ESRF	**Experiment title:** Non homogeneous flow of swollen hexagonal mesophases	**Experiment number**: SC-610
Beamline: ID02A	**Date of experiment**: from: 14 Nov. 99 to: 15 Nov. 99	**Date of report**: Feb. 00
Shifts: 4	**Local contact(s)**: Volker URBAN	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Laurence RAMOS*, François MOLINO* and Grégoire PORTE*

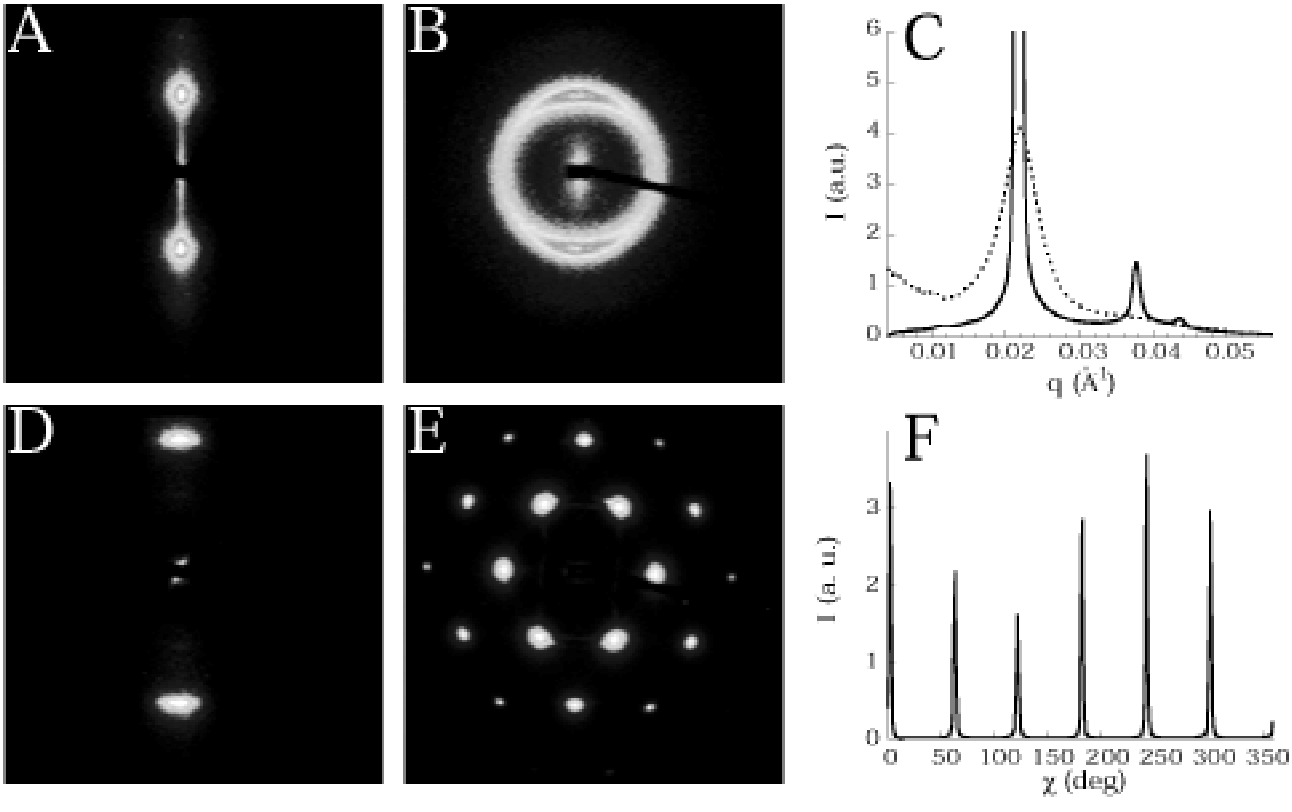
Groupe de Dynamique des Phases Condensées, Montpellier, France

Report:

Rheological studies of swollen hexagonal phases of surfactant indicate a shear-induced transition between two states of different viscosity. The main objective of these experiments was therefore to investigate the structures under shear of these materials.

We have performed small-angle X-ray (SAXS) scattering under shear using a Couette cell. The scattering profiles were recorded in two planes, one containing the vorticity and velocity directions (radial geometry), and the other one containing the vorticity and the velocity gradient directions (tangential geometry). In the low shear regime, the cylinders are preferentially oriented along the flow and the hexagonal phase exhibits a polycrystalline texture. A detailed analysis of the spectra hase been done, in particular to quantify the increasing orientation of the grains with increasing shear rates. More unexpected results have been obtained in the high shear regime. We found that a high shear has the effect of melting the long-range two-dimensional order of the cylinders, leading to a 2D liquid of cylinders strongly aligned along the flow (Fig. A, B, C). Moreover, when the high shear is abruptly stopped, the patterns of a extremely well oriented hexagonal phase (Fig. D, E, F) is recovered within a few seconds. The single crystal morphology is in particular characterized by a 6-fold symmetry in the tangential pattern (Fig. E). Moreover, at intermediate shear rates, the radial patterns suggest the coexistence of the two types of structures, namely the pollycrystalline hexagonal phase and the melted phase. Such coexistence is consistent with the concept of first-order structural transition under shear.

To conclude, the most striking result of these experiments is the evidence a melting transition, which is, to the best of our knowledge, the first example of shear-induced melting transition in lyotropic liquid crystals.



Radial (A) and tangential (B) SAXS patterns of the sample submitted to a shear rate of 1490 s^{-1}. Radial (D) and tangential (E) patterns of the same sample taken immediately after cesation of the shear. (C) : intensity I versus q, obtained from an azimuthal integration of pattern B (dotted line) and E (full line). (F) : azimuthal scan of pattern E (I is averaged over an annulus of radius q_0, the wavevector of the first diffraction peak).