ESRF	**Experiment title:** Flow properties of a soft crystal: aqueous solution of an amphiphilic copolymer under shear.	**Experiment number:** SC155
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Report:

We have used ID2-BL4 to investigate in a systematic manner the structural changes induced by shear in a cubic mesoscopic structure which forms spontaneously in aqueous solutions of a triblock amphiphilic copolymer. At high enough temperature (typically above 20°c), the so called F108 triblock copolymer ($EO_{127}PO_{49}EO_{127}$) self assemble in water in the form of spherical micelles having a dense PO core and a diffuse EO corona. These micelles have been characterized in neutron scattering in the dilute range (110Å effective radius). At sufficient concentration (above 25% typically), they pile up regularly in space into a long range f.c.c. cubic lattice having a well defined yield stress and readily measurable mechanical properties. We used the Couette cell transparent to X-rays in two complementary geometries: in the radial geometry, the incident beam aims towards the axis of the cell perpendicular to the shear plane; in the tangential geometry the incident beam is tangent to the shear plane and parallel to the velocity direction. So, two different sections of the reciprocal space could be observed for all flow regimes. We studied samples of different concentrations: 25%, 28%, 30%, and 35%.

At all concentrations the same structural sequence was observed upon increasing shear rates:

- at rest, just after crystallization, a powder pattern is seen with a sequence of rings characteristic of a f.c.c. lattice.

- at very low shear rates (below 1 s^{-1}) the polycrystalline structure persists with only a weakly prefered orientation in the shear direction. The long range f.c.c. structure remains and the flow is

mediated by the high density of defects at the grain boundaries.

- at high shear rates (100 s^{-1} typically) the structure is strongly oriented with the dense hexagonal planes sliding on the top of each other parallel to the shear plane **(layer sliding regime).** After abrupt cessation of shear, the frozen structure remains perfectly oriented, the dense planes being **randomly** stacked the one on the top of the other (high density of stacking faults revealed by the pattern in the tangential geometry see fig. 1).

- starting from the previous frozen structure, all stacking faults could be annealed by shear oscillations of moderate amplitude: a **perfect f.c.c.single crystal** is so obtained totally free all stacking faults over the whole thickness of the shear cell (note the asymmetry of the pattern in the tangential geometry in fig 2 which proves that one only of the two possible f.c.c. twins is here present).

From such accurate structural descriptions of the different flow regimes, we are now in a good position to interprete the time evolution of the stress response to shear which appear to depend strongly on the characteristics of the starting state. This rheological study of the transient response is currently under progress.

Publications:

J. F. BERRET, F. MOLINO, G. PORTE, 0. DIAT, P. LINDNER
"The shear-induced transition between oriented textures and layer-sliding-mediated flows in a micellar cubic crystal"
J. Phys. Condens. Matter, 8, (1996), 9513

0. DIAT, G. PORTE, J. -F. BERRET
"Orientation and twin separation in a micellar cubic crystal under oscillating shear"
Phys.Rev. B, 54, (1996), 14869

F. MOLINO, J.-F. BERRET, G. PORTE, 0. DIAT, P. LINDNER
"Identification of flow mechanisms for a soft crystal"
Submitted to J. Phys. II France.