Creation of chemical guiding patterns for DSA of block copolymers by high resolution resistless nanolithography methods

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Abstract

Two novel approaches for the creation of chemical guiding patterns on PS-OH brush layers to direct the self-assembly of lamella forming PS-b-PMMA (L0 = 28 nm) are presented. In the first approach the guiding patterns are created by directly exposing the surface to electrons, and the second one is based on using AFM based nanolithography. Moreover, besides offering the possibility of creating high resolution guiding patterns, there is also a reduction in the number of process steps since the use of a resist is not required.

E-beam resistless nanolithography method

- 1. PS-OH grafting to the silicon substrate
- 2. Chemical surface modification by direct e-beam exposure
- 3. PS-b-PMMA (L0 = 28 nm) deposition
- 4. PS-b-PMMA self-assembly

AFM based nanolithography method

- 1. PS-OH grafting to the silicon substrate
- 2. Chemical surface modification by AFM
- 3. PS-b-PMMA (L0 = 28 nm) deposition
- 4. PS-b-PMMA self-assembly

Guiding patterns formed by AFM nanolithography can be of diverse chemical/physical nature, depending on the magnitude of the applied voltage. When a topographical and chemical change are induced on the brush layer, the alignment is more effective.

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The AFM images show that the guiding pattern has almost no topographic change but a chemical change can be easily appreciated in the phase image.

The XPS analysis suggests that the direct electron exposure of the brush layer induces the breakage of the aromatic ring of polystyrene, promoting the cross-linking of the PS molecules. In consequence, the exposed areas became more attractive to the PS domains.

When a topographical and chemical change are induced on the brush layer, the alignment is more effective.