

## Internship offer 2023/2024

Laboratory: INSP institute for nanosciences of Paris

Director: Marangolo

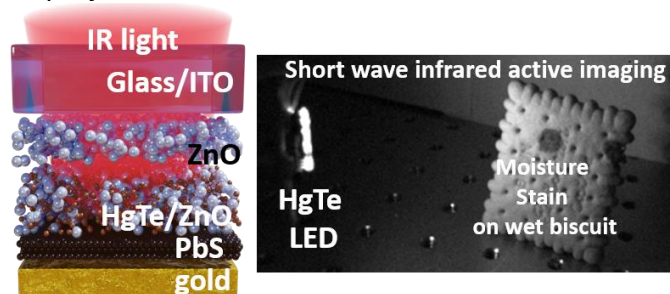
Address: 4 place jussieu, 75005 Paris

Person in charge of the internship: Emmanuel Lhuillier

e-mail: [el@insp.upmc.fr](mailto:el@insp.upmc.fr)

### Infrared electroluminescence using nanocrystals

**Scientific project:** Nanocrystals are semiconductor nanoparticles with tunable optical features from UV to THz. They have become key building block of optoelectronics with their integration as light source in display. The INSP team is working on **narrow band gap nanocrystals and their applications for infrared optoelectronics**. Here, we use to work with HgTe nanocrystals presenting light emission in the 1-5  $\mu\text{m}$  range. The goal of the project is to design/fabricate and characterized light emitting diode from these nanocrystals. The INSP has obtained some promising preliminary results (ref 1-3) and now aim to push toward longer wavelength and purchase a brand new broad band spectrometer in this purpose. Current performances remain modest and LED design will benefit from new design strategies. Here we target to develop strategies where multiple photon can be obtained per injected charge. A second aspect of the project will deal with light extraction and require to integrate at the LED level some light management strategies (4) based on nanoantenna. This part of the project will be done in collaboration with Quad team at LPENS



*Scheme of a nanocrystal based LED (left) and infrared image of a scene illuminated by the LED (right)*

#### Ref from the group on the topic

1. Mercury Chalcogenide Quantum Dots: Material Perspective for Device Integration, **Chemical Reviews** 121, 3627 (2021)
2. Electroluminescence from nanocrystals above 2  $\mu\text{m}$ , **Nature photonics** in press (2021)
3. Electroluminescence from HgTe Nanocrystals and its Use for Active Imaging, **Nano Letters** 20, 6185 (2020)
4. Plasmon-Assisted Directional Infrared Photoluminescence of HgTe Nanocrystals, E Bossavit et al, **Advanced Optical Materials**, 2300863 (2023)

**Methods and techniques:** The work includes nanocrystal synthesis (with support from engineer), the LED fabrication (clean room, glove box processing), measurement by photoemission and optoelectronic device characterization. Skills in physics and chemistry are appreciated.

Possibility to go on with a PhD ? Yes actually preferred

Envisaged fellowship ? ERC already secured