DUV-induced nanopatterning of polyanhydride films deposited by pulsed plasma polymerization

Olivier Soppera [a], Ali Dirani [a], Vincent Roucoules [b], Arnaud Ponche[b]

[a] *Département de Photochimie Génèrale, CNRS UMR 7525, Maison du Technopole, 34 rue Marc Seguin, BP 72005, 68058 MULHOUSE Cedex, FRANCE*
e-mail: olivier.soppera@uha.fr

[b] *Institut de Chimie des Surfaces et Interfaces, CNRS UPR 9069, Université de Haute-Alsace, 15 rue J. Starcky, 68057, MULHOUSE France*

We describe here a new method for fabrication of chemical and topographical functional materials on the micrometer and on the nanometer scale. This technique entails a deposition of the polymer film by pulsed plasma polymerization and nanopatterning is achieved by means of DUV interferometry at 193 nm.

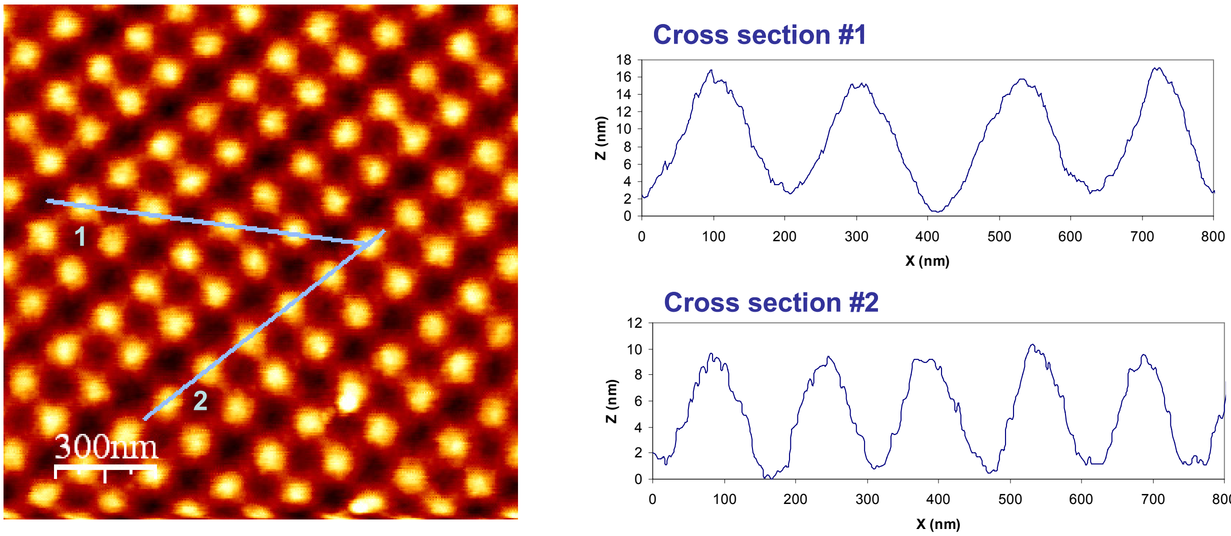
Pulsed plasma polymerization has become a useful candidate in all problems dealing with functionalized surfaces. Some inherent advantages of this approach include the fact that i) the plasmachemical surface functionalization step is substrate-independent, ii) the plasma polymer thin film provides a good adhesion with most of the substrates, iii) the surface density of immobilized molecular species can be finely tuned by varying the pulsed plasma duty cycle and iv) the plasma polymerization step is easily scale up to industrial dimension. Among other compounds, maleic anhydride pulsed plasma polymer films are useful because of the maleic anhydride group reactivity. They readily undergo ring opening to form diacids after hydrolysis or other intermediates after reaction of amine functionalized molecule via the aminolysis reaction.

In the present study, we report a new approach to pattern solid surfaces with reactive groups based on maleic anhydride pulsed plasma polymerization. The DUV lithography based on an interferometric approach allows a fast patterning on large surface area (few cm^2). DUV modifications were analyzed by XPS and PM-IRRAS spectroscopy. Nanopatterning was characterized by AFM.

Using this approach, it is possible to generate multi-scale topographical or chemical images and create combinatorial patterned surfaces. This procedure opens thus a door to a control of both chemistry and topography on polymer films at different scales ranging from nano to macro. Great promises in the field of biology are expected from this work: we have already validated that such surface was compatible with cell or bacteria development. Such patterned polymer films appear as excellent candidate to study the effect of nanostructuration on the development of biofilms.

[1] O. Soppera, A. Dirani, A. Ponche, V. Roucoules, *Nanotechnology*, 19, 395304 (2008)
[2] O. Soppera, A. Dinani, A. Ponche, V. Roucoule, *Microelectronics Engineering*, in press

A)



B)

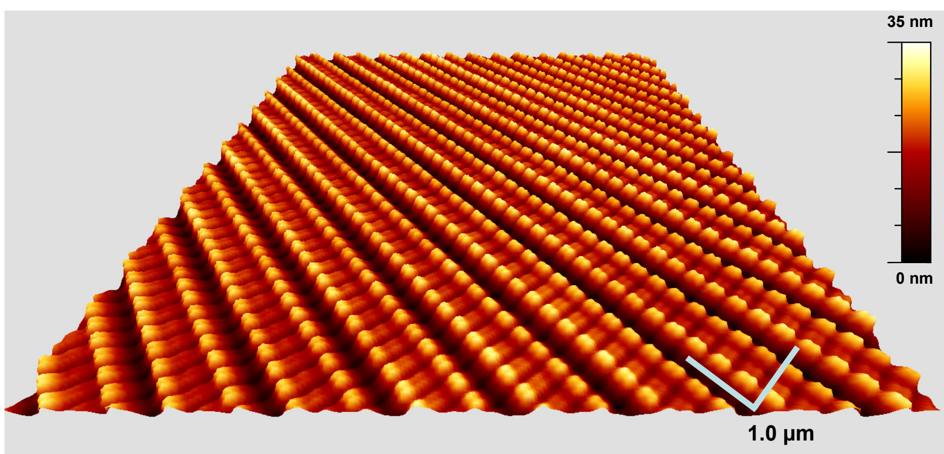


Figure: 2D periodic patterns generated by double exposure of the plasma deposited polymer film. A) Both irradiations were carried out with a 300 nm phase mask (top view and cross section). B) First irradiation was led with 300 nm and second irradiation with 1000 nm phase mask (rotated of 90° from first irradiation). 10x10 µm² image.