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ID03, the New Hard X-ray Microscopy Beamline at the ESRF

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The newly built beamline ID03 specializes in hard x-ray microscopy. The main technique offered is dark field x-ray microscopy (DFXM), as pioneered on the prototype instrument on ID06-HXM.

DFXM is a combination of x-ray topography and full field microscopy, where an x-ray objective lens is placed in the Bragg diffracted beam between the sample and a high resolution detector. The magnified image has an effective resolution of approximately 150 nm and is sensitive to minute variations of the crystal lattice, such as strain fields, dislocations, domains formed by phase transitions, etc. The technique can be applied to a wide range of materials, ranging from structural materials such as metals and alloys to functional materials such as ferroelectrics to biominerals.

ID03 was designed from the ground up to offer the best experimental conditions for DFXM with photon energies ranging from 12 to 60 keV. The source device is a latest-generation cryogenically cooled permanent magnet undulator (CPMU) with period 16 mm and a minimum gap of 5 mm (a future upgrade to 4 mm is planned). Most of the head load from this device is absorbed in the Front End. The first optical element is a multilayer monochromator, which receives up to 3.6 kW in a 2(h) x 1(v) mm² white beam. This is followed by a diagnostics module and Si(111) channel cut monochromator that can be used optionally (i.e. experiments can be carried out with pink (bandwidth $\approx 10^{-2}$) or monochromatic (bandwidth $\approx 10^{-4}$) beam. The beam can be pre-focused by a transfocator equipped with diamond refractive lenses.

The experimental station was transferred from ID06-HXM. However, it is now housed in a hutch that is temperature controlled to $\pm 0.1^{\circ}$ C. The goniometer was upgraded to a geometry optimized for 'topo-tomo' scans that can be reconstructed into a volume map of the strain fields within the sample.

The beamline started user operation in April 2024 and is open for user proposals via the ESRF general user programme.

I plan to submit also conference proceedings

Yes

Primary author: DETLEFS, Carsten (European Synchrotron Radiation Facility)

Presenter: DETLEFS, Carsten (European Synchrotron Radiation Facility)

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