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Controlled self-assembly of gyroid-forming block copolymer templates for optical metamaterials

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Nowadays, nanostructured materials fabricated based on the self-assembly of block copolymers become more interesting due to their potential applications in manufacturing of lithography masks, nanophotonic structures and optical metamaterials.
The fabrication of optical metamaterials requires controlling the self-assembly of an alternating gyroid with sufficient long-range order. A way of increasing the grain size in block copolymer morphologies is using solvent vapour annealing. The effect of solvent vapour annealing on the degree of ordering in gyroid systems has only been scarcely investigated.
To study the thermodynamics and kinetics of a gyroid-forming block copolymer thin film during solvent vapour annealing real-time *in situ* Grazing-Incidence Small-Angle X-ray Scattering was used to track morphological changes in the polymer film during the process of solvent vapour annealing. The effects of varying the solvent vapour concentration and composition on the lattice parameters. An *in situ* Grazing-Incidence Small-Angle X-ray Scattering study was extended to different molecular weights of gyroid-forming triblock terpolymers having the same chemical composition and gyroid-forming triblock terpolymer having a different chemical composition.
The use of solvent vapour annealing creates long-range order in terpolymer films with alternating gyroid morphology exhibiting a previously unreported orientation. Although the controlled solvent vapour annealing of gyroid-forming terpolymers in films still gives micro-grains structures, it constitutes a first important step towards creating true three dimensional long-range order in solvent-annealed polymer films.
Combining solvent vapour annealing of gyroid-forming terpolymers, for example, with directed self-assembly, which employs chemically or topographically patterned substrates, appears a reasonable next step toward this goal.

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