Master in Photonics – "PHOTONICS BCN"
Master ERASMUS Mundus "EuroPhotonics"

MASTER THESIS PROPOSAL

Dates: April 2021 - September 2022

Laboratory: Single Molecule Biophotonics
Institution: ICFO-Institut de Ciencies Fotoniques
City, Country: Castelldefels, Barcelona, Spain

Title of the master thesis: Fabrication and characterization of bio-compatible plasmonic antennas

Name of the master thesis supervisor and co-supervisor: Maria Garcia-Parajo
(for external proposals a co-supervisor from the Master program in needed)
Email address: maria.garcia-parajo@icfo.eu
Phone number: +34 93 553 4158
Mail address: Av. Carl Friedrich Gauss, 3. 08860 Castelldefels (Barcelona), Spain.

Keywords: Plasmonic nano-antennas, clean room fabrication, fluorescence correlation spectroscopy, biocompatible substrates

Summary of the subject (maximum 1 page):

Metallic nanostructures (also known as nanoantennas) with a typical size of 50 – 200 nm can exhibit so-called plasmonic resonances that allow to confine and enhance the incident field of a light source by several orders of magnitude. This makes them interesting for life science applications as it allows to detect the weak signal of a single biomolecule at physiologically relevant molecule concentrations, which is not possible with conventional diffraction-limited approaches. While the physics behind plasmonics is well understood there remain several technological challenges when applying metallic nanostructures to biological samples like living cells. On the one hand, depending on the nanoantenna material, destructive interactions can take place destroying the nanoantennas, the biological specimen, or both. On the other hand, the three-dimensional shape of the nanostructures can impose stress onto the cell membrane causing artifacts on the experimental findings.

The research project thus aims to establish and optimize approaches to passivate and planarize existing plasmonic nanoantenna arrays using atomic layer deposition (ALD) and template

stripping. The resulting biocompatible nanostructures will be characterized using scanning electron microscopy (SEM) and atomic force microscopy (AFM) to ensure that the very high fabrication demands are met. Electron beam lithography (EBL) and physical vapor deposition (PVD) will be used for the antenna fabrication. Characterization of the antennas biocompatibility will be performed on biologically relevant samples at the single molecule level by means of fluorescence correlation spectroscopy.

Altogether, the student will be offered with extensive insights into some of the most advanced nanofabrication methods while working on a scientifically relevant and exciting project.

Additional information (if needed):

* Required skills : No prior knowledge on clean room technology or biology are required, yet the student is expected to learn and master concepts of bio-functionalization and passivation of substrates. Preferable background in nanophotonics and affinity for working in a clean room environment.

* Miscellaneous :