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SCIENTIFIC REPORT EUROPEAN SCIENCE FOUNDATION

Short visit at *University of Padova: Istituto di chimica inorganica e delle superfici, ITALY*

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Hosting Research Groups

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1. Purpose of the visit

This project has connected **University of Mulhouse: Institut des Surfaces et Interaces (France)** with **University of Padova: Istituto di chimica inorganica e delle superfici** and **Italian National Institute for the Physics of Matter (Italy).**

Lithographic methods have played a central role in the development of modern microelectronics. With the development of Nanotechnology and molecular engineering, more nonconventional methods of surface patterning must be developed. To these ends tit is important to control the lateral placement of molecules on surfaces with a resolution < 100nm.
In the past few years, promising methods such as microcontact printing have been developed for patterning of surfaces wit molecular nanostructures and self-assembled monolayers. These techniques became a routine for fabrication of large-area arrays of patterned SAMs with micron resolution, but not enough to for nanometer resolution patterning of surfaces.
Nanoimprint technologies offer a variety of surface patterning possibilities and have been developed during the last few years to an impressive maturity.
Thus, using Hot Embossing and lift off, represent a promising route to prepare periodic structures with features inferior to 100nm with a lateral resolution of some tens of nm.

2. Description of the work carried out during the visit

During this short visit at ***University of Padova: Istituto di chimica inorganica e delle superfici (Italy)*** Dr. Marco Natali and Prof. Giampaolo Misrura have taught me the procedure to prepare nanostrutured surfaces using Nanoimprint lithography. We have spent one and half day at preparing the samples.
The procedure is devided in 5 main steps:

- Embossing,
- Demolding,
- RIE etching,
- SAMS gafting
- and finally lift-off.

After preparing the substrates we have characterized them with AFM in Tapping Mode. Different patterns: stripes and dots were fabricated showing the difficulty to obtain some of these features due to molecules diffusion during the grafting and lateral resolution limitation.
This training was really efficient as Dr Marco Natali has enhanced most of the main problems to carry out the patterns transfer which remains the main limitation of this technique. It should be noted that the lateral resolution of the chemical patterns produced via Hot Embossing Lithigraphy (HEL) is strongly influenced by the topographical profile of the embossed structures.
However, this method provides a simple and new way for the fabrication of chemical patterns with the feature size below 100nm.

This process requires specific skill and instruments not available at this time in my Institut - ***Institut des Surfaces et Interaces (France),*** as a result a collaboration seems to be really important and necessary.

This trip was also the opportunity for me to teach at this scientific group the sequential procedure developed at my Institut to prepare random nanoheterogeneous surfaces. This exchange of technology between these two Institut represent an efficient

Finally, Prof. G.Mistura and Dr. M.Natali have given me the opportunity to give a talk at ***University of Padova***, entitled: **Nanofriction on Organic Nanopatterned Surfaces.**

3. Future collaboration with host institution

During this short visit, Prof. G. Mistura, Dr. M.Natali and I have become aware of the complementary potential of our group. We have discussed the possibilities together our strength to develop our themes and research activities. The future collaboration will be the exchange of students between ***University of Mulhouse: Institut des Surfaces et Interaces (France) and University of Padova: Istituto di chimica inorganica e delle superfici and Italian National Institute for the Physics of Matter (Italy)***.

We have commonly decided to apply for the Galilee Project launched by European Community that will enable this exchange of knowledge to bring together a synergetic team of investigators with the required expertise to develop novel approaches to create molecularly engineered interfaces.

Developing the molecular “toolkit” for crafting engineered interfaces will be a central focus for this collaboration. Several approaches will be considered to create spatial variations in chemistry, patterns and topologies.

Specifically, we have the following specific aims:

- Develop and combine the molecular tools for creating new engineered interfaces.
- Develop procedures to test these surfaces on dynamic Nanofriction.

Subsequent fabrication of nanometer-sized channels will be also performed using lithographic techniques.