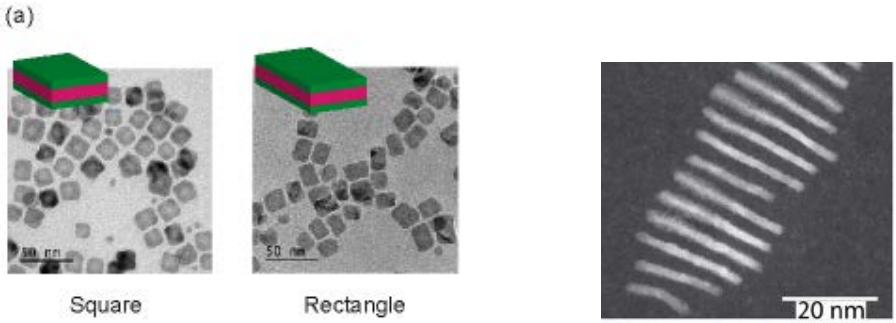

Figure : (a) TEM images of square and rectangular nanoplatelets (B. Dubertret, ESPCI) [2] ; (b) (right) TEM images of nanoplatelets stacked together by self-assembly (B. Abécassis et al., Science Advances 2017).

Our group works in particular on the fluorescence properties of individual emitters, studied by fluorescence microscopy, which reveal in particular quantum optical properties such as the emission of « single photons » (emitted one-by-one). In order to characterize

the emitting dipole of semiconductor nanostructures, we have developed in the last years characterization methods combining polarization measurement, angular radiation analysis and manipulation of the emitter's optical environment [1]. Applied to nanoplatelets (fig. a) of various geometries [2], these methods showed different dipole moments and orientations depending on the platelets geometries and deposition orientation, with effects both of the electron-hole quantum confinement in the platelet and of their dielectric shape.

The nanoplatelets' ligands and solvent can be manipulated to create architectures of self-organized stacked platelets (fig. b). These structures then present optical and electronic properties which also may involve a coupling between the platelets. The aim of the internship will be to use fluorescence microscopy and various analysis techniques (spectroscopy, polarimetry, Fourier-plane analysis, low temperature measurements) in order to characterize the emission of the stacks of platelets and analyze coupling effects.

[1] C. Lethiec, J. Laverdant, H. Vallon, C. Javaux, B. Dubertret, J.-M. Frigerio, C. Schwob, L. Coolen and A. Maître, Phys. Rev. X **4**, 021037 (2013),
[2] Fu Feng, Loan Thu Nguyen, Michel Nasilowski, Brice Nadal, Benoît Dubertret, Laurent Coolen et Agnès Maître, Nano Research **11**, 3593 (2018) ; Fu Feng, Loan Thu Nguyen, Michel Nasilowski, Brice Nadal, Benoît Dubertret, Agnès Maître and Laurent Coolen, ACS Photonics **5**, 1994 (2018).

Techniques involved: Photoluminescence microscopy

Type of internship: mostly experimental
Paid internship: Yes
Can this internship be continued for a PhD? Yes
If yes, type of PhD funding envisaged is: application to Ecole doctorale

Unité mixte de recherche 7588 – CNRS / Sorbonne Université
Campus Jussieu – Tours 22 et 23 – Case courrier 840
4 place Jussieu – 75252 Paris Cedex 5 – France
Tél. : +33 (0)1 44 27 63 72 – Fax : +33 (0)1 44 27 46 09 – www.insp.upmc.fr