Vapour phase methods for inclusion of inorganic materials into block copolymer patterns

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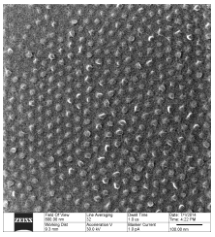

TiO_2 nanodots formed by vapour phase inclusion into a PS-b-PEO nanopatterns

Abstract:

Block copolymers are macromolecules where distinct chemical blocks are present and are covalently linked. If the blocks are substantially chemically different, these systems will phase separate. However, the phase separation is frustrated by the chemical bonds between blocks ensuring that the phase separation occurs into distinct nanopatterns that minimize interactions between blocks. This form of self-assembly is known as microphase separation and in favourable circumstances can yield arrangements at substrates that have close to lithographic dimension and periodicity. This has led to these materials being seen as potential solutions to scaling challenges in the microelectronic fabrication industry.

However, the pattern has little practical use and must be converted into an inorganic structure be either pattern transfer (using the pattern as a mask) or by selected inclusion into one of the blocks where the polymer acts as a template. Here we report work on the polystyrene-b-polyethylene oxide (PS-b-PEO) as a template for nanodimensioned TiO_2 formation. Using volatile titanium precursors, titanium ions are selectively introduced into the PEO block of well-defined PS-b-PEO structures. Simple UV-ozone exposure renders an inorganic mimic of the polymer pattern. By control of exposure time, temperature and humidity, fidelity between the titania structure and the original BCP pattern can be defined. This work reports the details of the methodology and the structural and spectroscopic analysis of the nanopatterns.

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