Crystal quality investigated by X-ray diffraction topography

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X-ray diffraction topography is an imaging technique based on Bragg diffraction. It provides a two-dimensional intensity mapping of the beam(s) diffracted by a crystal. This technique is used for the visualisation of defects (dislocations, twins, domain walls, inclusions, impurity distribution, …) present in the crystal volume. More exactly, it records the long-range distortion fields and/or the strain fields associated with a macroscopic crystal deformation (e.g. bending, "heat bump"). This becomes possible because these distortion fields may affect the diffracted intensity, so give "contrast" (non-homogeneous intensity distribution) in the image. In this way topography is a study of the fine structure of a Bragg spot which contains the information about the departures from the perfect crystal structure, that is the defect structure.

The lecture will give a short introduction into two basic, often used methods – white beam and monochromatic beam topography. Properties like spatial resolution and strain sensitivity will be mentioned. The kind of detectable defects and possibilities for their qualitative and quantitative characterisation will be discussed. The defect structure or "quality" of diamonds that may be tolerated for X-ray optical applications depends strongly on the application itself (monochromators/beam splitter, filters, phase plates/polarisers) and on the application mode – "counting" or "imaging". This question will be shortly discussed on some practical examples.