Contribution ID: **74** Type: **Poster**

Morphologies and Solvent Distribution During Solvent Vapor Annealing of Block Copolymer Thin Films: In situ, Real-time GISAXS Investigations

Tuesday, 18 September 2018 17:15 (15 minutes)

Block copolymer (BCP) thin films have been proposed for a number of nanotechnology applications. Solvent vapor annealing (SVA) has emerged as a powerful technique for manipulating the structure of BCP thin films. Grazing-incidence small-angle X-ray scattering (GISAXS) allows studying the SVA process, providing detailed information of the pathways and mechanisms of SVA induced restructuring in BCP thin films [1]. We present a new method, namely SVA with two independently prepared vapors of different selectivities for the two blocks [2] at the example of a thin film from a cylinder-forming polystyrene-b-poly(dimethyl siloxane) (PS-b-PDMS) diblock copolymer. The film is first swollen in the vapor of n-heptane (strongly selective for PDMS), which is stepwise replaced by the vapor of toluene (weakly selective for PS). The initial cylindrical morphology is transformed into, among others, the lamellar one. To determine the distribution of the two solvents in the two types of nanodomains during SVA, we use the intensities of the Bragg reflections in the 2D GISAXS maps along with the measured swelling ratio of the film and relate these to the morphologies observed.

References

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Session Classification: Poster session 2

Track Classification: P2 Soft matter