Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Responsable du stage / *internship supervisor*: **Dr. Aurélien Crut / Pr. Francesco Banfi**

Tél : 04 72 44 81 82

Courriel / *mail*: aurelien.crut@univ-lyon1.fr

Nom du Laboratoire / *laboratory name*: **Institut Lumière Matière (iLM) - FemtoNanoOptics group**

Code d'identification : UMR5306 Organisme : Université Claude Bernard Lyon 1

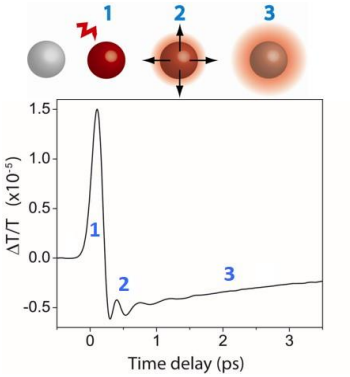
Site Internet / *web site*: http://ilm.univ-lyon1.fr/femtonanooptics

Adresse / *address:* Bâtiment Kastler, 10 rue Ada Byron, 69622 Villeurbanne CEDEX, France

Lieu du stage / *internship place*: Campus LyonTech-La Doua (LYON)

Ultrafast charge and energy transfer at the interface between metal nanoparticles and molecules

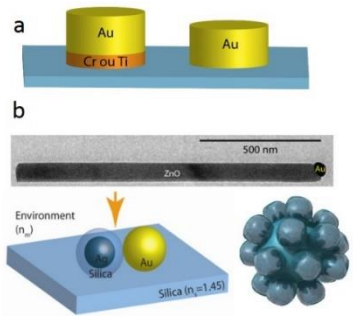
The sudden absorption of electromagnetic energy by a nano-object induces a cascade of relaxation processes (internal thermalization, acoustic vibrations, cooling, …) involving femtosecond and picosecond timescales. Their study is of major interest in fundamental physics, as it allows to clarify how the **macroscopic laws** ruling electronic interactions, elasticity, thermal transport or interfacial energy transfer are **modified at the nanoscale**.



Monitoring of the ultrafast dynamics of metal nano-objects with pump-probe spectroscopy

The FemtoNanoOptics group can rely on powerful tools to precisely address these issues, via **quantitative linear and ultrafast measurements on individual nano-objets** [1] (which avoids the spurious averaging effects inherent to ensemble measurements), their morphological characterization using electron microscopy and the modeling of their ultrafast response using finite-element numerical simulations [2].

In this context, the aim of this internship project consists in studying the external (towards the environment) and internal (between the components of a nanohybrid) **mechanisms governing the transfer of the energy** optically injected in the nano-object. More precisely, its first part will consist in optical investigations of the acoustic properties of suspended (**gold nanowires**) or substrate-deposited (lithographed **gold nanodisks, in collaboration with Pisa and Milano** [3]) nano-objects. The vibrational quality factors, which reflect both mechanical coupling with the environment and internal damping mechanisms, will be analyzed.



(a) Lithographed nanodisks
(b) Bimetallic nanowires and nanohybrids

The second part of the internship will be devoted to the investigation of chemically synthesized metal-dielectric hybrid nano-objects (**bimetallic or carbon nanotubes/polymer, collaboration with Bordeaux and Torino**), and will aim at selectively exciting and probing their components, to reveal their acoustic and **thermal transport** and to optically monitor the ultrafast evolution of their temperatures. The experimental results will be confronted to analytical and finite-element models.

This internship can be extended into a PhD.

[1] Animation movie on the Spatial Modulation Spectroscopy technics on the group homepage.
[2] A. Crut, P. Maioli, N. Del Fatti, and F. Vallée, Chem. Soc. Rev. 43, 3921 (2014)
[3] F. Medeghini, A. Crut, M. Gandolfi, F. Rossella, P. Maioli, F. Vallée, F. Banfi and N. Del Fatti, Nano Lett. 18, 5159 (2018)

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : YES**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: Fellowship « école doctorale »**

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**