

2019-2020

Internship proposal at LMGP Lab.

Depositing inorganic materials thin films on gold surface to study protein-materials interaction by surface plasmon resonance

Abstract

In nature, some proteins, like spider silks or barnacle cements, have adhesive properties for material surfaces. They give animals the ability to attach themselves to natural or artificial materials or to anchor complex structures like webs and cocoons to solid surfaces. Thanks to genome sequencing, the protein sequences of several of these proteins are now available, which allows studying their structure in order to understand the molecular basis of their remarkable properties. These proteins are indeed able to rapidly self-assemble when released by the animal, either in air (spider) or in a liquid environment (barnacle).

These organisms are able to anchor to a large variety of organic and inorganic supports. The diversity and complexity of protein composition of silks and cements may therefore provide enough chemical diversity to adapt to natural and artificial surfaces. In order to explore this diversity, it is necessary to develop a larger set of model surfaces representative of natural surfaces. Furthermore, these surfaces should be 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 a thin film (20 nm) of different metal oxides on a gold layer. Surface Plasmon Resonance and Quartz Crystal Microbalance are indeed commonly used techniques to measure protein binding on surfaces. SiO₂, TiO₂, Al₂O₃, and ZnO will be first deposited on surfaces. Silicates and aluminates are indeed important constituents of many minerals. In addition, the morphology and crystallinity of the deposited materials will be characterized.

Methodology: Gold coated prisms will be purchased at Horiba. Metal oxide thin films will be deposited by Atomic Layer Deposition or Spatial Atomic Layer Deposition at a temperature low enough to avoid gold delamination from the glass prism. After deposition, thermal annealing will be applied to increase the crystallinity of the samples. The structure of the deposited oxide layers will be studied by XRD and Raman spectroscopy. The surface chemical composition will be determined by XPS. The thickness of the metal oxide layer will be measured by ellipsometry and the morphology of the thin film will be observed by electron microscopy. The prism functionalized with a metal oxide thin film will then be used to monitor the adsorption of different proteins (insulin, antibodies, and eventually adhesive proteins). The stability of metal oxide thin films during surface regeneration will also be studied.

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 NanoSurf teams. 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: <http://www.lmgp.grenoble-inp.fr/>

Profile & requested skills:

We look for a 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 good writing skills (report, presentation...) and a good knowledge of spoken and written English.

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

Subject could be continued with a PhD thesis: Possibly

Allowance: Internship allowance will be provided

CONTACT

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