VISUALIZING THE DYNAMICS OF GRAINS AND DISLOCATIONS STRUCTURES

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3D X-Ray Diffraction (3DXRD) microscopy is an emerging tool for fast and non-destructive characterization of the individual grains and sub-grains inside bulk materials [1]. The method is based on diffraction with hard x-rays, enabling 3D studies of millimetre - centimetre thick specimens. Ray tracing with several detectors is applied. The position, morphology, orientation, and elastic strain can be derived for hundreds of diffracting units (grains or sub-grains) simultaneously. Notably, the method is sufficiently fast for in situ characterization of typical processing steps such as annealing or deformation.

In this talk focus is on recent results within two areas:

- By applying tomographic reconstruction principles, 3D grain maps can be derived. New algorithms are presented which extend the application of such methods also to maps of deformed specimens [2]. First results for dynamic studies of recrystallisation [3] and grain growth are summarized.

- “Ultra-high resolution 3DXRD” is a technique which enables 3D reciprocal maps to be derived of individual deeply embedded dislocation structures. With a resolution of 0.0005 Å⁻¹, in favorable conditions, individual dislocations can be probed. First results obtained during tensile deformation revealed unexpected intermittent dynamics of the dislocation structures in pure Cu [4].

The work presented was obtained in collaboration with
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APS: J. Almer, U. Lienert, S.D. Shastri
City University of New York: A. Alpers, G. Herman, L. Rodek

References: