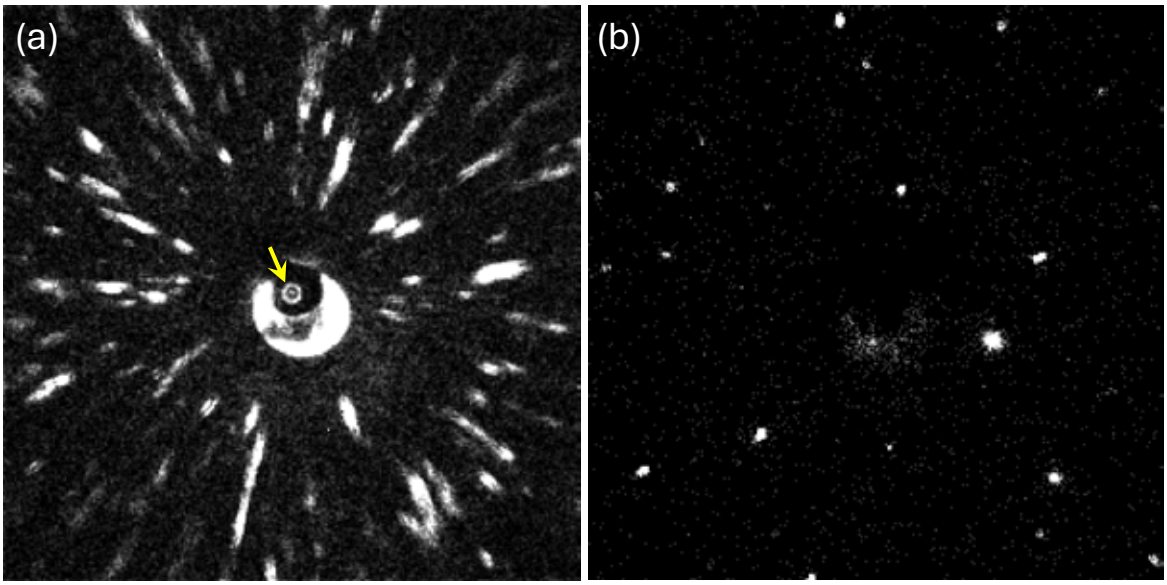
Highlight

# Laboratory 3D X-ray micro-beam diffraction – now patented




Lab3DμXRD images from (a) as-printed AlSi10Mg alloy and (b) a Si single crystal collected using a photon counting detector (Advacam s.r.o., 256×256 pixels and 55 μm/pixel). The ring feature marked by the yellow arrow in (a) is the footprint of the direct focused beam penetrating the beamstop, while the large bright area at the central region is from a leakage of the direct beam through the pinhole in the shielding. The higher background level in (a) than (b) is the result of longer exposure time, 20 s versus 1 s.

The development of 3D non-destructive X-ray characterization techniques in home laboratories is essential for establishing 3D characterization as a new standard for materials research. Recent advancements have focused on techniques such as laboratory diffraction contrast tomography (LabDCT), which allows for the 3D characterization of fully recrystallized materials with grain size larger than 15 μm, achieving a spatial resolution of 5 μm using commercial X-ray CT systems. To further enhance the capabilities of laboratory-based instruments, we have invented a new method and filed a patent: Laboratory-based 3D scanning X-ray Laue Microdiffraction system and method (Lab-3DμXRD), which has now been granted in the USA under patent number WO2022013127.

In collaboration with Xnovo Technology A/S (Denmark), we have established a Lab-3DμXRD setup, using a conventional X-ray CT system and newly developed Pt-coated twin paraboloidal capillary X-ray optics. We have successfully demonstrated the feasibility of the methodology, and by incorporating a state-of-the-art photon counting detector, we have managed to characterize small grains (~5 μm) and additively manufactured materials, which are particularly challenging because of their high content of defects (see figure above).

For further reading, please see:

Y. Zhang, M. Defer, W. Liu, E. F. F. Knipschildt-Okkels, J. Oddershede, A. Slyamov, F. Bachmann, E. Lauridsen, and D. Juul Jensen (2024). Challenges in characterizing additively manufactured AlSi10Mg using X-ray Laue micro-beam diffraction. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1310, p. 012034). IOP Publishing.