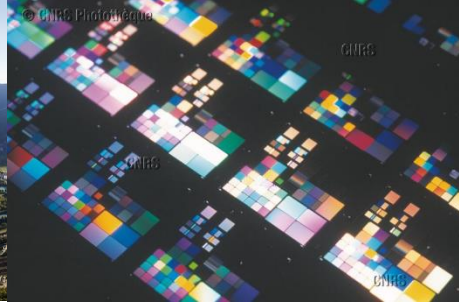


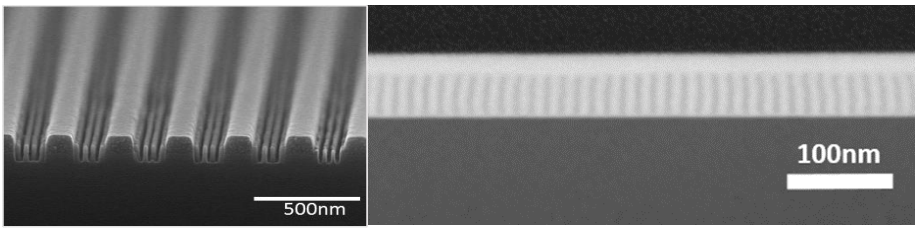
Master 2 Internship

Directed self-assembly and dry etching of high-χ block copolymers for high-resolution fabrication in microelectronics

Keywords: lithography, block copolymers, self-assembly, surface energy, plasma dry etching

Context :

Block copolymers are one class of polymeric materials consisting of at least two blocks of different types. Depending on the relative affinity of these blocks and their respective molecular weights, it is possible to create periodic patterns of high resolution on the surface of a substrate by self-assembly. The control of this self-assembly and its combination with conventional photolithography is a very promising approach for the realization of certain lithographic technological steps in microelectronics.



Examples of block copolymer nanostructures

Objectives:

The copolymer PS-b-PMMA is already seriously considered for integration in microelectronics and is likely to meet some resolution needs, for example for the dimension reduction of contact holes of the most aggressive contact levels. Nevertheless, for sub-10 nm nodes, other copolymers with higher chemical contrasts (called "high-χ") between the two blocs should be used. The associated lower affinity between the two blocks is not only an advantage for higher resolutions, but also facilitates the removal of one block relative to the other to create the lithography mask. However, this also causes difficulties for the use and self-organization of these thin film materials (preferential wetting of one block to a surface or interface, need of dedicated under-layers and top-coats, difficulty in creating neutral surfaces (i.e. surfaces having equivalent wetting for the two blocks) and difficult control of the thermodynamic stability of these materials in thin films).

LTM, in close collaboration with the company ARKEMA, are working on the development and integration of new high-χ block copolymers compatible with a microelectronics industrial environment. The requested work for this internship is to participate to this work. In particular, the student will undertake surface energies measurements at higher temperature (temperature of self-assembly, about 250 °C) of different polymers on different polymeric surfaces in order to understand and predict the neutral nature of a surface in regards to a known di-block copolymer. The theory behind these experiments should be explored and compared with the measurements. In the meantime, simulations of these thin film stacks should be undertaken (for example with the simulation software Comsol Multiphysiscs) to explore their thermodynamic stability. These findings will be compared to the experimental work conducted in the lab on the different available polymers and surface treatments.

On the experimental side, new plasma etching technologies (use of a new “downstream”-type plasma chamber from applied materials) will also be evaluated on these ultra-high resolution patterns.

Hosting lab:
Laboratoire des Technologies de la Microélectronique (LTM/CNRS)
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- ✓ **Duration: 6 mois**
- ✓ **Starting March 2021**

TO APPLY

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