

**Experiment title:**

Coherent X-ray diffraction of a charge density wave screw dislocation under electric field

Experiment number:

HE 2289

Beamline:

Id20

Date of experiment:

from: 30/08/06 to: 5/09/06

Date of report:**Shifts:**

18

Local contact(s):

L. Paolasini

*Received at ESRF:***Names and affiliations of applicants (* indicates experimentalists):**

Le Bolloc'h, LPS bât 510,91405 Orsay

Vincent Jacques, LPS bât 510,91405 Orsay

Jean Dumas, LEPES Grenoble

Ravy, synchrotron Soleil, 91000

Report:

High-resolution coherent x-ray diffraction experiment has been performed on the charge density wave (CDW) system $K0.3MoO_3$. The $2k_F$ satellite reflection associated with the CDW has been measured as respect to external dc currents. This experiment was the following of the HE1955 experiment.

The coherent x-ray diffraction experiment has been performed at the ID20 beamline. We used the same high quality single crystal than in our previous experiment (see report he1955). The $0.5 \times 2 \times 0.2 \text{ mm}^3$ sample was mounted in a top-loading Cryostat cooled down to 75K. The sample was initially aligned with the b^* axis vertical, and the $2a^*-c^*$ axis in the horizontal scattering plane. The patterns were recorded on a direct illuminated CCD camera ($22 \mu\text{m} \times 22 \mu\text{m}$ pixel size) located 1.20m from the sample position. The data were analyzed by a Droplet algorithm. A resolution of $dq = 0.7 \cdot 10^{-4} \text{ \AA}^{-1}$ along b^* (i.e. $dq = 0.8 \cdot 10^{-4}$ in b^* units) was achieved at 7.5 keV $\lambda = 1.65 \text{ \AA}$ by using a $10 \mu\text{m} \times 10 \mu\text{m}$ entrance slits. The beam quality and its transverse coherence length were tested by closing the entrance slits at $2 \mu\text{m} \times 2 \mu\text{m}$, in order to observe the corresponding diffraction in the Fraunhofer regime. The experiment consisted in recording the 2D diffraction patterns of the $Q_s = (5, -1, -3) + qc$ satellite reflection, and the $(6, 0, -3)$ fundamental Bragg peak, far from any electric contact. Due to the experimental geometry, the 2D reciprocal plane probed by the CCD at the satellite reflection corresponds to the (b^*, t^*) plane, where t^* is the direction tilted at 19.5° from the $2a^*-c^*$ direction. For each fundamental Bragg and satellite reflections, several CCD acquisitions have been recorded for different incident θ angles, with 10^{-3} degree steps. In blue bronze, we are able to observe the behavior of the $2k_F$ reflection and the main Bragg reflection in the three directions of the reciprocal lattice, especially along the chain direction b^* and the transverse direction $2a^*-c^*$.

In the sliding regime, the $2k_F$ satellite reflection displays field-induced satellites along the chain axis which corresponds to correlation up to the micrometer scale (see figure below). This super long range order is 1500 times larger than the CDW period itself. We were able to follow the behavior of the super long range order as respect to the current. The corresponding wave vector seems to increase linearly with the CDW current. An article has been submitted.

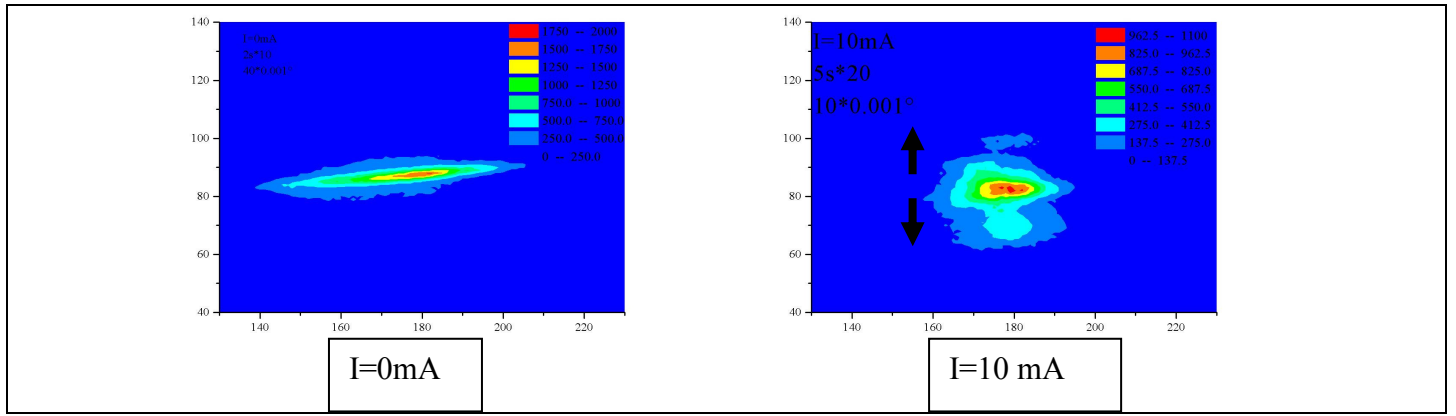


Fig. 2D patterns obtained at the $2k_F$ incommensurate satellite without and with a 10mA electric current. In the sliding regime, the $2k_F$ reflection superstructure displays satellites along the chain direction (see arrows).

