ESRF

Experiment title:
Visualisation of dislocations by depolarisation of x-ray radiation in the micrometer scale

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HS 1187

Beamline:
ID 22

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Report:

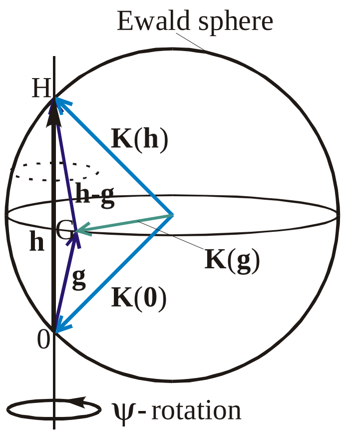

Fig. 1: three-beam case in the reciprocal space

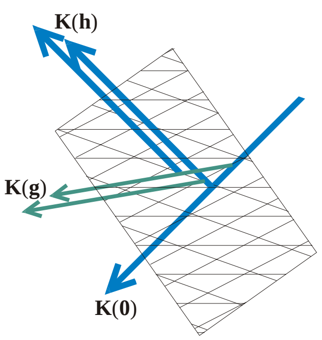

Fig. 2: three-beam case in the real space

The purpose of this experiment was the visualisation of dislocations and stacking faults by X-ray topography dependent on the polarisation using a deflection of 90°. Therefore a diffraction in the plane perpendicular to the plane of the polarisation vector of the incoming synchrotron beam as well as a diffraction in the plane parallel to it was used. In the latter case no intensity should be observed because of polarisation obliteration due to the law of Brewster. But when exciting a non coplanar three beam case an intensity transfer in a direction parallel to the plane of the polarisation vector of the incoming synchrotron beam could be possible. In this instance three wave fields **K**(**0**), **K**(**h**), **K**(**g**) exist simultaneously inside the crystal. If the diffraction plane spread out by **K**(**0**) and **K**(**h**) is parallel to the polarisation plane of **K**(**0**), intensity diffracted into the direction of **K**(**h**) is obtained due to a wave which is diffracted at **g** and afterwards at **h**-**g** (Umweg wave). For the systematical investigation of such a case, a Ψ - rotation (a rotation around the primary diffraction vector **h**) was used. Thus, the distance of the reciprocal lattice point G to the Ewald sphere can be changed independently of H.

For the comparison of the polarisation dependent effects we depicted the same area of the crystal in the two beam and the three beam case in two different geometries with the diffraction plane perpendicular and parallel to the polarisation vector of the incoming beam.

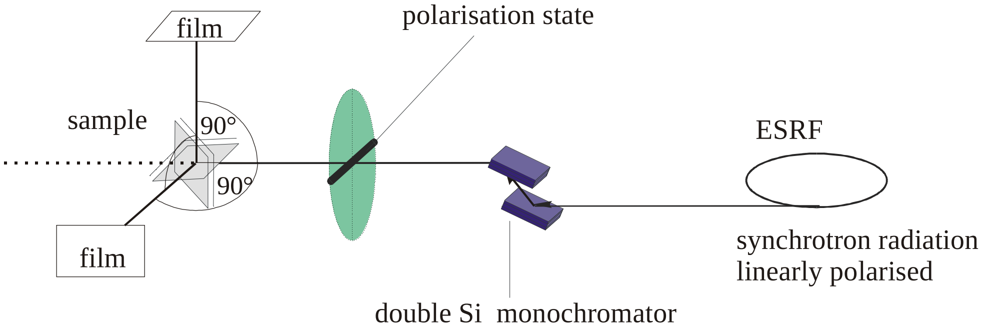

Figure 3: experimental arrangement

With this experimental setup we took series of topographs in both positions (σ and π). The excited netplane was 6 -6 0 which has at the used wavelength of 0.9052Å a Bragg angle of 45.0021°. Additionally the beam was reflected in the many beam case at the 5 -1 -1 netplane. This combination was choosen because of the equal structure factor of **g** and **h-g**. The ψ - position of the crystal was the control parameter. Because of the precise and fast six-circle diffractometer at ID22 we could reach a very good relation between the topograph and the ψ - position.

The result of our experiment shows that in spite of polarisation obliteration topographs image the dislocations and stacking faults if a many beam case is excited. Figure 4 shows two topographs taken at different ψ positions of the three beam case, where the polarisation obliteration is avoided. The small differences between the topographs are caused by the corresponding exciting conditions. The lower intensity on the flank was compensated by a longer exposition time.

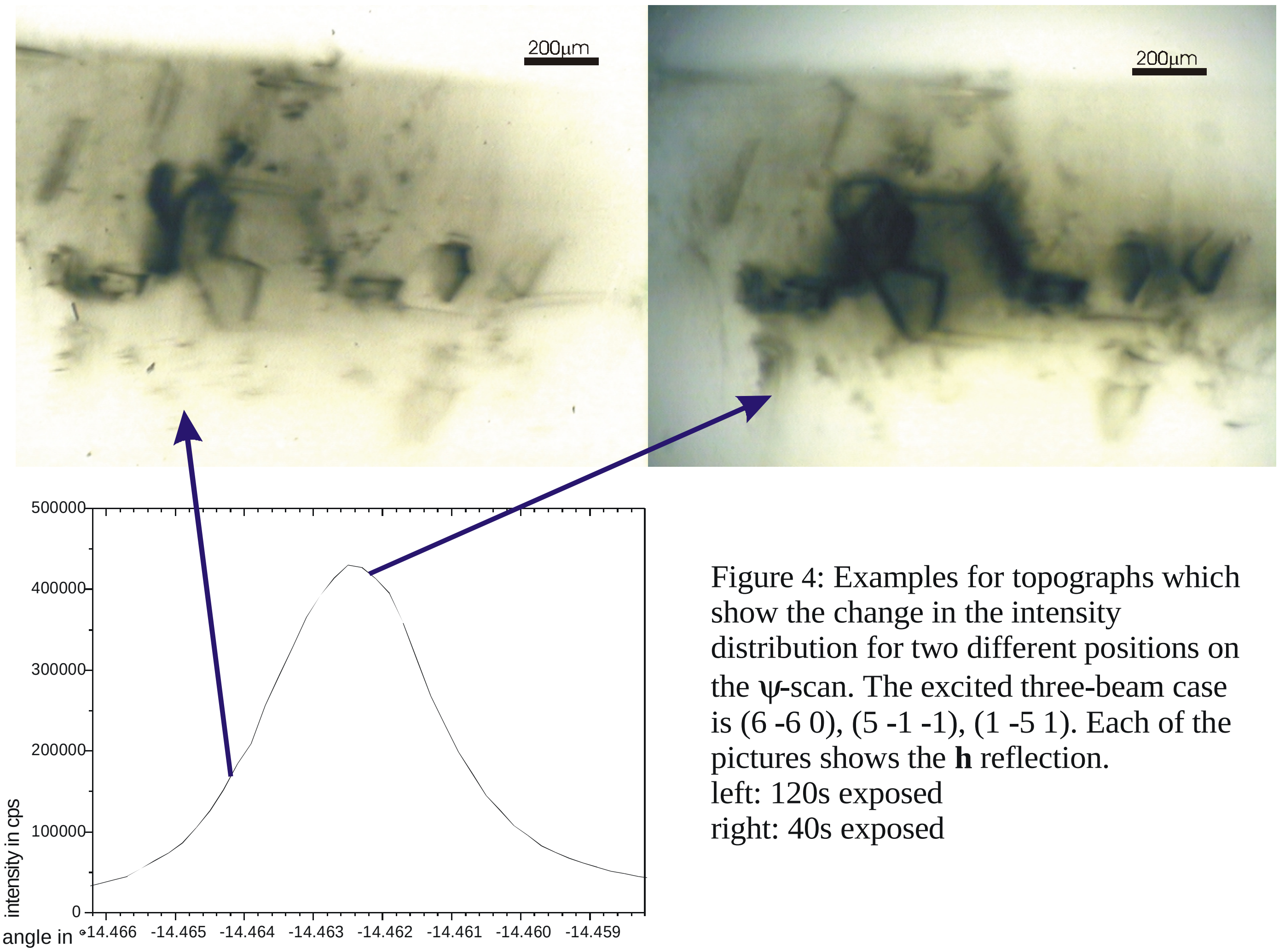

Figure 4: Examples for topographs which show the change in the intensity distribution for two different positions on the ψ-scan. The excited three-beam case is (6 -6 0), (5 -1 -1), (1 -5 1). Each of the pictures shows the **h** reflection.
left: 120s exposed
right: 40s exposed