«X-Ray Orientation Microscopy using Topo-tomography and multi-mode Diffraction Contrast Tomography»

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Polycrystal orientation mapping techniques based on full-field acquisition schemes like X-ray Diffraction Contrast Tomography and certain other variants of 3D X-Ray Diffraction or near-field High Energy Diffraction Microscopy enable time efficient mapping of 3D grain microstructures. The spatial resolution obtained with this class of monochromatic beam X-ray diffraction imaging approaches remains typically below the ultimate spatial resolution achievable with X-ray imaging detectors.

In this contribution, we propose an approach to improve the spatial resolution of existing full-field grain mapping techniques based on a generalization of the previously introduced 6D reconstruction framework [1, 2] which now includes support for Topo-tomography and allows for joint reconstruction of the orientation field from an arbitrary combination of DCT and TT projections in a common reference frame. This means that the generalized reconstruction framework now provides support for: (a) reconstructing spatially resolved crystal orientation from topo-tomography experiments, (b) combining projection data acquired using different detector positions, rotation axis, pixel resolution and sample tilt settings in the same reconstruction. The combination of limited projection data acquired at high spatial resolution (e.g. Topo-tomography of individual grains or partial DCT data acquired on a high resolution detector) with data acquired at lower spatial resolution can result in significant improvements in the reconstruction quality [3].

If performed on the same instrument, the described technique can be used for pre-characterization of samples studied by DFXM and for rapid alignment of selected grain(s) of interest as a function of grain neighbourhood, grain sub-structure (twins, inclusions) and mosaicity.

References

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