Coherent scattering by isolated dislocations in a Si single crystal

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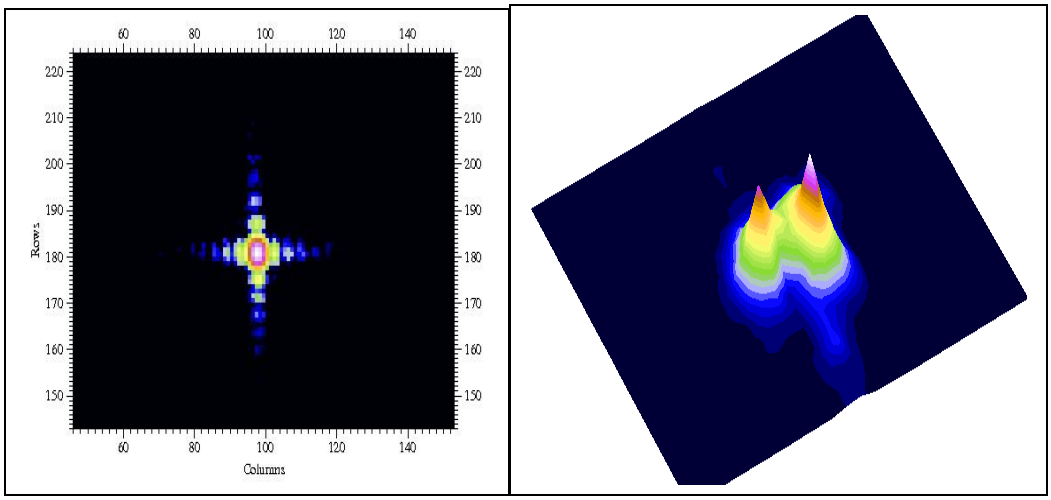
Coherent X-ray scattering opens the possibility of studying crystal defects of a "mesoscopic" extension, like dislocations, subgrain boundaries... As the beam extension is of the order of a few microns, first studies have to be carried out in systems with individual isolated defects. Silicon single crystals have a highly perfect lattice, with a very low amount of dislocations.

A float-zone single crystal has been studied, where oxygen inclusions have precipitated in Frank loops with a diameter of the order of 0.1 millimeter. A topographic study of this sample showed that Frank loops were of suitable size and concentration. X-ray coherent scattering experiment were performed at the BM2 beamline of the ESRF. A high degree of transverse coherence was obtained in a beam of 2 microns diameter by using carefully polished precision slits. As silicon is a light element, the penetration depth of x-rays is of the order of 10 microns, and the Si333 bragg diffraction of the monochromator was used for improving the longitudinal coherence length to the micron scale, in order to observe interferences in the diffracted beam.

In the vicinity of the distorsion induced by a dislocation, the change in the shape of the Bragg peak has been observed, and a typical double peak was observed close to the dislocation core. The general shape of the observed peak profile is nevertheless difficult to interpret, and needs some further modelisation.



a) b)

Figure 1: *a) Diffraction from 2x2µm slits; b) double peak observed at the dislocation core.*