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Morphological Studies of the Ordering of Block Copolymer Thin Films in Applied Electric Field using Neutron Reflectometry

Block copolymers (BCPs) are polymeric analogs of surfactants that form three-dimensional, ordered structures in the bulk and in thin films. Ordering of BCPs thin films is important as nanostructured materials find application in diverse areas such as chip-based (bio)sensors, battery electrolytes, and optoelectronic devices. It is well-known that the organization and alignment of a microphase separated block copolymer thin film can be enhanced by the application of an electric field, resulting in alignment parallel to the direction of the electric field (here, perpendicular to the surface). The ordering depends on several factors, including field strength, the dielectric constant of each polymer block, time, and interfacial energy between the contacting block and the solid support. In this study deuterated polystyrene-block-poly(ethylene oxide) (dPS-b-PEO) was spin-coated from a non-selective good solvent, creating disordered films that were tens of nanometers in thickness. These films were then subjected to an electric field and elevated temperatures, resulting in microphase-separated lamellae structures. Neutron reflectometry was used to determine the morphological structures of the BCP thin films by probing the laterally-averaged depth-profile of the dPS-b-PEO films. It was found that the formation of lamellae domains aligned both parallel and perpendicular to the solid support surface in dPS-b-PEO thin films is dependent on the electric field strength, temperature, and time. We plan to present the neutron reflectivity of block copolymer thin films as a function of applied electric field strength and temperature.

Topical Area

Soft matter: polymers, and complex fluids

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