A deep look into polycrystals: X-ray diffraction contrast tomography

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We present here two possible extensions of X-ray microtomography, capable to characterize the shape and the orientation of individual grains in the bulk of *undeformed* polycrystalline materials: (i) diffraction contrast tomography in "topo-tomography" alignment [1] and (ii) diffraction contrast tomography in conventional alignment. In both cases, Bragg diffraction (transmission case) gives rise to an additional contribution to the local attenuation coefficient, which in turn can be exploited by means of analytic or algebraic tomographic reconstruction techniques in order to reconstruct the three dimensional grain outlines. The second approach offers in addition the possibility to determine grain orientations.

The imaging principle and related data analysis strategies will be illustrated for both methods with the help of first experimental data, obtained from a coarse grained Al (1050) multicrystal. A comparison of diffraction contrast tomography with respect to the more widely applicable 3DXRD approach [2] will be given. Based on this, we will discuss possible future developments and applications for combined tomographic imaging and diffraction experiments.

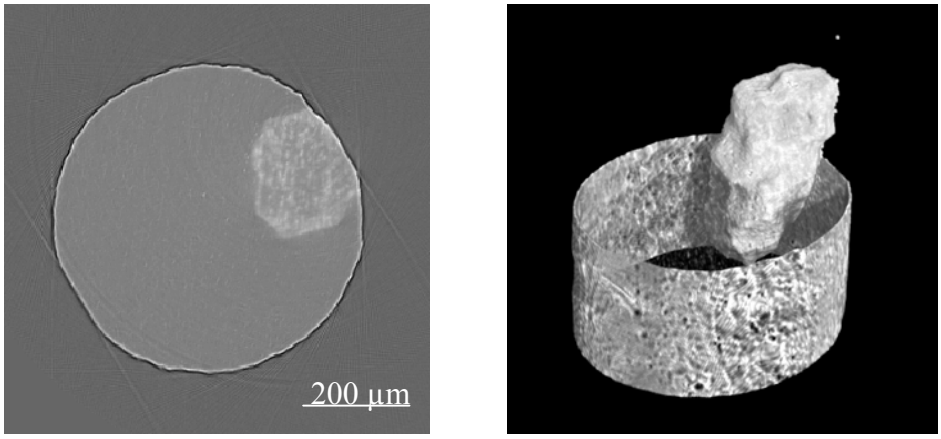

Fig.1: Diffraction contrast tomography (topo-tomo alignment) of an undeformed, coarse grained Al (1050) multicrystal. (a) tomographic slice showing the outline of the cylindrical sample as well as the shape of the diffracting grain with some substructure (inclusions). (b) 3D rendition of the diffracting grain, the Al matrix has been set to transparent.

[1] W. Ludwig et al, J. Appl. Cryst. 34, (2001), p. 602
[2] H.F. Poulsen, Three-dimensional X-ray diffraction microscopy, Springer (2004)