

Internship offer 2023/2024

Laboratory: INSP institute for nanosciences of Paris

Director: Marangolo

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Person in charge of the internship: Emmanuel Lhuillier

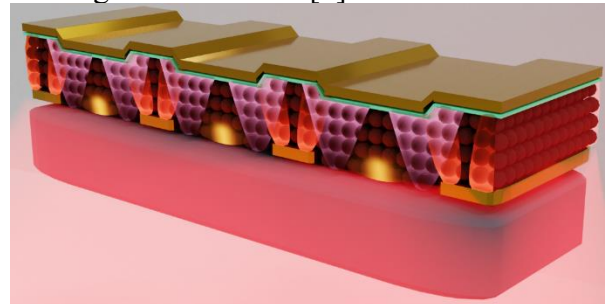
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Nanocrystal- based infrared sensor with designed light matter coupling

Scientific project:

Nanocrystals are colloiddally grown semiconductor and they have gain maturity over the last two decades [1]. A broad variety of material can be synthesized and atomic precision can be achieved. However, conduction in such granular material occurs through hopping which limit the carrier diffusion length. In other word, charge collection is only efficient over a few hundred of nm while the absorption depth is one order of magnitude longer. Thus, it becomes of utmost interest to couple thin nanocrystal thin film to efficiently absorb the light. Our group has been deeply investigated in this research direction over the past years and we now target to introduce new functionalities, such as broad band enhancement of the light absorption or

reconfigurable spectral response (*ie* a response that can be tuned through bias application) [2-4]. Our long term goal also includes the transfer of such resonator at the camera level which add further technological constrains. [5]



Schematic of a multi resonant structure used as infrared detector

The project will be in collaboration with Onera for the electromagnetic design and with New Imaging technologies for the camera side.

Background : the applicant will have a background in semiconductor physics. Skills in clean room, nanocrystals, infrared, programming or electrical measurements will be a plus but are not mandatory. The group being international, the applicant must speak english.

References

- [1] Mercury Chalcogenides Quantum Dots: a Material Perspective for Device Integration, C. Gréboval, et al Chem Rev 121, 3627 (2021).
- [2] Near Unity Absorption in Nanocrystal Based Short Wave infrared Photodetector using Guided Mode Resonator, A. Chu et al, ACS Photonics 6, 10, 2553-2561 (2019)
- [3] Broadband enhancement of mid-wave infrared absorption in a multi resonant device, T. H. Dang et al, Adv Opt Mater 10, 2200297 (2022).
- [4] Bias Reconfigurable Photoresponse of an Infrared Nanocrystal Film Integrated into a Coupled Fabry-Perot Resonator TH Dang et al, ACS photonics 10, 1601 (2023)
- [5] Photoconductive focal plane array based on HgTe quantum dots for fast and cost-effective short-wave infrared imaging, C. Gréboval, et al, Nanoscale 14, 9359 (2022)

Methods and techniques: The applicant will have in charge the design (electromagnetic simulation), the fabrication (clean room and glove box processing) as well as the device characterization (electronic transport in cryogenic conditions).

Possibility to go on with a PhD ? Yes actually preferred

Envisaged fellowship ? ERC already secured