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Self-Assembly in ultrahigh molecular weight diblock copolymer thin films

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Self-assembly of ultrahigh molecular weight diblock copolymer nanostructures with micro-phase separation structures larger than 150 nm can yield ordered structures for the fabrication of many nanotechnology materials, such as optical, electronic and magnetic devices. Therefore, it is significant to study the structural development in ultrahigh molecular weight diblock copolymer thin films systematically. In this work, the authors fabricate homogeneous polystyrene-block-polymethylmethacrylate diblock copolymer (Mn = 1061.60 kg/mol) thin films, having a characteristic structure larger than 160 nm, with nitrogen gas (N2) to blow away the solvent vapor (dimethylformamid) inside the chamber for accelerating solvent volatilization during spin coating combined with a solvent annealing process. As a function of film thickness, we demonstrate a similar orientation evolution of cylindrical structures as known for normal molecular weight diblock copolymers. Well-ordered nanostructures with a vertical cylindrical morphology, average domain dimeter of 82 nm and distance of 162 nm, are readily generated through the control of solvent annealing time. The film morphology is probed with optical microscopy (OM), atomic force microscopy (AFM), and grazing incidence small angle X-ray scattering (GISAXS).

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