UTT PhD position on Ultrafast plasmonic biosensors based on strong coupling with photonic modes

CDD 36 Months
CNRS - L2n UMR 7076

Troyes - Grand Est - France

- Sciences de l'ingénieur
- Physique

Keywords : Nanophotonics, Plasmonics, Optical biosensors
Starting date : 01/10/2025

Employer

The laboratory Light, nanomaterials and nanotechnologies (L2n) aims at the development of nano-optics, which addresses a number of technological, scientific and socio-economic challenges. The L2n is a joint UTT/CNRS laboratory of more than 100 people comprising faculty membres, CNRS researchers, research and project engineers, technicians, post-doctorate fellows, PhD students, graduate students and visitors. Researchers at the L2n work on new concepts and approaches, developing both innovative instrumentation and nanocharacterisation and nanofabrication methods. Website :https://recherche.utt.fr/light-nanomaterials-nanotechnologies-l2n

Project description

This PhD project is based on a funded ANR COUUPPLES project with partners of L2n (University of Technology of Troyes), LuMIn and LBPA (University Paris-Saclay). It will take up the challenge of exploiting the susceptibility to the environment of the plasmon-microcavity polariton modes, and their ultrafast dynamics, to realize new types of plasmon-based biosensors with high sensitivity and large effective volume. Using both ultrastrong coupling and ultrafast dynamics within the context of plasmon-based sensors can potentially lead to a breakthrough in this area.
More infos : https://anr.fr/Projet-ANR-23-CE42-0005

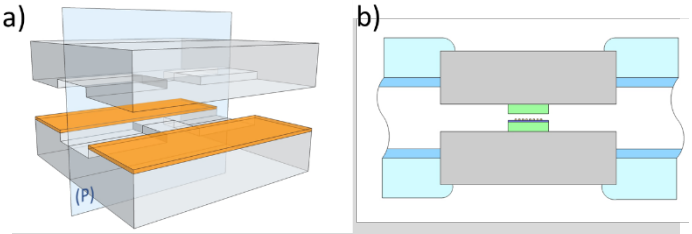


Fig. 1. Envisaged hybrid cavity with plasmonic gold nanorods (Au NRs) coupled to a microfluidic chip. a) 3D view. The spacer with controlled thickness is represented in orange. b) Side view: vertical cross section at the middle of the structure, within the (P) plane represented in a).

Project objectives

Building on our previous achievements, this project aims to exploit recent developments in plasmonics to propose entirely new sensing principles.

This will be further applied for developing innovative sensors for optical detection of a model analyte as a proof of concept, with progressive complexity from a simple monochromatic continuous illumination to the exploitation of the spectral and temporal signatures of the device ultrafast response. In this aim, the cavity will be modified by replacing half of its defect layer, above the plasmonic gold nanorods (Au NRs), by a microfluidic cell (Fig. 1).

Missions of the PhD student

The recruitment of the PhD student will enable him/her to be involved in the project on an ongoing, day-to-day basis. He/she will be supervised by both L2n and LuMIn. He/she will be mainly involved in the design, fabrication, and characterisation of the microfluidic chip, illustrated in figure 1. She/he will then assess the sensing ability of the chip under refractive index change of the nanoparticle environment, in the 6 configurations of optical interrogation planned, exhibiting growing complexity (from monocolor stationary experiments to broadband ultrafast transient spectroscopy using femtosecond laser pulses), together with the team in LuMIn. Then, he/she will participate to the biofunctionalization of the chip with the team in LBPA, and test the sensing configurations in realistic biological conditions.

The results of this thesis project mainly concern the publication of scientific articles in journals with a high impact factor in various domains (nanophotonics, ultrafast optics, sensing, biomedical...). In addition, the presentation of results in renowned international conferences should allow the doctoral student to make herself/himself known in order to perpetuate her/his scientific career. The filing of a patent concerning the optical biosensors based on the hybrid anisotropic microcavity can be also an important goal for this project.

Expected profile

The candidates sought must hold a master's degree and have preferably experience in microfluidics design and fabrication, knowledges in optics and nanophotonics and also motivation for pluridisciplinary research. Qualified candidates are requested to submit the CV with the contact details of 2 references and a motivation letter for this PhD thesis.

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