**QD-Ink / PhD project**

**Development of Photoluminescent functional fluids based on Cadmium-free Quantum Dots**

**PhD Position**
Start: 01/10/2022 End: 30/09/2025
Financing: Public / Funding by ministerial scholarship / Competitive recruitment of Doctoral School I-MEP²
Host Laboratory: LGP2 (Grenoble)
Partner Laboratory: ICCF (Clermont-Ferrand)
Application deadline: 15/04/2022

## Project Description

The advances in printing over the last years inspired numerous functional fluids development with the incorporation of tailored active nanomaterials. Quantum Dots (QDs) are semiconductor nanocrystals typically measuring between 2 and 10 nm in diameter that own remarkable optical properties such as photoluminescence. Depending on their chemical nature and size, QDs can emit light in a wide range of wavelengths, which ranges from 450 nm to 1500 nm, under UV or blue excitation. The fields of application of QDs are immense: medical imaging, micro-display (micro-screens), anti-counterfeiting, etc. The QD-INK project proposes to develop functional inks based on cadmium-free QDs. The innovative nature of this project rely on the materials used and on the deposition processes envisaged: (i) Most of the QDs are now semiconductors containing cadmium. In order to overcome the toxicity of Cd2+ ions, the QDs developed will be based on indium phosphide InP (Cd-free). (ii) The printing processes envisaged are multiple (inkjet, screen printing, 3D printing, etc.) and will be optimized according to the properties of the functional inks, the desired thicknesses, the substrates and the intended application. To date, the state of the art mainly reports on the synthesis of polymer composites including QDs in their matrix and very few scientific articles relate the implementation of QDs in the form of thin films by printing functional fluid. The QD-INK project brings together two laboratories in the region: the Laboratory of Engineering of Paper Processes and Printing Processes (LGP2) of Grenoble and the Luminescent Materials group of the Institute of Chemistry of Clermont Ferrand (ICCF), which wish to combine their skills to offer innovative and reliable solutions.

The QD-INK project will have to lift several locks, including to:

- Control the dispersion of cadmium-free QDs in liquids with a wide variety of physico-chemical and rheological properties, depending on the printing process envisaged, the functional inks will be formulated in organic solvents, water, or photopolymerizable monomers. It will be necessary to optimize the surface chemistry of the QDs to ensure an adequate level of dispersion in the formulations envisaged.
- Identify and understand the correlations between each critical parameter of the system (surface chemistry of the QDs, QD concentration, nature of the solvent, deposition processes, thickness of the deposit, nature of the supports etc.) and the emission performance of the active thin films.
- Make functional fluids developed compatible with printing media of very different natures (glass, polymer films, papers, textiles, etc.), without altering the light-emitting properties
- Evaluate the permanence of fluorescence properties after deposition by printing and understand the phenomena involved.
- Efficiently integrate solutions developed within application devices, provided that the different properties or associated key parameters are adapted to the intended application. We can mention of course the fluorescence intensity of QDs, the stability of their optical properties upon several stresses (thermal or photonic), but also the adhesion to the substrate. Beyond integration, it will be necessary to constantly ask the question, with the industrial partners, of the cost and recyclability of the devices thus developed.

The expected results target the development of several grades of functional fluids differing in their photoluminescent properties and in the process implemented, according to the targeted application specifications

**Mots clés associés :** Nanoparticles (Quantum Dots), Complex Functional Fluid, Formulation, Process Engineering, Fluid Media Mechanics, Surface chemistry

## For more information about Laboratories involved:

LGP2 : https://lgp2.grenoble-inp.fr

ICC : https://iccf.uca.fr

Doctoral School IMEP²: https://www.adum.fr/as/ed/edimep2

## Candidate Profile:

- ⊃ master's degree (or engineering degree)
- ⊃ Given the multidisciplinary aspect of the project, several types of skills can be valued:
  - Expertise in the field of materials (nanoparticles, luminescent materials)
  - Expertise in fluid formulation and characterization
  - Expertise in printing processes
- ⊃ Autonomy, professionalism, capacity to analyze and synthesize, motivation, ability to work in a team
- ⊃ Good level in English

**To apply to this offer, please send a detailed CV, an application letter and the contact information of a referring person if possible.**

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