2021-22 M2 Internship proposal at LMGP

MeOx thin film deposition on interface sensors for protein adsorption sensing

Abstract: Sticking to material surfaces is a widespread phenomenon that is used by many animal and plant species to anchor their body or external structures permanently or temporarily on solid surfaces. This is often achieved via secreted proteins (and other organic molecules) that adsorb and self-organize into a sticky glue or cement on solid surfaces.
The sequences of several of these “glue” proteins contain repeated segments which can self-assemble and thereby transform these proteins into fibrous gels in contact with material surfaces.
The functional properties of such sticky gels rely on complex, dynamic protein-surface interactions that involve both protein and material surface characteristics. The proteinaceous glues are able to anchor to a large variety of natural and man-made materials. In order to explore this diversity, it is necessary to develop a set of “study surfaces” that are representative of existing materials and compatible with the biophysical techniques used to probe protein binding and accumulation at material-liquid interfaces.
Project description: The aim of the project is to deposit by spatial atomic layer deposition (SALD) a thin film (20 nm) of different metal oxides (MeOx) on surface sensors. These sensors are gold-coated prisms for Surface Plasmon Resonance (SPR) and quartz crystals for Microbalance (QCM) monitoring of protein binding on surfaces. Among MeOxs, SiO_2, TiO_2 and Al_2O_3 are interesting because silicates and aluminates are important constituents of many minerals
Methodology: MeOx thin films will be deposited by SALD at a temperature low enough to avoid gold dewetting from the glass sensors. After deposition, thermal annealing will be applied to control the crystallinity of the samples. Sample structure will be studied by XRD and Raman spectroscopy. The surface chemical composition will be determined by XPS. The thickness of the MeOx layer will be measured by ellipsometry and the morphology of the thin film will be observed by electron microscopy. The MeOx thin films on the sensors will be assessed for their stability in contact with aqueous buffers and their compatibility with the sensing techniques.
Objectives: The outcome will be to extend the range of protein-materials interaction studied by Surface Plasmon Resonance to metal oxides that form the core of many minerals. The next goal will be to vary grain size to study how it affects protein binding. These new surfaces will be extremely interesting to characterize the chemical specificity of different adhesion proteins derived from spider silks or barnacle cement proteins.

Scientific environment: The candidate will work within the LMGP, Materials and Physical Engineering Laboratory, both in the IMBM and the FunSurf teams. She/he will access a large variety of characterization techniques, either in the lab or at the Consortium des Moyens Techniques Communs. Located in the heart of an exceptional scientific environment, the LMGP offers the applicant a rewarding place to work.

LMGP Web Site: https://lmgp.grenoble-inp.fr/

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Profile & requested skills:

We look for a highly motivated student with a strong knowledge in material science and some interest for protein biochemistry and biophysical methods. The student should be able to work in a team, have excellent writing skills (report, presentation…) and a good knowledge of spoken and written English. Knowledge in CAD and 3D drawing and design and 3D printing will be valuable.

The internship will be from February 2020 for a duration of 6 months.

Subject could be continued with a PhD thesis: no

Allowance: Internship allowance will be provided

CONTACT: Send a *C.V*. and a motivation letter to David Muñoz-Rojas : david.munoz-rojas@grenoble-inp.fr