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Microtome sliced block copolymers as masks for nanolithography

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Block copolymers self-assembling properties are commonly used for creation of very fine nanostructures [1]. Goal of our project is to test new methods of the block-copolymer mask preparation. Currently we are working on pattern transfer from polymer flakes got by microtome slicing of cylindrical morphology block copolymers. The challenging task is to get super flat mask (1 nm thickness variations at 10 μm scale) and transfer it intact onto another surface. Creation of regular nanoscale patterns on, for example, graphene is important for investigation of new phenomena on this material.

Group of Self-organized Nanoporous Materials in Technical University of Denmark has developed series of block copolymers of Polybutadiene-b-Polydimethylsiloxane (PB-b-PDMS) of different morphologies with period of structure of ~24nm [2]. It was shown that cylindrical block copolymer with PDMS cylinders in PB matrix can be mechanically shear-aligned and then PB can be cross-linked to fix cylinder orientation is the direction of shearing. Afterwards PDMS can be chemically etched from the PB matrix. If one is making slices with microtome perpendicular to the axis of alignment, flakes with hexagonal pattern will be obtained. After these flakes are transferred to some substrate, for example, silicon wafer, etching with plasma is performed. At first PDMS is selectively etched then silicon substrate is etched through pores. Or if PDMS was etched prior to slicing, just silicon etch is performed.

[1] R.A. Segalman, Mat. Sci. Eng. R, 48, 191 (2005).

[2] L. Schulte et al, Polymer, 52, 422 (2011).