INV-31

Local structure determination in polycrystalline materials using high energy synchrotron radiation

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We have developed techniques for determination of the local structure: strain, texture, grain, orientation, structural phase, etc., within the bulk of cm-sized specimens. The spatial resolution is currently of order 10-100 μm. With typical energies of 80 keV, we use broad-band angle-dispersive methods, on-line 2D detectors and conical slit systems. Characterization is done at the level of the individual grains and grain-boundaries as well as on ensembles of grains.

The techniques are of major interest for metallurgical applications where processing and functionality requires the use of large specimens, and where *in-situ* studies in complicated sample environments often is called for (industrial process-optimization).

We present four examples of applications:

1. Three-dimensional mappings of the residual stresses around inclusions in metal matrix composites (accuracy of $\Delta\varepsilon \leq 5 \bullet 10^{-5}$).
2. Pilot experiments within the field of recrystallization showing the possibility for monitoring the growth of the individual grains during the early stage and for performing three-dimensional maps of the grain boundary topology in the late stage.
3. *In-situ* measurements of the phase transformations and texture developments during synthesis of Bi-2223/Ag superconducting tapes.
4. Studies of the structural changes within buried layers, such as the electrolyte in solid oxide fuel cells under operational conditions.