Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 7 novembre 2016

Responsable du stage / *internship supervisor*: Codruta MARINICA/ Andrey Borissov

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Nom du Laboratoire / *laboratory name*: Institut des Sciences Moléculaires d'Orsay (ISMO)

Code d'identification : UMR 8214 Organisme : Univ. Paris Sud, CNRS

Site Internet / *web site*: www.ismo.u-psud.fr

Adresse / *address:* Campus d'Orsay, bât. 210-350-351, 91405 Orsay cedex

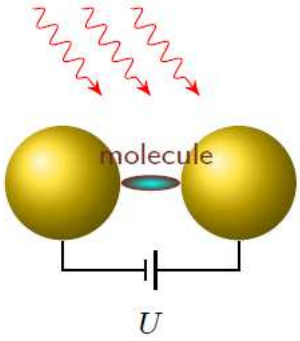
Lieu du stage / *internship place*: Campus d'Orsay, bât. 351

Titre du stage / *internship title*: Active control of the optical response of plasmonic molecular junctions

Résumé / *summary*

Interaction of light with metallic nanoparticles may be strongly enhanced if the incident radiation is in resonance with plasmons, collective excitations of the conduction electrons in the metal. Driven by the prospect of controlling light at the nanoscale, the field of plasmonics has raised a stimulating interest over the past two decades. Sought plasmonic responses have been obtained so far either during the manufacturing process, through shape or material design, or by selecting the dielectric environement. In contrast with this passive tailoring of the plasmonic properties, active control strategies have recently stimulated considerable interest due to the promising real-life applications in fields such as communications and information processing.

Optical gap nanoantennas (two adjacent metallic nanoparticles separated by a nanometer-sized gap junction) have been extensively used to strengthen the light-matter interaction at the nanoscale. Recent experimental and theoretical studies on nanonatennas with subnanometer gaps have shown that the electron tunneling across the junction significantly modifies the optical response of the system. We have proposed and demonstrated very recently a novel strategy for active electrical control of the optical response of metallic nanostructures. By applying an external dc bias across a narrow gap, significant change in the dynamical ac conductance at optical frequencies leads to modifications in the plasmonic response of the system.



The internship proposed here addresses the issue of electrically controlled optical response of molecular junction plasmonic systems (plasmonic gap junctions functionalised with molecules, see figure). The basic concept is to use an external voltage to tune the alignement of the electronic levels of the molecular bridge with respect to the Fermi energies of the plasmonic leads. Depending on the energies of the molecular orbitals, the molecular junction is expected to either block or allow the photon-assisted electronic transport. The main goal is to identify the fingerprints of this electrical tuning in the optical response of the system.

The person involved in this project may need to develop a simple two-level molecular model system and to include it into an approach based on the time dependent density functional theory (TDDFT). This method allows to efficiently solve the time-dependent Schrodinger equation for many-electrons system. The recent developments in our group have allowed us to implement and test the electronic transport description of biased plasmonic systems in the frame of TDDFT.

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

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

Lumière, Matière, Interactions	**x**	Lasers, Optique, Matière	**x**

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