ESRF	Coherent Scattering from dislocations in monocrystalline silicon	**Experiment number:** 02-02-677
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Shifts: 12	**Local contact(s):** Dr. Frederic LIVET	*Received at ESRF:*

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Report:

In this experiment, the shape of the Bragg peaks in a distorted region of a silicon single crystal was studied with an X-ray coherent beam.

The Beam We have used the (333) Bragg peak and 2 μm square slits to select a large enough volume of coherence at 9 Kev.

Detection For the imaging of the shape of the Bragg peaks, we have used a direct-illumination CCD with a 22 μm resolution, at a 1.25 m distance.

slit diffraction We have observed the frauenhofer fringes from the 2 μm slits (see figure) and this provides a check of the stability of the setup and of the quality of the slits, which is an important parameter for future quantitative calculations.

Sample A Si crystal of (202) orientation was obtained by the Czochralski method, containing about 10^{18} Oxygen atoms/cm^3 was annealed 35 hours at 1050 C. After this heat treatment, oxygen atoms form "Franck loops" in (111) planes, surrounded by dislocations. These could be observed by topograms obtained at the ID19 beamline.

Observation of distorted regions The lattice distorsion in the vicinity of a dislocation of $\vec{B}$ Burgers vector can be observed with a Bragg peak $\vec{G}$ provided that $\vec{G}\vec{B} \neq 0$. An exploration of the surface of the sample showed distorted regions in the vicinity of lines, which were oxigen-rich planes of Franck loops, and these lines ended with strongly distorted regions corresponding to dislocations. These were observed with a point detector and the intensty increase or the rotation of the diffracting planes could be observed by simply scanning our 2 μm beam across the sample.

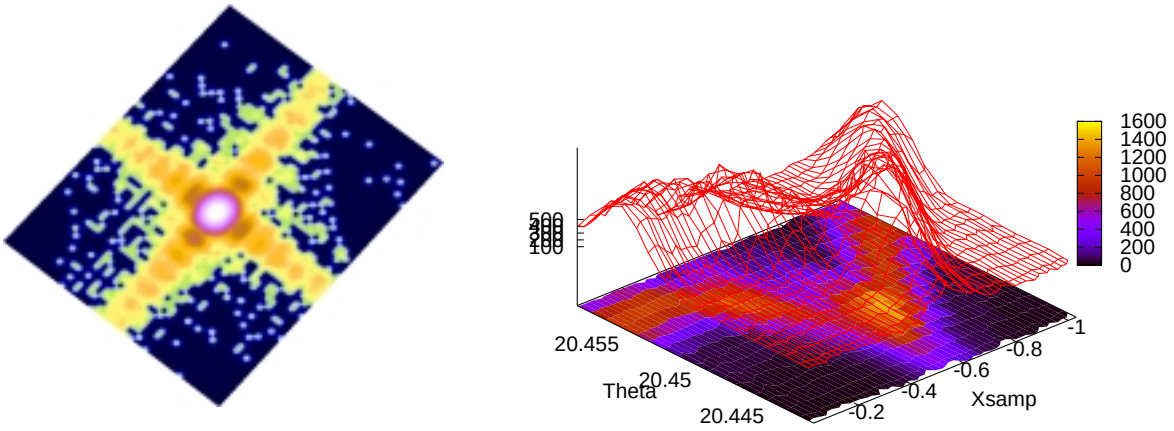

Fig. 1-*Coherent diffraction from slits and distorsion in the vicinity of a dislocation observed at a* 202 *Bragg peak*

The coherent scattered intensity from the Bragg peak in the vicinity of a dislocation has been studied, and a typical split of the Bragg intensity is observed.

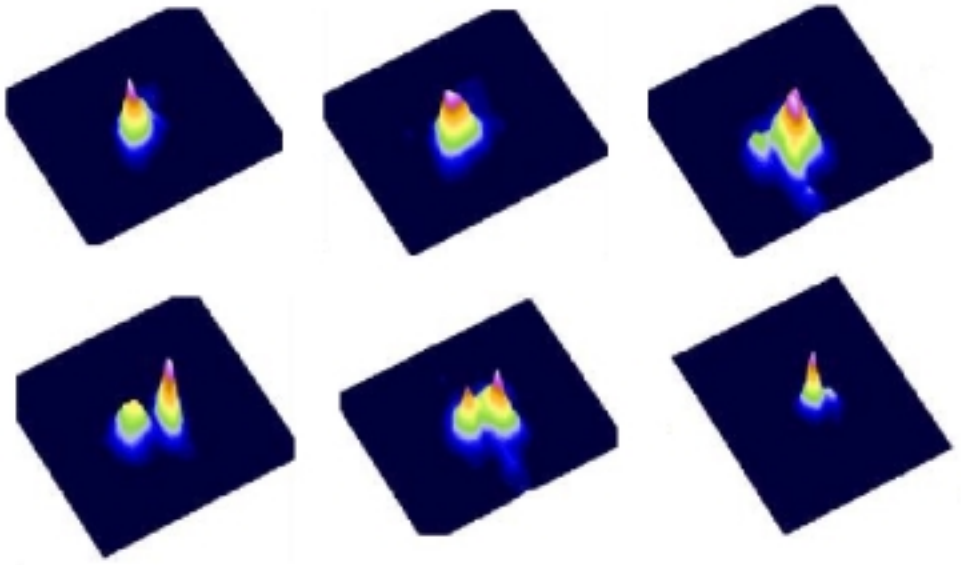

Fig. 2-*Observation of the double Bragg peak at the position of the dislocation*

The observed splitting of the Bragg peak when an individual dislocation is in the observed area can be predicted from the phase change introduced in the diffracting planes around the dislocation centre. In this experiment, the slits to sample distance is of the order of the near field/far field limit $(\phi^2/\lambda) \simeq 3$ cm, and the full modelisation of the scattered amplitude is difficult.

Reference:

V. Jacques, F. Livet, F. Picca, G. Rolland and D Lebolloc'h; Coherence 2007, June 25-28, Asimolar Conf. Center Ca, USA