Séminaire LIONS

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Thick Oriented Nanostructure of Block Copolymer by Multilayer Assembly

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Block copolymers (BCPs) consist of two different polymer chains which are incompatible but linked by a covalent bond. Due to the incompatibility, microphase separation makes BCPs form specific well-ordered nanostructure in polymer films on a substrate. However it is still a challenge to precisely control and direct the nanostructure with respect to the substrate. For instance many applications would require thick (~1µm) lamellar phases where the lamellae of period of tens of nanometers are perpendicular to the substrate.

In this work, we built such a thick ordered BCPs film by multilayer fabrication. Homopolymer (PMMA) was added into copolymer (PS-b-PMMA) as a bottom layer to stabilize the film. Subsequently, the copolymer layers were coated on the top layer one by one so that the thickness of BCPs film reaches around 500 nm. We also observed that the nanostructure in BCPs films partially reconstructs from a lamellar phase to a pillar phase, which is rare to be seen for the structure in BCPs films. The lower part of this film is this pillar phase of ~200-nm thickness, and the lamellar structure with a thickness of more than 200 nm exists in upper part. This simple method to make thick BCPs films with an oriented 3-D nanostructure does not to need synthesis or chemical modification of polymer and special fabrication for each layer. It is remarkable that in the upper lamellar phase, the multilayer deposition results in perfectly registered, perpendicular to the substrate, lamellar phase. This way to build a 3-D structure including two kinds of well-ordered phase, pillars and lamellae, in polymer films, has a potential to be applied for optical materials or membranes.