

Control of PS-*b*-PMMA Block Copolymer Thin Films Orientation using Surfactants

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Block copolymers are well-known by the spontaneously forming a wide range of nano-structures. In thin films, they are additionally affected by the presence of substrate and free surface. This often leads to a morphology composed of block domains oriented in a parallel direction to the substrate. However, for the fabrication of functional nanostructures, a perpendicular orientation is needed. In this study, we present a new route based on the use of surfactants in order to control the morphology of Polystyrene-*block*-Polymethylmethacrylate (PS-*b*-PMMA) thin films. The addition of surfactant, which interacted with PMMA domain and modifies the surface and interfacial energy of the system, induces perpendicular orientation of block copolymer thin film microdomains regardless of substrates. We verified surfactant assisted perpendicular orientation using AFM, SEM and Grazing Incidence Small Angle X-ray Scattering (GISAXS) experiments. And for high aspect ratio and defect-free block copolymer perpendicular orientation, we combined surfactant assisted self-assembly with directed self-assembly on chemically patterned substrates by Extreme-UV (EUV) Lithography.