

Master 2 research internship (6 months, 1^{er} semester 2023)

Coupling of microscopy methods for a discriminative extracellular vesicles analysis

Context : The aim of this project is to improve and further extend an in-house NanoBioAnalytical (NBA) platform developed by Obeid et al. 2017 in the group, which can assist in the characterization of EVs subsets (ref1,2). A chemically modified gold chip developed at MIMENTO technology platform is used in Surface Plasmon Resonance Imaging (SPRi) as the multiplex biosensor to detect and to characterize EVs subsets according to their phenotype. These chemically modified biochips, once EVs are captured on the different arrays of specific ligands, are then studied under Atomic Force Microscopy (AFM), which establishes the metrology of the EVs, size distribution and extracts the morpho-mechanical information of the different subsets. We have already established that our biochips can be used to characterize samples coming from the complex biological samples, i.e., conditioned media, plasma samples, etc (ref3).

In this study, Geetika Raizada, the 2nd year PhD student, aims to increase the throughput and speed of the analysis by increasing the number of ligands on the biochip (from 16 to 100 as a minimum) and utilizing the high-speed AFM. We further propose to use these multiplexed biochips to obtain complementary & multimodal information on the protein, lipid, and cargo contents of EVs subsets, by analyzing them by Infrared and Raman spectroscopy (ref4).

- 1.Obeid S. et al, Biosens Bioelectron 2017
- 2.Obeid S. et al, NBM 2019
- 3.Namasivayam B. et al, 2022 (under review)
- 4.Raizada G et al, JOVE 2022 (under review)

Objectives of the internship : In parallel to the characterization mentioned above, we would like to set up the coupling between AFM and fluorescence microscopy. Indeed, the sample of interest is composed of large EVs containing mitochondria that are fluorescently labelled. The interest of the methods coupling would be to better discriminate EVs containing those organelles from the others in the sample, and to correlate that with morphomechanical characterization of the different EVs immobilized on the gold chip.

Competences : strong interest for research, for biofluids characterization by microscopy, knowledge in biology. Competences in python programmation would be also considered, since helping in high throughput characterization of multiplexed chip.

Location of internship : FEMTO-ST institute, Besancon (research dpt : MicroNanoSciences and systems), in a group constituted of associate professors, researchers and engineers devoted to the analysis of biofluids of interest, with expertises in biophysics, biodetection & nanobiocharacterization.

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