

Internship proposal 2009-2010

Two laboratories would be involved :

1) Laboratory : Laboratoire de Réactivité de Surface,
UMR Paris6-CNRS 7197

Address : UPMC, 4, Pl Jussieu, 75005-Paris

Laboratory director : Claire-Marie PRADIER

2) Division for Surface and Interface Science

Dept of Physics and Materials Science

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Adsorption of biological molecules on nanostructured surfaces

Scientific project: Control of the reactivity of metal surfaces, at the nanoscale, in a biological environment is of crucial importance for various domains of applications, like biocompatibility or biosensors for example.

In this context, we would like to investigate the adsorption of molecules of biological interest on nanostructured surfaces, starting from single crystals, but also, in a further step, nano particles or nanopatterned surfaces.

Adopting an integrated approach, we suggest starting by studying a small peptide, made of 3-4 aminoacids and having the same chemical functions as a protein, and go towards more complex polypeptides up to proteins. The chosen metal will be gold; as it is well suited for surface science studies and is commonly used in biosensing or electronic devices. Surface characterisation, after, or during the interaction with a gas or a liquid containing the peptide, will be carried out both under model conditions (UHV) and in more real ones, that is in liquid phase. Interesting will be the comparison of the results obtained thanks to these two experimental modes, with a particular attention to the role of water upon the interactions.

The questions to address are the following:

- what is the exact nature of the metal-molecule interaction ? (what type of bonding, which are the atoms involved?)
- do the molecules adopt a 2D structure, do they show some chiral arrangement ?
- does adsorption induce changes in the conformation/orientation of peptides and proteins?

This is a large research area; for the Master internship, we will choose one molecule, a tri-peptide, and consider two possible gold single crystals surfaces having different orientations, for example the dense Au(111) and the chiral Au (643).

In France, adsorption will be mainly characterised i) in UHV by Polarisation Modulation Infrared Spectroscopy (PM-IRRAS) and XPS, to control the chemistry of adsorption ii) in liquid phase by Quartz Crystal Microbalance (QCM), to characterise the kinetics of adsorption

In Sweden, the systems will be characterised by XPS, in order to insure the equivalence of the surface preparation between the two sites and scanning probe microscopy, the later allowing measurements to be performed both in UHV, in air and/or in liquids.

Techniques in use :

A large panel of surface characterisation techniques is available:

For **UHV surface characterisation**: PM-IRRAS, LEED, X-ray Photoelectron spectroscopy (XPS), Scanning Tunneling Microscopy (STM)

For **characterisations in the air or in liquid**: PM-IRRAS, Surface Plasmon Resonance (SPR), Quartz Crystal Microbalance (QCM), Scanning Probe Microscopy (SPM)

Applicant skills : Surface Science, Surface functionalisation, biosensor elaboration

Granted internship : yes (400 €month) / no

C'nano IdF laboratory (France only) : yes / ~~no~~

Possibility for a thesis : yes