	Experiment title: *Coherent diffraction of charge density wave in the blue bronze under lectric current*	**Experiment number**: Hs2402
Beamline : ID20	**Date of experiment**: from: 07/07/04 to: 11/07/04	**Date of report**: 02/09/04
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Report

Diffraction patterns obtained from a coherent X-ray beam are sensitive to any phase field deformations of the medium. In hard condensed matter, information on dislocations embedded in the bulk can thus be obtained from coherent hard X rays. Our study of a Charge Density Wave (CDW) system provides an illustration of this phenomenon.
The blue bronze ($K_{0.3}MoO_3$) is a model CDW system which undergoes a electronic density modulation at twice the Fermi vector $2k_F$ and an incommensurate lattice distortion. As any crystal, this electronic crystal can exhibit intrinsic defects like dislocations. Detailed knowledge of these dislocations is essential to understand the CDW dynamics (as first suggested in Ref.[1]) or the narrow band noise generated by the CDW sliding[2]. From an experimental point of view, no direct observation of such defects has been measured so far, even though indirect evidence of CDW dislocations close to contacts has been reported by classical x-ray diffraction[3].

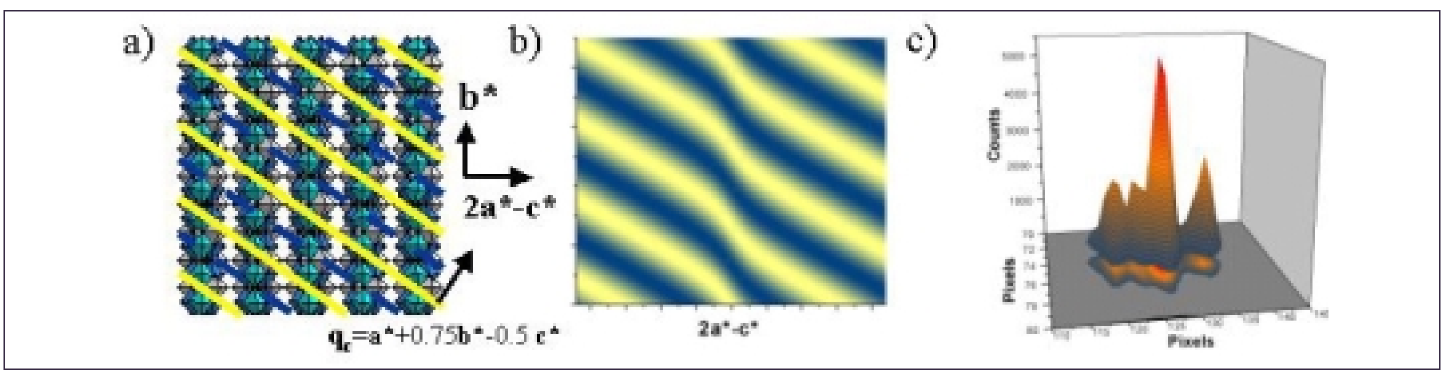

Fig.1. a) Schematic representation of the CDW phase fronts in the Blue Bronze. B) Sections of the CDW screw-like dislocation c).Typical diffraction profile of the satellite reflection **Qs.**

Four gold contacts are deposited onto the blue bronze of standard size ($1*0.5*0.2mm^3$). A specific sample holder (including a local rotation of the sample) has been designed in our laboratory in order to put the (8 0 –4) Bragg reflection and the (6 0.249 –3.5) satellite reflection in the horizontal scattering plane. The sample was mounted onto an orange cryostat (T_c=183K) available at the sample environment at the ESRF. The conditions of coherence have been obtained by limiting the size and the divergence of the beam. We used a direct illuminating CCD with small pixel size ($22*22\ \mu m^2$) and low noise which allow to resolve speckles.

Results

In Fig.1 is displayed a typical diffraction pattern of the incommensurate satellite reflection $\mathbf{Q}_s$=(6,-0.252,-3.5) obtained at the ID20 beamline at the ESRF, under coherent illumination. For some beam positions on the sample, regular fringes appear, in only one direction (see Fig.1c) while no fringe has ever been observed on the (6 0 -3) fundamental Bragg reflection. From elastic theory and knowing the experimental elastic constants, we show that this diffraction pattern is consistent with a single screw dislocation with the Burgers vector along the CDW modulation and the screw axis along **b*** (see Fig.1b) [4]. Note that this screw-like dislocation does not lead to any compression or dilatation of the CDW along the **b*** direction which would be expensive in terms of Coulomb energy.

References

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