Self-assembly methods for nanoelectronics

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For many decades, miniaturization has been the driven force for the evolution of the microelectronics industry. In recent years, advances in high-resolution lithographic and nano-fabrication techniques have raised the possibility to obtain nanoelectronic devices approaching the single nanometre scale. Size scales of ~20 nm or even less can now be achieved using advanced optical lithography in combination with multiple patterning, as well as by alternative lithography methods such as scanning probe lithography, state-of-the art high-resolution electron beam lithography, and material modification techniques such as focused ion-beam patterning [1]. However, it is still missing a lithography method that combines single nanometer resolution along with high throughput, low defectivity and affordable costs. These three last conditions are necessary for the industrial future relevance of nanoelectronic devices.

A complementary approach to pure top-down lithography based fabrication is the use of self-assembly methods, in which small entities define the smallest parts of the devices. In this talk, we will present two approaches in which we have been involved during the last years: directed self-assembly of block copolymers [2,3] and self-assembly of nanocrystal in nanopillars [4]. In the first case (Figure 1), we have developed methods to create guiding patterns that orientate thin films of block copolymers. In the second case, ion exposure of nanowires and nanopillars create embedded silicon crystals, which can be used to generate a single electron device.

References

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Figures

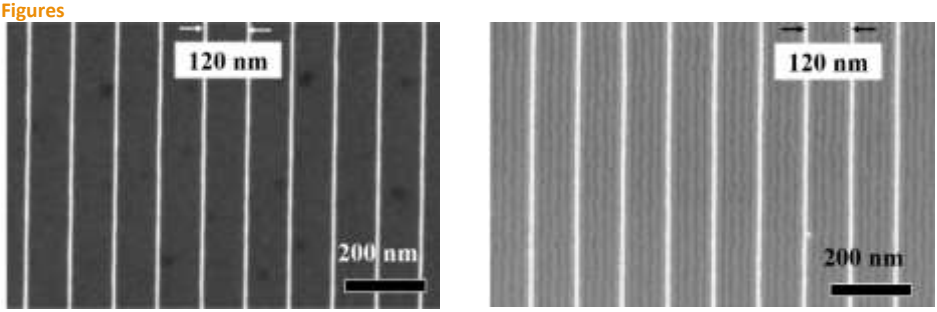

Figure 1: Example of directed self-assembly of block copolymers. The image on the left shows a guiding pattern composed of silicon oxide lines of 9 nm width. The image on the right shows the result of the self-assembly of PS-b-PMMA block copolymers directed by this guiding pattern. [3]