# PhD Position @ L2n (former LNIO), Troyes (France)

## Control of a quantum dots photoluminescence by the use of active materials and plasmonic nanostructures

Supervision: Pr. Pierre-Michel ADAM & Dr. Anne-Laure BAUDRION

**Work environment**

The **Light, Nanomaterials and Nanotechnologies (L2N) group** is part of the University of Technology at Troyes, France. About 100 people (including staff, engineers, postdocs and PhD students) work on nano-optics, nanofabrication, molecular plasmonics, photonics and nanobiophotonics. The lab equipments include a nanofabrication platform (clean room, e-beam and optical lithography, Reactive Ion Etching, evaporation facilities...), scattering and extinction optical microscopes, fluorescence microscopes, ultrafast lasers...

**Research project**

Our group studies the interaction between plasmonic nanostructures and molecules in order to develop new tools and materials in Nano-Optics. The current project concerns **the control of quantum dots (QDs) photoluminescence by the use of metallic nanoparticles (NPs) and active materials**. The coupling between QDs and NPs can lead to the enhancement or to the quenching of their photoluminescence depending on the spectral overlap between the Localized Surface Plasmon Resonance (LSPR) and the QD emission [1]. A shift of about 20 nm in the LSPR is enough to change from quenching to enhancement. The main research topic here is to find a way to modify the LSPR without changing the nanoparticles properties (geometry, material, position…). Recently, we coupled photochromic molecules (PM) with metallic nanoparticles and we observed a reversible change in the optical properties of the system [2]. Photochromic molecules can go from a transparent state to a colored one through the absorption of UV light. This transition is accompanied by a high change in the refractive index of the organic material (up to 0.25). Moreover, this transition is reversible and this can be achieved either by absorption of visible light or by a heating process. In the continuity of these results, we covered silver NPs with a mixture of PM and QDs and studied the photoluminescence by Fluorescence Lifetime Imaging Microscopy (FLIM). This technique allows to image both the intensity and the lifetime of the QD photoluminescence. We proved an active optical control of the photoluminescence emitted by a QD-NP coupled system and we were able to optically switch from quenching to enhancement of the photoluminescence [3].

The goal of this work is to go further in this study by using different active materials (mainly photochromic molecules and liquid crystals) to achieve both a better optical switch (improving of the ON/OFF contrast with photochromic molecules), and also an electrical or a thermal control of this photoluminescence emission. In this framework, we offer a **three-years** PhD position starting from October 2018. The PhD student will benefit from the Nano'Mat platform facilities and will be trained on the cleanroom nanofabrication techniques. Finally, the PhD student will work on a new FLIM system arriving during the beginning of 2019.

**Prerequisites & other requirements**

A master degree in Physics, Physical Chemistry or Material Science is required, and you must have strong interest in experimental nanophysics (the subject is mainly based on experimental work).

**Deadline for applying: 2018 May 15th**

**Web Links:** L2N (ex-LNIO): http://lnio.utt.fr/en/index.html

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[1] Viste, P., Plain, J., Jaffiol, R., Vial, A., Adam, P.-M., & Royer, P. (2010). Enhancement and Quenching Regimes in Metal– Semiconductor Hybrid Optical Nanosources. ACS Nano, 4(2), 759–764.

[2] Baudrion, A.-L.; Perron, A.; Veltri, A.; Bouhelier, A.; Adam, P.- M.; Bachelot, R. Reversible Strong Coupling in Silver Nanoparticle Arrays Using Photochromic Molecules. Nano Lett. 2013, 13, 282– 286.

[3] G. Lamri, et al., Active optical control of a plasmon – emitter coupled system by using photochromic molecules, under preparation