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Abstract of presentation

Title

3D and 4D sub-grain mapping of lattice strains and orientations in polycrystals using Diffraction Contrast Tomography (DCT)

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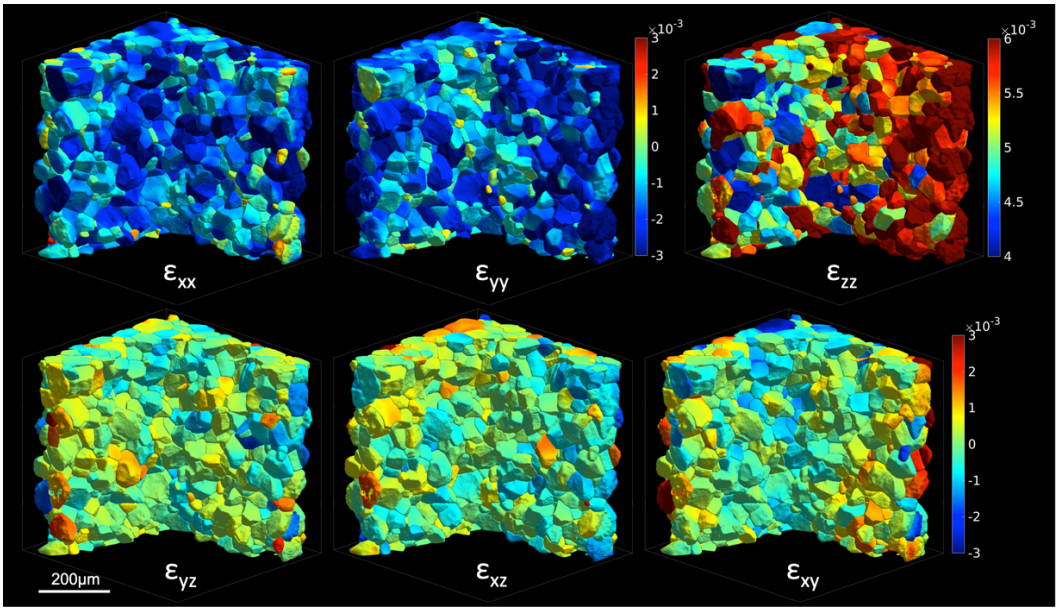
Abstract

We demonstrate the capability of efficiently mapping the complete local strain and orientation tensor field at the sub-grain level in three dimensions inside a polycrystal, in a non-destructive way.

Diffraction Contract Tomography can provide detailed 3D grain maps of moderately deformed polycrystals at the micrometre scale, utilising high-energy, monochromatic synchrotron X-rays. Using full-beam illumination and a single sample rotation enables fast and efficient scans, although it poses a limitation on grain mosaicity. The ESRF source upgrade will bring scanning times of the order of tens of minutes in in-situ experiments within reach.

The highly convoluted experimental data pose a large-scale, 12-dimensional, ill-posed, non-linear reconstruction problem. A forward model and iterative solver has been developed to infer the grain shapes, sub-grain orientation and strain fields with a potential sensitivity in the range 10^{-4} to 10^{-3}. Furthermore, the single-crystal elastic moduli of the material are fitted from the strain data.

The data acquisition and processing method, and experimental validation on a Gum metal sample under tensile load will be discussed.



Reischig & Ludwig, Current Opinion in Solid State & Materials Science, 24 (2020) 100851