Synchrotron Laminography for Multimodal, Hierarchical, and in situ 3D Imaging

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In collaboration with DESY and ESRF, KIT has substantially expanded its computed laminography (CL) instrument portfolio by refurbishing ID19 beamline's LAMINO I station at ESRF, constructing the new LAMINO II station at the IMAGE beamline at the KIT Light Source, and commissioning the laminography mode at the new HIKA station at PETRA III's P23 beamline. CL enables the three-dimensional imaging of laterally extended specimens that may vastly exceed the detector field of view. The instruments take advantage of the specific properties of their respective storage rings and beamline optics to offer a variety of contrast mechanisms, energy ranges, band-widths, fields of view, and spatial resolutions.

With continuous development driven by new applications, today these instruments enable hierarchical, non-destructive imaging workflows ranging from large-area screening to local high-resolution investigations, extending to nanoscale resolution by combining CL with magnified projection microscopy [1]. Online reconstruction and volume stitching further allow immediate inspection, e.g., for quality assurance or region-of-interest identification. The integration of dedicated sample environments for mechanical loading, stress testing, and operando device characterization, together with correlative techniques like optical microscopy, enable in situ and operando studies of dynamic processes under application-relevant conditions through multimodal approaches across multiple length scales.

Here, we will present our current capabilities of hierarchical large-area CL for the investigation of plate-shaped fossils. Moreover, we will show the recent progress in multimodal and correlative studies of metal-sheet deformation [2], operando investigations of battery degradation during cycling [3], and monitoring battery failure in simulated crash scenarios using a dedicated indentation chamber [4].

References

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[2] Hurst et al., Particle-induced void growth under shear loading revealed by 3D X-ray laminography and finite element modelling, Int. J. Plast., accepted, 2026
[3] Du et al., 3D hierarchical characterisation of degradation and failure in all-solid-state-battery by synchrotron X-ray computed laminography, under review, 2026
[4] Tancogne-Dejean et al., Fracture is not enough: interlayer destabilization drives battery short circuits under mechanical abuse, under review,2026