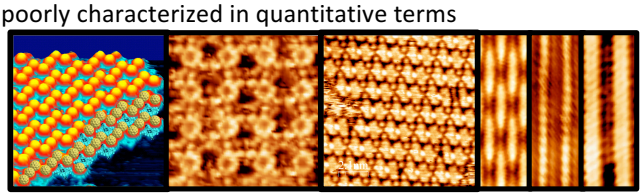
Title	On-Surface Synthesis of Functional Nanomaterials
PI	SAMBI Mauro
Research Group	Surface Supramolecular Chemistry – DiSC
Curriculum	Scienze Chimiche
Contact	**web:** www.chimica.unipd.it/mauro.sambi
	email: mauro.sambi@unipd.it

Project description:

In recent years, direct **on-surface synthesis** (OSS) in ultra-high vacuum (UHV) has been exploited as a promising strategy to obtain thermally and chemically stable structures by covalent bonding of suitable precursors. So far, covalent linking of organic molecules onto metal, semiconducting and bulk insulator surfaces has been mostly carried out thermally: heat supplied to the system promotes the formation of covalent bonds between the monomeric building units either simultaneously with the surface diffusion phenomena it promotes (i.e. under dynamic bond-forming conditions) or as a trigger, after a pre-assembly step into a surface-supported supramolecular, non-covalent network. However, heat as a tool for OSS has the capacity to be beneficial and detrimental to the production and to the structural quality of the covalently-linked network at the same time. The close interplay between molecular surface diffusion, chemical reactivity and temperature, in fact, often hampers the possibility to independently control the reaction initiation and the surface mobility, ultimately leading to highly defective covalent networks, poorly ordered on the long range.

Photochemically activated reactions are a potentially powerful tool to stabilize self-organized structures without disrupting the long-range order. Yet, to date photo-initiated on-surface reactions are still rather uncommon, since the processes following light absorption are not completely understood and, in particular, the role of the substrate is still poorly characterized in quantitative terms



The proposed research activity is focused on the synthesis of gradually more complex and controlled mono- and two-dimensional (1D & 2D) molecular nanostructures by means of self-organization techniques on a solid surface in UHV, and their stabilization through intermolecular covalent bonds. Bond formation will be triggered by either thermal of photochemical means. The focus of the work will be put (i) on improving the long-range order and the monodispersity of the obtained nanostructures based on by now established reaction schemes; (ii) on exploring new reaction schemes based on organic synthesis know-how adapted to the in-vacuum and strictly bidimensional reaction conditions and (iii) on the detailed understanding of light-induced on-surface reactivity when the photochemical path is exploited.

The candidate will become familiar with a whole set of in situ preparation tools and surface science characterization techniques (scanning probe microscopy, photoemission, electron diffraction, x-ray absorption spectroscopy, etc) either in-house or at synchrotron radiation sources, and possibly in the laboratories of collaborating groups in Europe, as well as with different light sources, such as a monochromatic continuous diode lasers and a UV-Vis tunable pulsed laser in the nanosecond range for on-surface photochemistry.

Publications:

J. Am. Chem. Soc. **2016**, 138, 10151-10156; *ACS Nano* **2016**, 10, 2644-2651; *J. Am. Chem. Soc.* **2015**, 137, 1802-1808; *Chem. Commun.* **2015**, 51, 12593-12596; *Chem. Eur. J.* **2014**, 20, 14296-14304; *Nat. Mater.* **2012**, 11, 970-977.

Collaborations/Network:

F. Bartolomé, University of Saragoza, Spain; S. De Feyter, University of Leuven, Belgium; D. G. De Oteyza, Donostia International Physics Center, Spain; L. Floreano, IOM-CNR & Aloisa Beamline, Trieste, Italy; S. Pagliara, Catholic University, Brescia, Italy; Diego Peña, University of Santiago de Compostela, Spain; C. A. Pignedoli, EMPA, Dübendorf, Switzerland.

Research funding:

PRAT CPDA154322 "AMNES"; Piscopia - Marie Curie Fellowship Programme