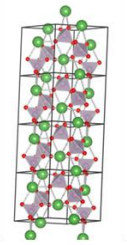
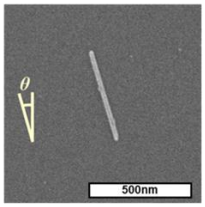
# Internship proposal 2018/19

| | Anisotropic luminescent nanocrystals as versatile nano-sources of light |
|---|---|
| **Location :** | Laboratoire PMC - École polytechnique, Route de Saclay – 91128 Palaiseau |
| **Supervision:** | Thierry Gacoin – Jongwook Kim |
| **e-mail/ phone :** | thierry.gacoin@polytechnique.edu , 01 69 33 46 56<br>jong-wook.kim@polytechnique.edu, 01 69 33 46 83 |
| | Details / additional bibliography here – Group website : here |
| **Techniques to be used** | Nanocrystal synthesis through colloid chemistry, Structural characterizations (XRD, TEM, SEM), Optical spectroscopies (luminescence, polarization) |
| **Candidate profile :** | Interest on the fundamental materials science. This interdisciplinary project may be adjusted depending on the profile of the candidate (Chemistry/Physics). |
| **Possibility to go on with a PhD :** | yes |

Nanoparticles have been widely studied with the interest in the novel physical properties emerging in the nanoscale and their functional applications in optics, biotechnology, quantum information processing, or for lighting and display devices. Although most studies have been performed on spherical particles with isotropic properties, our group focuses on anisotropic nanocrystal species that present directional and tunable properties. The combination of crystalline anisotropy and specific morphology (rods, discs, prisms…) leads, in addition to the size effect, to anisotropic physical properties associated to the spatial orientation of the particles. It is thus possible to create devices with tunable functionalities by controlling the orientation of individual nanocrystals or their organization at the macroscopic scale. In this way, we have so far developed devices based on polarized luminescence signaling the particle orientation in fluids, thereby mapping the shear stress profile in microfluidic channels [1].

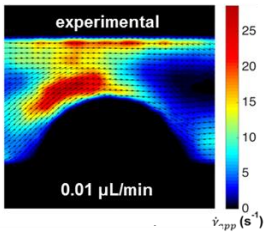


Cristallin structure of the rods




SEM image of single rod

$LaPO_4$:Eu luminescence




Mapping of the liquid flow in a microfluidic channel

Based on the recent works done in our group on $LaPO_4$ nanorods (in rhabdophane crystal structure synthesized in colloidal solution), we now wish to explore new systems with optimized properties, concerning their polarized luminescence properties and their colloidal dispersion in biocompatible environment. The proposed work thus consists in:

- Colloidal synthesis of $LaPO_4$ nanocrystals in the monazite crystal structure, which was shown to exhibit highly appealing luminescence properties [2];
- Surface chemistry of nanocrystals for the dispersion in various environment (physiological media, organic solvent, polymer) as application platforms;
- Characterization of the structure and morphology of the nanocrystals;
- Micro-spectroscopy of the luminescence properties of the dynamical or organized states of the nanocrystals;

[1] J Kim et al, *Nature Nanotechnology*, 12, 914-919 (2017) – DOI : 10.1038/nnano.2017.111

[2] E. Chaudan et al, J. Am. Chem. Soc. 140, 30, 9512-9517 (2018) – DOI : 10.1021/jacs.8b03983