Master QLMN (Quantum, Light, Materials and Nano Sciences)

Proposition de stage / Internship proposal

Date de la proposition :

Responsable du stage / *internship supervisor*:

Nom: Greffet Prénom: Jean-Jacques

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Nom du Laboratoire / *laboratory name*: LCF Charles Fabry

Etablissement / *institution* :IOGS Code d'identification : UMR 8501

Site Internet / *web site*: https://www.lcf.institutoptique.fr/groupes-de-recherche/nanophotonique/themes-de-recherche/plasmonique-et-nanophotonique-quantique

Adresse / *address:* 2 av Fresnel, 91127 Palaiseau

Lieu du stage / *internship place*: LCF, Palaiseau

Titre du stage Light emission by inelastic tunneling assisted by resonant nano antennas

When applying a voltage V between two metals separated by a transparent insulating dielectric with a thickne on the order of 2-4 nm, light can be emitted at frequency lower than eV/h where h is Planck's constant by inelastic tunnel effect. This emission process has many attractive features: it can be implemented at nanoscale is controlled electrically, it can be modulated at high frequency, the emission frequency can be tuned.

We have developed recently an improved version of this effect using resonant plasmonic antennas [1-3] so th the signal is enhanced and the emission frequency is selected. However, elastic tunneling is still the dominant tunnel mechanism so that the efficiency of the emission process in terms of emitted photons per electron is ve low. The purpose of the internship is to reduce drastically the elastic tunneling. Two different approaches wil be studied and implemented.

The internship is theoretical. It is based on a quantum modeling of the current fluctuations and a classical modeling of light emission in a nanophotonics environment. It can be followed by a PhD which is both theoretical and experimental. Experiments include STM and AFM measurements, microscopy and spectrosco at ambiant and low temperature.

The global project is a joint project with C2N in charge of sample design and fabrication, LPS in charge of transport in tinnel junctions and ISMO in charge of near-field characterization.

1. Antenna surface plasmon emission by inelastic tunneling, Cheng Zhang, Jean-Paul Hugonin, Anne-Lise Coutrot, Christophe Sauvan, François Marquier, Jean-Jacques Greffet, Nature Commun. (2019) doi.org/10.1038/s41467-019-12866-3
2. Surface Plasmon Polaritons Emission with Nanopatch Antennas: Enhancement by Means of Mode Hybridization, C. Zhang, J.I Hugonin, J.J. Greffet, C. Sauvan, ACS Photonics 6, 11, 2788 (2019). https://doi.org/10.1021/acsphotonics.9b00797
3. Electrical generation of visible surface plasmon polaritons by a nanopillars antenna array, C. Zhang, J.-P. Hugonin, A.-L. Cout Vest and J.-J. Greffet, APL Photonics **6**, 056102 (2021) https://doi.org/10.1063/5.0046013

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

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

Si oui, financement de thèse envisagé ou acquis / *financial support for the PhD* **? YES**

Financement acquis / *Secured funding*		Nature du financement */Type of funding*	
Financement demandé / *Requested funding*	*X*	Nature du financement */Type of funding*	*ANR*