Real time SANS studies on the transformation between the hexagonal cylinder phase and the bi-continuous gyroid structure: transient structures

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Combined application of SANS and oscillatory shear is effective tools for studying structure and real-time dynamics of soft matter materials. Large-amplitude oscillatory shear can be used to effectively control the texture of soft materials in the ordered states. We will show experimental data proving that the 10-spot pattern often characterizing the gyroid phase of block copolymer melts as well as surfactant systems is a 2D powder-pattern, originating from the dominating structure of the cylinder axis when grown from single-domain hexagonal structures. We show that the gyroid state is unstable when exposed to large amplitude / large frequency shear, transforming into the a hexagonal cylinder phase. The transformation is completely reversibly. With the slow kinetics, it is possibly in detail to follow the complex materials transformation from one-dimensional cylinders to the complex three-dimensional gyroid phase of block copolymers. The transformation kinetics is different within the various crystallographic directions, and shows the transformation through a transient structure rather similar to that found in SCFT-studies.

1Supported by the Danish Research Council, Natural Sciences.
2Eskimergen et al., Macromol 38, 1286 (2005)
3Mortensen et al, unpubl.
4Ly et al. Macromol 40, 2928 (2007)