'Physique et Chimie des Matériaux' – ED 397 – année 2022

PhD project for funding, to send by 28/02/2022 to

nadine.witkowski@sorbonne-universite.fr under PDF form « acronyme labo_nom PI.pdf »

Research unit (full name + acronym) : Institut des NanoSciences de Paris - INSP

Team if applicable : NanoOpt

Address : 4 place Jussieu - tBC840 - 75005 Paris

Project leader (PI): Gallas Bruno HDR? yes Position : Researcher CNRS

Tel 01 44 27 51 24 email : bruno.gallas@insp.jussieu.fr

Nber of phD under supervision 1 Participation to supervisor training? yes Year 2003

Co-supervisor : HDR? select Position : select

Tel email :

Research unit :

International co-supervision ? select

Keyword 1 : plasmonics Keyword 2 : chirality

Keyword 3 : photonics Keyword 4 : experiments

Select co-funding programme if applicable : select

Project title : Enhancement of optical activity in metallic nanostructures for the detection of biomolecules

Project Description :

The enhancement of the optical properties associated with localized surface plasmon resonances in metallic nano-objects find numerous applications in nanophotonics. In particular, it has been shown that resonators exhibiting optical activity may be used to concentrate a chiral local field. This property may be used to exacerbate the sensitivity of detectors to biomolecules based on the measurement of circular dichroism. Circular dichroism is defined as the reflectivity difference between right and left circular polarizations. We have already observed this effect in arrays of U-shaped plasmonic resonators. We are now aiming at extending this effect to achiral resonators and detect chiral biomolecules.

Project : During the internship, we want to monitor the absorption of chiral molecules using polarized measurements in liquid environment. The molecules used are photosynthetic Light Harvesting Complexes that are found in plants or bacteria. They are interacting strongly with light and exhibit chiral absorption bands in the visible that can be coupled to plasmon resonances. The metasurfaces consisting in arrays of plasmonic resonators will be realized in the clean room of the INSP. We will develop the measurement in liquid a liquid cell that will be adapted to our home-made micro-polarimeter. Optical measurements will be then performed for different surface functionalization of the plasmonic resonators and different concentration of biomolecules in the liquid above the metasurface. The aim is to establish the relation between the polarimetric properties of the metasurface and the surface coverage of biomolecules. The work will consist in designing resonators (numerical simulation), realizing them using e-beam lithography techniques and adapting the micropolarimeter setup to measurements in liquid environment.

This internship can be continued in a PhD thesis work where the understanding of the electromagnetic nearfield properties will be used to exacerbate the sensitivity of polarimetric measurements to the handedness.

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