

3D grain mapping using 3D detector at beamline ID11 at ESRF

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X-ray diffraction can be used to visualise the microstructure of crystalline materials. The 3D-XRD technique [1] provides information about the orientation, position, size and strain of each individual grain within an illuminated area containing many grains. The technique is based on high energy X-rays enabling non destructive characterization of samples of typically mm thickness.

At ID11 we have implemented a “3D detector” consisting of a semi-transparent high resolution detector positioned close to the sample, used in transmission, and a larger area detector with coarser resolution positioned further downstream from the sample, allowing simultaneous image acquisition on both detectors.

From the data collected on the larger area detector the crystallographic orientation and 3-dimensional strain state, as well as the centre of mass of the individual grains and ultimately a full crystallographic description can be determined using software packages ImageD11 [2] and GrainSpotter [3].

3D grain boundary maps (including crystallographic orientations) can be reconstructed from the high resolution detector. The resulting grain boundary map has a resolution of about 5-10 micrometers (currently limited by the detector resolution) [4].

Different grain maps produced using this mapping technique will be shown. Grain maps containing more than 1000 grains have been produced.

References

- [1] Three dimensional X-ray diffraction microscopy, Mapping polycrystals and their dynamics. H F Poulsen (Springer, Berlin, 2004)
- [2] <http://fable.wiki.sourceforge.net/imaged11>
- [3] <http://fable.wiki.sourceforge.net/GrainSpotter>
- [4] <http://fable.wiki.sourceforge.net/GrainSweeper>