PhD Position Available:
Surface-Directed Elaboration of Covalent Networks

On-surface synthesis is a newly developing field of research that aims at making use of well-defined solid surfaces as confinement templates to initiate chemical reactions.[(1)] The concepts of supramolecular chemistry are here applied to provide well-defined functional surfaces from the "bottom-up" self-assembly of nanometer-sized elementary building-blocks. The interest for creating covalent nanoarchitectures directly on surfaces is manifold. On-surface synthesis gives access to original reactions mechanisms in mild conditions that would be not easily accessible in standard chemistry conditions. Also, it represents an efficient route to the formation of robust organic networks and 2D polymers. Finally, the full range of available surface science techniques can deliver exquisite characterization of the different reaction processes with atomic precision.
Recently, we have developed a new molecular building block[(2,3)] capable to initiate two different polymerization pathways, namely an oxidative coupling or a Knoevenagel reaction. Discrimination between the two possible reactions was obtained by the crystallographic orientation of the surface. The aim of the project will be to explore the reactivity of these novel surface reactions by modulating the structure of the precursor. A PhD student is currently working on the organic syntheses. The molecules will be deposited in ultrahigh vacuum (UHV) and characterized by scanning probe microscopy (STM/AFM) at low temperature (10 K), combined with spectroscopic measurements (ARPES/XPS/NEXAFS).

(1) Clair, S.; De Oteyza, D. G. Controlling a Chemical Coupling Reaction on a Surface: Tools and Strategies for On-Surface Synthesis. *Chem. Rev.* **2019**, DOI: 10.1021/acs.chemrev.8b00601.
(2) Kalashnyk, N.; Salomon, E.; Mun, S. H.; Jung, J.; Giovanelli, L.; Angot, T.; Dumur, F.; Gigmes, D.; Clair, S. The Orientation of Silver Surfaces Drives the Reactivity and the Selectivity in Homo-Coupling Reactions. *ChemPhysChem* **2018**, *19*, 1802-1808.
(3) Kalashnyk, N.; Mouhat, K.; Oh, J.; Jung, J.; Xie, Y.; Salomon, E.; Angot, T.; Dumur, F.; Gigmes, D.; Clair, S. On-Surface Synthesis of Aligned Functional Nanoribbons Monitored by Scanning Tunneling Microscopy and Vibrational Spectroscopy. *Nat. Commun.* **2017**, *8*, 14735.

The thesis will be carried in the Nanostructuration team at the Institut Matériaux Microélectronique et Nanosciences de Provence (IM2NP-UMR 7334) and in the framework of a collaborating ANR project involving in total 9 persons from the laboratories Physique des Interactions Ioniques et Moléculaires (PIIM) and Institut de Chimie Radicalaire (ICR), all on the Saint-Jérôme Campus in Marseille, France. The thesis is part of the ANR project "DUALITY".

The candidate must have a good experience in material science and more specifically in surface science. Knowledge of the candidate in scanning probe microscopy, photoelectron spectroscopy and/or UHV technology will also be appreciated. The thesis MUST begin BEFORE October 1st, 2019.

Position: 3 year Ph.D. funding, ANR project DUALITY
Place: Aix-Marseille University, campus de Saint Jérôme, Marseille
Keywords: Surface Science, Physical Chemistry, Scanning Probe Microscopy (STM/AFM), Photoemission spectroscopy, Synchrotron Light Source

Interested candidates are invited to send CV, motivation letter, diploma with transcripts and contact details of two referees to Sylvain Clair (sylvain.clair@im2np.fr).