

## X-ray Laue Diffraction 3D Microscopy

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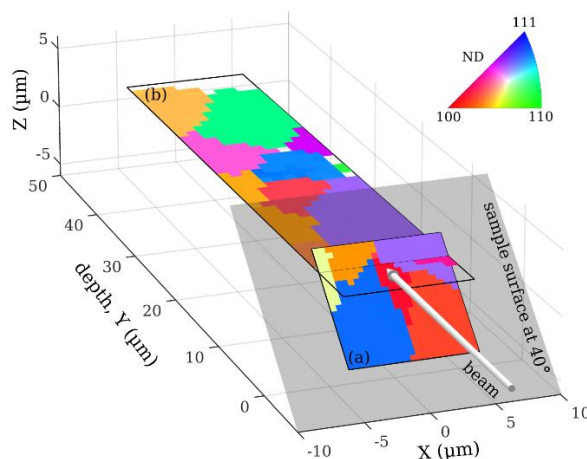
Laue microdiffraction is a powerful and widely-used technique for spatially-resolved characterization of crystalline microstructures [1]. Using a white micro-focused X-ray beam from a synchrotron source, it allows mapping orientation and elastic strain fields with a spatial resolution down to 100 nm and an angular resolution as good as  $10^{-4}$ , which allows for detailed investigations of crystal-related phenomena, such as plastic deformation and damage.

The classical analysis of Laue patterns provides in practice surface information that integrates the intensity diffracted all along the penetration course of the incident beam. Therefore, the 3D Laue microdiffraction, or « Differential Aperture X-Ray Microscopy » [2], was proposed to resolve this dimension along the beam with a submicron resolution and get from “2D” to spatially 3D characterizations. To this end, an absorbing wire placed between the sample and the detector is used to scan the sample surface in micron steps and gradually mask portions of the scattered spots. Analyses of the intensity variations between successive images, combined with geometrical considerations, allow then to reconstruct the scattered intensity profiles as a function of depth below the sample surface.

Such a 3D imaging instrument is now available to the users of the CRG-IF BM32 beamline at ESRF (cf Figure). This was achieved in the last years, thanks to improvements of calibration and reconstruction algorithms, the development of a software package for complete data treatment and the recent commissioning of a faster camera. Here, we describe these advances and illustrate with a few examples the perspectives offered by this technique.

[1] Ulrich O., Biquard X., Bleuet P., Geaymond O., Gergaud P., Micha J.S., Robach O. and Rieutord F, *Rev. Sci. Instr.*, **2011**, 82.

[2] B.C. Larson, W. Yang, G.E. Ice, J.D. Budai et J.Z. Tischler, *Nature*, **2002**, 415.



**Figure:** Polycrystalline thin film of yttria-stabilized zirconia: (a)  $\mu$ Laue orientation map of sample surface tilted at  $40^\circ$  and (b) depth reconstruction by 3D- $\mu$ Laue. Inverse pole figure coloring.