Invited Speaker

SUPRAMOLECULAR NANOMATERIALS

Jurriaan Huskens

University of Twente, MESA$^+$ Institute for Nanotechnology,
Molecular Nanofabrication group
P.O. Box 217, 7500 AE Enschede, The Netherlands
e-mail: j.huskens@utwente.nl

Nanotechnology deals with enabling technologies for the fabrication and study of materials (atoms, molecules, particles, etc.) on the nanoscale. In order to study nanoobjects, the preparation of nanoobjects is not enough: careful study of their individual properties usually requires anchoring to a substrate, and preferably to targeted or prepatterned areas of a substrate.
Nanofabrication is the subdiscipline that deals with the development of general fabrication methodologies for the preparation of nanoobjects as well as of patterned substrates and of assembly methods for the anchoring of the objects to the patterned areas. In general, nanofabrication methods fall into two classes, which are called top-down and bottom-up. The integration of top-down and bottom-up nanofabrication schemes is considered a key issue for the advance of nanotechnology.
In this paper, we will show elaborate examples of such an integration approach. We chose to use nanoimprint lithography (NIL) as the top-down technique [1], because it is a technique that allows sub-10 nm resolution in pattern replication. This was combined with the assembly of mesoscale (100-500 nm) polymer particles in order to create ordered particle assemblies. These were inverted by infiltration using layer-by-layer (LBL) assembly [2] of small gold nanoparticles and dendrimers using supramolecular interactions. The full integration of these methods, using this double templating strategy of NIL patterning and particle assembly, followed by removal of both templates, leads to the fabrication of free-standing 3D supramolecular nanoparticle objects of complex shapes [3]. For the LBL assembly, we have used a supramolecular approach [4], based on host-functionalized substrates ("molecular printboards" [5]) and nanoparticles [6] in combination with guest-functionalized dendrimers [7]. The whole procedure is shown to result in a multistep, high-fidelity process yielding 3D supramolecular nanoparticle objects. It will be shown that these maintain supramolecular recognition properties.

References

[1] P. Maury, M. Péter, V. Mahalingam, D. N. Reinhoudt, J. Huskens, *Adv. Funct. Mater.* **2005**, *15*, 451.
[2] G. Decher, *Science* **1997**, *277*, 1232.
[3] X. Y. Ling, I. Y. Phang, W. Maijenburg, H. Schönherr, D. N. Reinhoudt, G. J. Vancso, J. Huskens, *Angew. Chem. Int. Ed.* **2009**, *48*, in press.
[4] O. Crespo-Biel, B. Dordi, D. N. Reinhoudt, J. Huskens, *J. Am. Chem. Soc.* **2005**, *127*, 7594.
[5] M. J. W. Ludden, D. N. Reinhoudt, J. Huskens, *Chem. Soc. Rev.* **2006**, *35*, 1122.
[6] O. Crespo-Biel, A. Juković, M. Karlsson, D. N. Reinhoudt, J. Huskens, *Isr. J. Chem.* **2005**, *45*, 353.
[7] Michels, J. J.; Baars, M. W. P. L.; Meijer, E. W.; Huskens, J.; Reinhoudt, D. N. *J. Chem. Soc. Perkin Trans. 2* **2000**, 1914.