

Proposal of subject of Master 2 Research / Engineer internship 2021-2022

Title:

Development of a microfluidic device to initiate and analyze interactions between nanoparticles and blood proteins

Contact:

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<https://teams.femto-st.fr/BioMicroDevices/en>

In collaboration with:

Pr. Lionel Maurizi, Laboratoire ICB, Axe Nanosciences, Dijon

Objective:

The objective of this work is the development of a microfluidic device mimicking blood stream to allow the interaction of nanoparticles with blood proteins in physiological conditions. The aim is to control the flow of blood products, to introduce nanoparticles and to recover them at the exit of the device. These nanoparticles which will be modified on their surface after interaction with blood proteins will then be analyzed. The nanoparticles will be synthesized in the BH2N team ((Bio-)hybrid nanoparticles & nanostructures) of ICB (Dijon). The microfluidic device and the associate experimental bench will be designed, fabricated and tested at FEMTO-ST institute. The analyses will be performed at ICB and FEMTO-ST according to the characterization tools. This study will allow optimizing nanotechnologies for biomedical applications.

Description of the scientific project

The two main steps of this subject are:

- 1) Develop a microfluidic device and define the experimental bench to mimic the flow of blood products through the channels. To design the microfluidics circuit, the first step will be the simulation of fluids in different geometry configurations using a multiphysics software. After dimensioning the microfluidic device, the second step is the microfabrication. The device must be disposable and then will be manufactured in polymer technology using clean room techniques. The whole device must be packaged.
- 2) The fluid flow must be controlled by an experimental bench containing programmable syringe pumps. Several tests will have to be performed to make the fluidic device reliable before introducing the nanoparticles. After optimizing the performances of the test bench, tests will be carried out with the functionalized nanoparticles synthesized by the ICB. Interactions of nanoparticles with blood products will be started and the results of these interactions will be analysed.

Means

This Master project/ engineer internship will be done at FEMTO-ST institute in Besançon (France) in the team BMD (BioMicroDevices <https://teams.femto-st.fr/BioMicroDevices/en>). The host team has competences in microsystems, microsensors, microfluidics, microfabrication, microcharacterization for biomedical applications. This multidisciplinary project will mainly take place at the FEMTO-ST

institute but will also be in strong collaboration with BH2N team at ICB (Master thesis in parallel). We could use facilities from technological platforms: the ARCEN platform of ICB to characterize the NPs, the MIMENTO platform of FEMTO-ST for the clean room micro-fabrication of the device and the CLIPP platform of UBFC for the bio-functionalization and the analysis of proteins.

Missions and exchanges between the two Master students / engineers working conjointly will be an important part of the project. Strong collaborations with CHU of Dijon as well as University of Geneva for the proteins/NPs interactions are also planned.

Keywords:

Microfluidics, Microfabrication, Instrumentation, Nanoparticles, surface modification, characterizations, bio-interactions.

Minimum Qualifications

- Be in a Master degree / last year of engineering school in a relevant field (applied physics, microsystems, microfabrication, instrumentation, biomedical device)
- Strong interest in biomedical field
- Experimentalist with curiosity and adaptability for interdisciplinary projects and environment

Soft Skills

- Passion for science and the ability to multi-task and set priorities.
- Excellent oral and written communication skills.