ESRF	**Experiment title:** X-ray studies of the uniaxial stress induced changes in the charge density wave superstructure of $NbSe_3$.	**Experiment number:** HS 1138
Beamline: ID10 A	**Date of experiment:** from: 07 06 2000 to: 12 06. 2000	**Date of report:** 1 aug. 2000
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Report:

In CDW materials, such as $NbSe_3$, in which the wavelength of the CDW is incommensurate with the underlying lattice, sliding of the CDW is made possible by the application of an electrical current exceeding a threshold value I_T. Electrical measurements have shown that an uniaxial strain, ϵ, produces an enhancement of the threshold current value at low strain and a divergency of its value at $\epsilon \approx 2.6\%$. The most probable reason for that, is a stress-induced incommensurate-commensurate transition (ICT) of the CDW wavelength.
The purpose of this experiment was to perform structural studies as a function of the strain value, in order to verify this assumption.

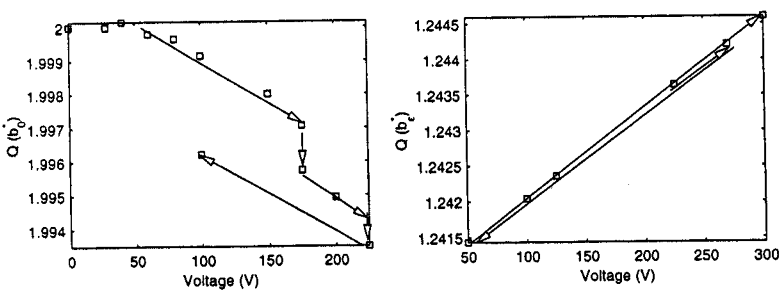

FIG. 1 Position of the (020) Bragg peak (lhs) and of the satellite (rhs), for several voltage values (applied successively as indicated by the arrows); $NbSe_3$; T=90K.

All measurements were performed on ID10 A, using a 100 μm-wide X-ray spot localised in the central part of a 400 μm long sample (sample cross-section: 20 μm x 10 μm). The sample was mounted horizontally on a bimorph-base puller, introduced into a cryo-cooler.
The first part of the experiment was devoted to direct measurements of the strain. It is possible to estimate the strain by monitoring the sample resistivity as a function of the potential difference V across the bimorphs. The variations of the sample resistivity, measured in situ, is compared then with extensive information on the R vs ϵ dependence of $NbSe_3$ obtained on other calibrated pullers [1].

Fig. 1 (lhs) shows the position of the (020) Bragg peak in reciprocal space for several voltage values V (applied successively as indicated by the arrows). Besides its changes in position, the (020) peak is split longitudinally into several peaks. This indicates that the stress is not uniform over the sample cross-section. The two abrupt changes in position (vertical arrows) are due to parts of the sample cross-section breaking during the measurements, the strain being redistributed over the remaining sample cross-section. Steps in the sample resistivity were simultaneously observed. Our direct measurements of the strain ($\epsilon \approx \Delta Q/Q$) differ (by about a factor of two) from the values deduced from the resistivity measurements [1]. The maximal strain ($\epsilon \approx 0.36$ %) was obtained for a voltage of 300 volts (before the sample broke at 340 Volts).

The second part of the experiment was to measure the position of the satellite peak in reciprocal space as a function of the strain. Fig. 1 (rhs) shows the position of the satellite peak (in b_ϵ^* units) as a function of the voltage value applied on the bimorphs. For V=300 Volts, the satellite position is shifted to 1.2445 b_ϵ^*, *i.e.* half way between the stress-free value 1.2414 b_0^* and the commensurate position 1.250 b_ϵ^*.

This first experiment showed that a stress-induced ICT is the most probable reason for the observed enhancement of the threshold current value with uniaxial stress. We expect that improved stress-application device will allow us to reach, in the future, the critical stress value for the ICT.

References

[1] J. Kuh *et al.*, Phys. Rev. B **57**, 14576 (1998).