

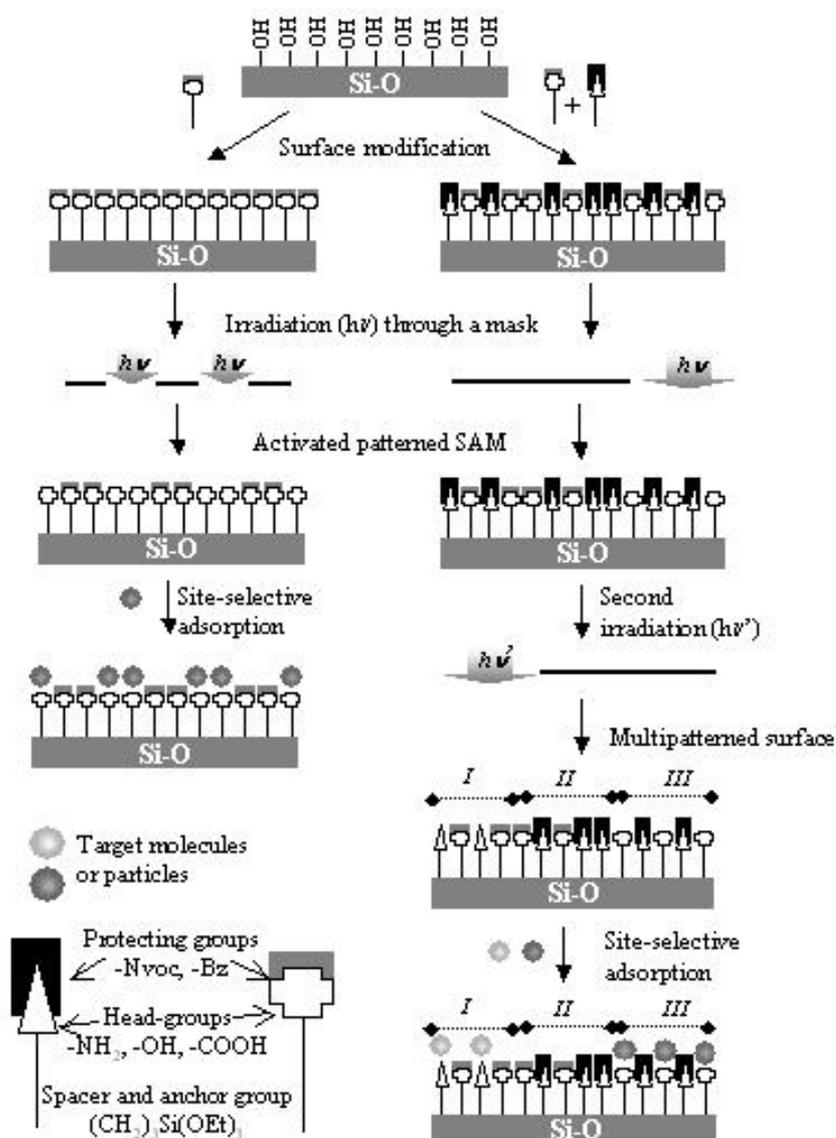
**HIERARCHICAL CHEMICAL PATTERNING OF PLANAR SURFACES  
THROUGH WAVELENGTH-SELECTIVE ACTIVATION OF ORTHOGONAL  
PHOTOLABILE SILANES**

A. del Campo, D. Boos, U. Jonas, I. J. Bruce, H. W. Spiess  
Max-Planck Institut für Polymer Forschung, Mainz, Germany  
University of Greenwich, London, UK  
Università degli Studi di Urbino, Urbino, Italy  
E-mail: aranzazu.delcampo@uniurb.it  
<http://www.uniurb.it/nbt>

Immobilisation onto surfaces is a demanding subject with current applications in a variety of important technologies: multifunctional biosensors, microarrays for diagnosis and high-throughput screening or controlled deposition of components in novel electronic and photonic devices. New developments in these fields depend heavily on the selectivity and efficiency of the adsorption of particular targets onto specific sites of a patterned surface. The adsorption is generally driven by a suitable combination of molecular interactions (electrostatic, H-bonding, van der Waals, ligand-receptor recognition...) between the functional groups located at the surface of the components (the so-called “bottom-up” approach in nanotechnology). Up to now the chemical patterning of a substrate to possess discrete features in the micro and nanometer range (over 100.000 per cm<sup>2</sup> in current DNA microarray technology!) remains one of the bottlenecks in the fabrication of these devices. It requires iterative combinations of patterning and surface activating methods whose number determines, to a great extent, the price and overall sensitivity of the array.

Smart silane chemistry opens interesting possibilities for the simplification of manufacturing chemically patterned surfaces. This new approach relies on a surface modification process with novel functionalised alkoxysilanes carrying protected reactive head-groups that can be removed by irradiation. In this way, both patterning and surface reactive groups are contained in the same molecule and surface irradiation in a one-step process can generate complex lateral chemical patterns on the substrate at any stage of the fabrication process. Furthermore, the complexity of the pattern (and therefore the number of discrete reactive features) can be increased by modifying the surface with two (or more) silanes that carry different protecting groups and which can be removed in successive irradiation processes using different wavelengths (orthogonality). This methodology is represented in the following figure.

The application of this approach to the fabrication of arrays for immobilisation of oligonucleotides and for the site-selective deposition of colloidal particles onto planar substrates will be demonstrated.



*Chemical patterning of surfaces by site-selective activation of the protected functionalities.*

*First, the surface is modified with the protected silanes (monofunctional or bifunctional surfaces can be obtained by coadsorption of one or two different silanes onto the substrate).*

*Irradiation through a mask selectively removes the photolabile protecting groups from irradiated regions. After deprotection, the entire surface is exposed to a solution (or suspension) of the molecules (or particles) that need to be adsorbed. Reaction occurs only in regions that were activated by light in the preceding step. If the surface is modified with two different photoremovable protecting groups, illumination through a second mask with a different wavelength activates a different region for reaction with a second target. The number of targets that can be immobilized by this technique is limited only by the experimental optical resolution.*