

**Experiment title:**

A SAXS study of shear-induced ordering of elongated block copolymer micelles

Experiment number:
SC262**Beamline:**

BL4

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Shifts:

6

Local contact(s):

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Report:

The effect of shear on the orientation of cubic micellar phases formed by a poly(oxyethylene)-poly(oxybutylene) diblock copolymer in aqueous solution has been investigated using small-angle x-ray scattering and small-angle neutron scattering (SAXS and SANS). SAXS was performed on samples oriented in a Couette cell using steady shear, and SANS was performed at Risø National Laboratory, Denmark on samples subject to oscillatory shear *in situ* in a rheometer with a shear sandwich configuration. A body-centred cubic phase observed for gels with concentrations greater than 30 wt% copolymer was found to orient into a polydomain structure, with the close-packed { 110 } planes both parallel and perpendicular to the shear plane. For gels with 30 wt% copolymer or less, an fcc phase was observed, and this was also observed on heating the more concentrated gels that formed a bcc phase at room temperature. The fcc phase could be oriented to form a highly twinned structure, with a significant deviation from the ABCABC . . . stacking sequence of the ideal structure due to the random

sequences resulting from slip of $\{111\}$ hexagonal close-packed planes. For the lower concentration gels, a transition from hard to soft gel on increasing temperature was found to be characterized by a change in the susceptibility of the sample to macroscopic shear orientation, as probed using SAXS. The hard gel could be oriented by shear into a twinned fcc structure, whereas the soft gel comprised an fcc phase with a small grain size, which could not be sheared to form a macroscopically oriented domain. Shear only homogenized the sample, producing a powder SAXS pattern from an fcc structure.

Publications

I.W.Hamley, J.A.Pople and O.Diat. “ A Thermally-induced Transition from a Body-Centred to a Face-Centred Cubic Lattice in a Diblock Copolymer Gel”, Colloid Polym. Sci., in press

I.W.Hamley, J.A.Pople, J.P.A.Fairclough, N.J.Terrill, A.J.Ryan, C.Booth, G.-E.Yu, O.Diat, K Almdal, K Mortensen and M.Vigild. “Effect of Shear on Cubic Phases in Gels of a Diblock Copolymer”, J. Chem. Phys., in press.