Aix-Marseille University, France

PhD position available:
Catalysis spatially resolved on a surface

The development of nanoscale structures in a controlled and reproducible way is a major challenge for the future development of functional materials. Organic or organometallic materials are well known for their remarkable optoelectronic, electronic, or magnetic properties. Through proper design of molecular materials at the nanometer scale, they are expected to deliver novel properties very efficiently.
The goal of this project is to design a range of nanometric objects with organic molecules and thus to obtain a whole range of applicable functionalities in fields such as molecular electronics, detection by biochips or nanosensors. The advantage of such devices is to be able to use very simple organic molecules (thus easily available and inexpensive) allowing a great diversity and variability of the created objects.
Self-assembled monolayers (SAMs) provide a convenient, flexible, and simple system with which to tailor the interfacial properties of metals, metal oxides, or semiconductors.
The main objective of the project is to use the tip of an atomic force microscope (AFM) carrying a catalyst of nanometer size as a tool to promote metal-catalyzed reactions on well defined areas on a SAM surface. We wish to show here that the use of an AFM tip supporting a metal catalyst is a well-adapted tool for the realization of local organic syntheses on a surface. In such way, a large variety of metal-catalyzed reactions between a molecule grafted on the surface and a reactant in solution can be controlled spatially at the molecular level.
For these studies, a new and original experimental set-up specially optimized for AFM imaging in liquid with a high level of stability will be used. The specificity of this set-up is its possibility to change the liquid while keeping the tip position relatively fixed towards the surface so as to be able to find back the nano- or micrometer sized modified areas. This issue is very important for flushing the liquid cell with an inert liquid to stop the reaction but also to change the liquid (that is the reaction medium) to a second one so that the reaction can go on with a second or third compound. The setup is already operational and a proof of principle was recently published (D.A. Valyaev et al., Chemical Science, *in press* (2013)).

The thesis will be carried in the Nanostructuration team at the Institut Matériaux Microélectronique et Nanosciences de Provence (IM2NP-UMR 7334) and in close collaboration with Jean-Luc Parrain and Olivier Chuzel from the STéRéO team at the Institut des Sciences Moléculaires de Marseille (iSm2-UMR 7313) on the Saint-Jérôme Campus in Marseille, France. The thesis is part of the ANR project “CASPARES”.

The candidate will participate to the creation and characterization of the organic polymers by AFM in liquid environment. He will also contribute to side experiments in ultrahigh vacuum environment (molecular beam epitaxy (MBE, X-ray photoemission spectroscopy (XPS)). Consequently, the candidate must have a good experience in material science and more specifically in surface science. Knowledge of the candidate in scanning probe microscopy will also be appreciated. With regards to the importance of the chemical aspect of the project, organic/organometallic synthesis should not be an obstacle.
The thesis MUST begin BEFORE October 1st, 2013.
Funding: following university regulations (~16 500 € annual) for three years.

Interested candidates are invited to send a CV and a cover to Sylvain Clair (sylvain.clair@im2np.fr) with copies to mathieu.abel@im2np.fr and to lionel.patrone@im2np.fr.