



	<b>Experiment title:</b> Structural investigation of Smectic liquid crystals by resonant x-ray diffraction	<b>Experiment number:</b> SC-586
<b>Beamline:</b> BM32	<b>Date of experiment:</b> from: 14 July 99 to: 21 July 99	<b>Date of report:</b> 20 Feb 2000
<b>Shifts:</b> 21	<b>Local contact(s):</b> RIEUTORD François (PLUO A)	<i>Received at ESRF:</i>
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### Report:

The goal of the experiment was to look for resonant scattering from a chiral smectic C liquid crystal (LC) at energies significantly higher than the sulfur K-edge (2.47 keV).

The first part of the experiment was performed at the bromine K-edge (13.49 keV) on a specially synthesized LC. A special oven designed for free standing films (10mK accuracy, helium flushed flight path, low scattering windows, video monitoring of optical textures) was brought over and installed successfully on the beamline.

The results obtained on this brominated LC were submitted (and accepted) to "Ferroelectrics". Below is a copy of the abstract of the paper :

### RESONANT X-RAY DIFFRACTION STUDY OF A NEW BROMINATED CHIRAL $\text{SmC}_A^*$ LIQUID CRYSTAL

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Abstract: We present a new high energy resonant x-ray scattering study of a brominated chiral liquid crystal material exhibiting antiferro, ferri and ferroelectric smectic C phases. The absorption K-edge of bromine is at much higher energy (13.49 keV) than the sulfur K-edge (2.47 keV) which should enable a wider variety of experimental geometries. A weak

resonant signal is detected on free standing films in the  $\text{SmC}_A^*$  phase only. Interestingly, the signal is stronger in binary mixtures with a bromine free thiobenzoate compound. This observation suggests that most chiral liquid crystal structures could be studied by resonant scattering after incorporation of a molecule bearing a resonant atom as a probe. Resonant x-ray diffraction profiles are also calculated for some recently proposed distorted clock models of the 4-layer ferroelectric phases. Finally, the influence of defects is investigated.

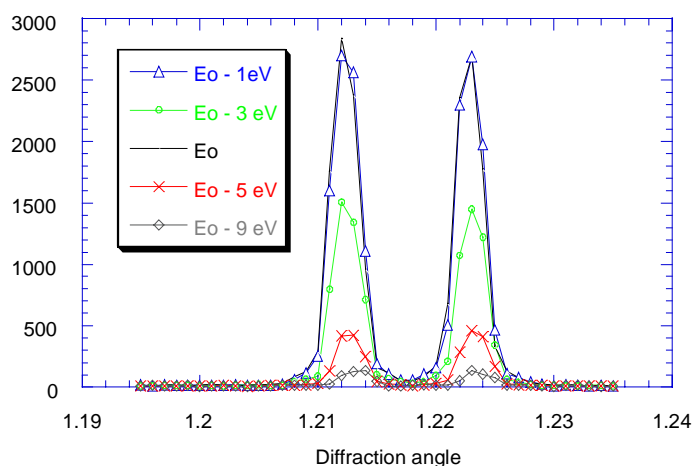
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Although these results provided us with useful information about the off-diagonal terms of the polarizability tensor, the extremely low level of resonant scattering observed in the Antiferroelectric smectic phase (500 times weaker than with sulfur) was rather disappointing for future experiments. We asked therefore to our colleagues in Great Britain to send us by overnight service some new LC material with a selenium atom. The resonance of selenium is in the same range of energy (13. keV). The material reached ESRF the very last day of the run.

### **Results obtained at selenium K-edge :**

The selenium LC material was mounted in the same geometry (free standing film). Very sharp and intense resonant peaks were observed at selenium edge in all chiral smectic phases.

The figure shows the the 1/2 order resonant doublet in the antiferroelectric smectic phase vs energy. Note the sharp decrease of the intensity upon shifting away from the absorption edge  $E_0$ .



### **Conclusions:**

We believe that experiment SC586 was very successful:

- we found that the resonant element can be incorporated in guest molecules in binary mixtures, hence extending the capabilities of the technique to binary mixtures.
- we showed that selenium (rather than bromine) is an appropriate resonant element for resonant scattering from chiral liquid crystals

- the intensity of the resonant peaks obtained with selenophene molecules is high enough to enable resonant diffraction in glass cell geometries, hence permitting structural characterization under strong anchoring conditions and external electric field.