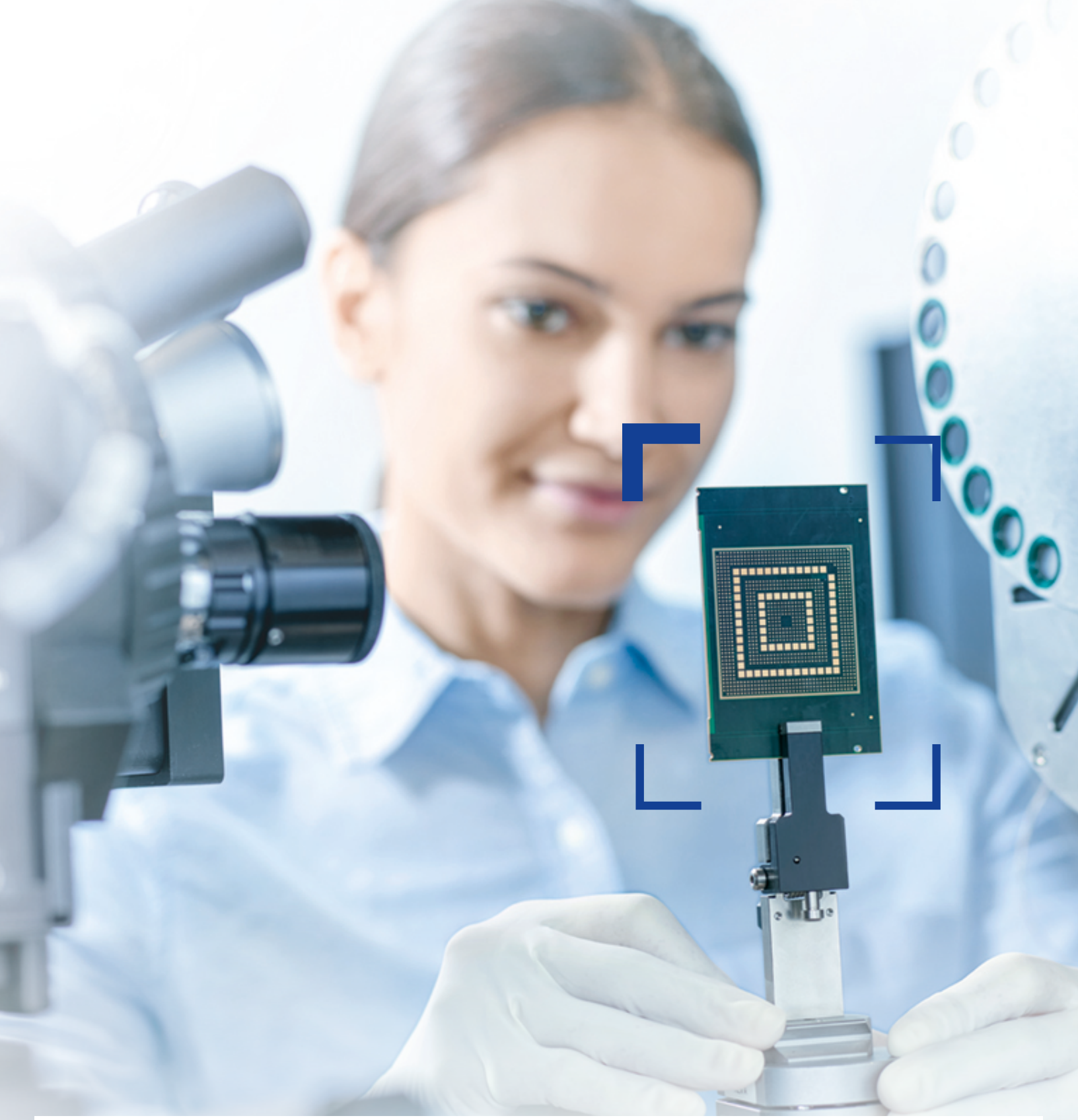


ZEISS Xradia Versa 3D X-ray Microscope

Accelerate Failure Analysis and Process Development for Next-generation Electronics

zeiss.com/xrm

Seeing beyond

Accelerate Failure Analysis and Process Development for Next-generation Electronics

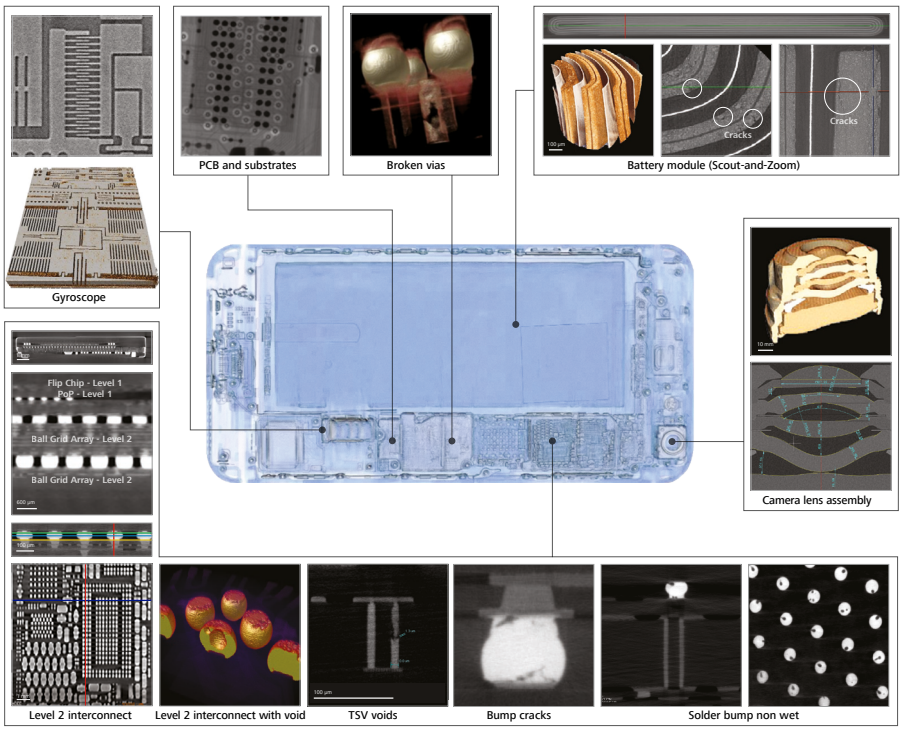
Advances in electronics and semiconductor packaging are fueled by consumer demands for greater bandwidth and lower cost in response to market trends of 5G, AI, big data, and autonomous vehicles. The growing adoption of advanced packages to increase the interconnect density results in complex package architectures, new manufacturing challenges, and risks of failures. Furthermore, since the physical fault region is often buried within these complex 3D architectures, conventional methods for visualizing failure locations are becoming less effective. New techniques are required to isolate and determine the root cause of failures whether they occur in packages, batteries, or other electronic components.

ZEISS Xradia Versa 3D X-ray microscopes (XRM) are an effective solution for non-destructive visualization and characterization of submicron defects buried within intact 3D packages.

Highest Resolution and Imaging Quality for the Broadest Range of Applications

Xradia Versa has become the industry standard for non-destructive 3D imaging failure analysis and device characterization. The unique detector design of Versa provide high resolution even for large working distances, enabling analysis of intact samples in a broad range of applications.

- Perform structural and failure analysis for process development, yield improvement, and construction analysis of electronic components, consumer devices, and 2.5/3D and other advanced semiconductor packages.
- Non-destructively image fully intact samples with submicron resolution for characterization of defects faster than conventional physical cross sectioning.
- Capture insights about defect locations and their distribution by viewing unlimited virtual cross sections from any desired angle throughout an entire 3D volume.



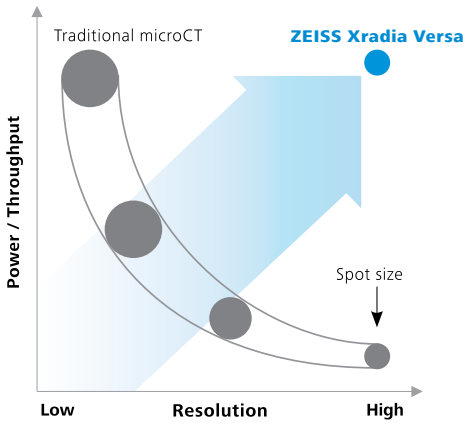
Versa XRM 3D images and virtual cross sections of defects deeply buried in a smartphones.

X-ray Microscopy Enables Highest Resolution with Fast Data Acquisition

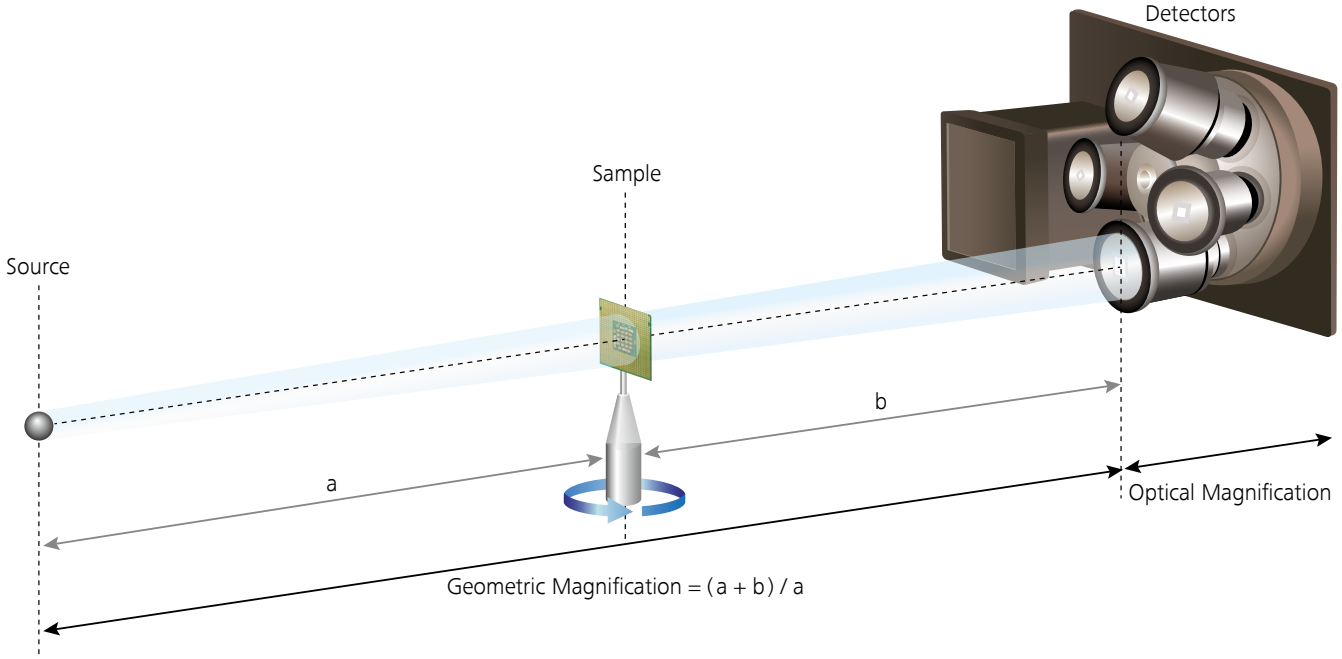
ZEISS Xradia Versa 3D XRM use uniquely designed and patented X-ray detectors and microscope objectives to provide 500 nm spatial resolution with minimum achievable voxels of 40 nm.

Xradia Versa detector technology uses optical magnification combined with geometric magnification to achieve unparalleled resolution even for large intact samples. This patented two-stage magnification technique enables high Resolution at a Distance (RaaD) which is required for imaging large samples.

Xradia Versa extends the boundaries of 3D submicron-resolution imaging. It enables fast data acquisition while maintaining resolution across the full energy and power range. With fast source activation, high spatial resolution, and enhanced contrast-to-noise ratio, Xradia Versa excels in structural and failure analysis, process development, yield improvement, and construction analysis. In addition, the stable, long-life source enables maximum uptime, consistent and optimized image quality, and high success rates for defect visualization.



Xradia Versa achieves highest resolution while maintaining fast scan times.



Xradia Versa scintillator-coupled optical detectors enable high resolution and contrast at long working distances.

Equipped with Flexible Application Modules

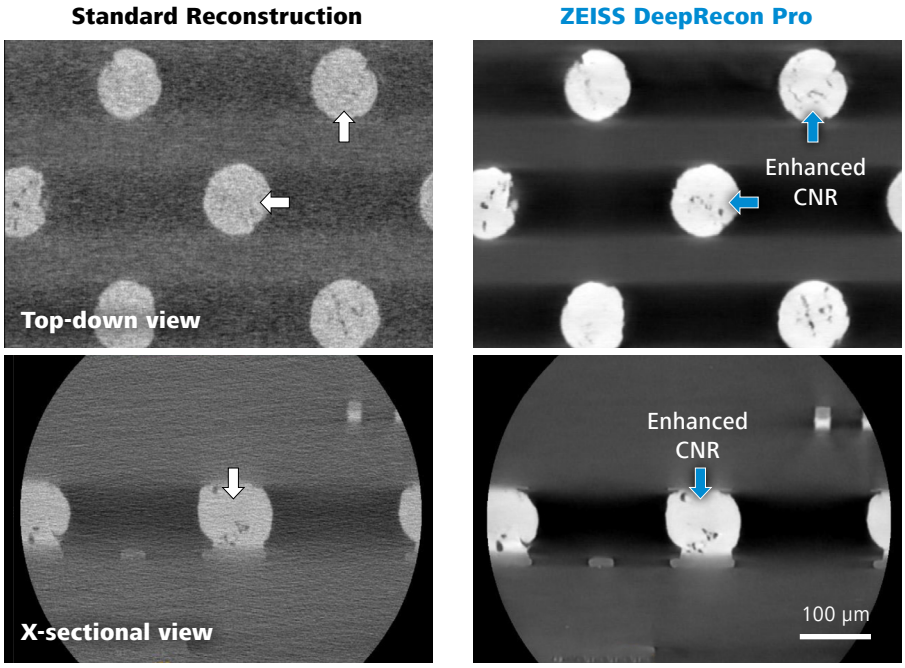
ZEISS Xradia Versa expands its industry-leading performance with optional modules for advanced reconstruction and inspection and measurement.

Advanced Reconstruction Solutions

ZEISS Advanced Reconstruction Toolbox includes two reconstructions solutions – ZEISS DeepRecon Pro and ZEISS OptiRecon. These solutions improve scan speed and image quality for the diverse range of sample types commonly found in electronics packaging.

ZEISS DeepRecon Pro Module

ZEISS DeepRecon Pro implements a new deep-learning reconstruction technology powered by artificial intelligence (AI). DeepRecon Pro enables up to 4X faster scans while preserving ZEISS's unique image quality advantages. In addition, DeepRecon Pro delivers superior data quality by substantially improving image contrast-to-noise ratio and reducing the aliasing artifacts common in the traditional Feldkamp-Davis-Kress (FDK) reconstruction method. The seamlessly integrated one-click network training solution allows user to generate deep-learning network models without the need for a machine-learning expert. Users can build their own network model library (with unlimited number of network models) to fit a broad range of workflows used in electronics failure analysis and packaging process development.



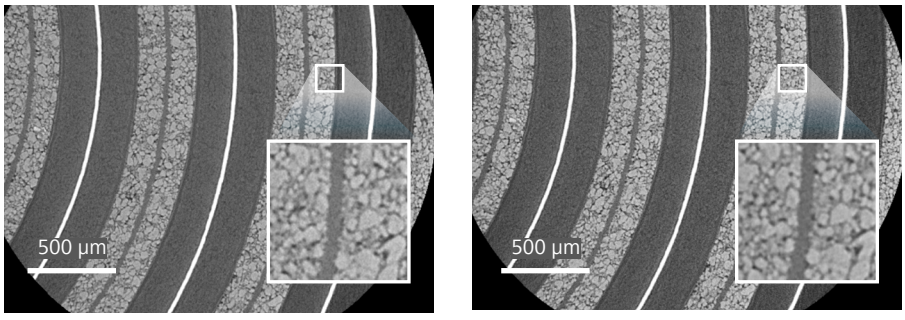
300 projections
Scan time: 30 minutes

300 projections
Scan time: 30 minutes

DeepRecon Pro for electronics failure analysis workflows: Superior image quality for electronics packages.

ZEISS OptiRecon Module

ZEISS OptiRecon enables significantly faster 3D X-ray image acquisition through an image reconstruction algorithm known as iterative reconstruction. OptiRecon provides up to 2X faster scan times, boosts productivity and image quality, and aids faster understanding of processes and defects. It is well-suited for failure analysis and development across a wide variety of electronic and semiconductor applications.



4501 projections
24 hour scan time

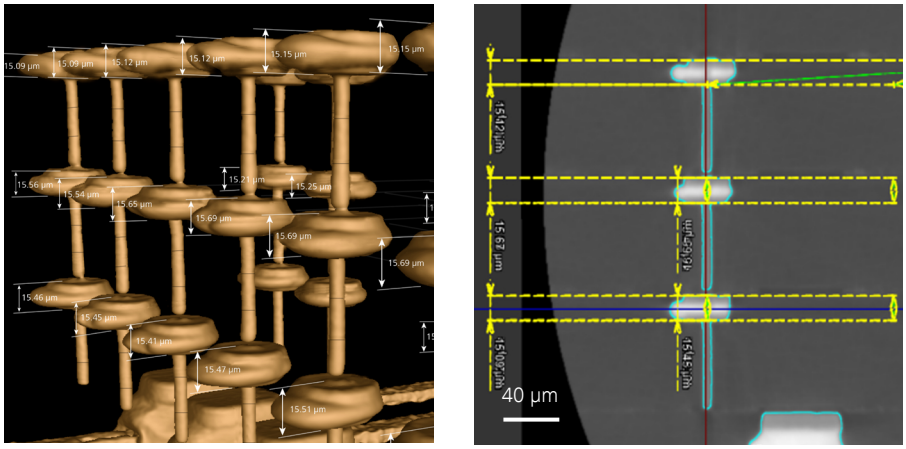
2251 projections
12 hour scan time

OptiRecon improves 3D X-ray image quality and increases scan speeds by 2X on a commercial smart watch battery.

Inspection and Measurement

ZEISS Xradia Versa RepScan

RepScan is a submicron-resolution, 3D non-destructive imaging solution for inspection and measurement that accelerates time to market for advanced IC packages. Using 3D XRM with RaaD technology and sophisticated analytical software, RepScan provides rich volumetric and linear measurements of buried features in the most advanced semiconductor packages. This cannot be achieved with existing methods such as physical cross sections, 2D X-ray, and conventional microCT. RepScan generates higher-accuracy engineering data that can be used to speed learning cycles and reduce package development times.



Xradia Versa RepScan results show bond line thickness measurements through stacked dies for a HBM device. 3D and a virtual slice at 0.7 µm/voxel are shown on the left and right, respectively.

RepScan includes customized sample holders and the ZEISS Autoloader, which are also available as options for Xradia Versa. ZEISS Autoloader reduces the frequency of user interaction and increases productivity by enabling multiple jobs to run unattended.

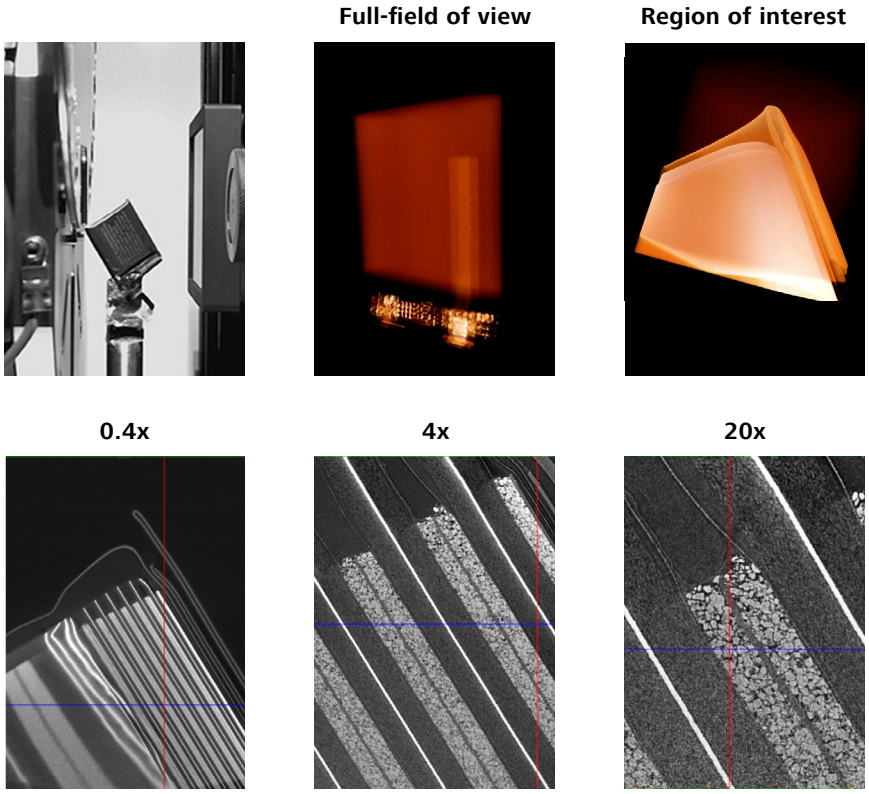
ZEISS Autoloader option enables you to program up to 70 samples at a time to run sequentially.

Other Electronics Applications

Lithium Ion Batteries

The microscopic study of lithium batteries is essential for understanding battery performance, aging effects, and cycling lifetime. Working with an intact battery is a requirement for evaluating electrochemical property variations and underlying failure mechanisms.

ZEISS Xradia Versa 3D XRM enable non-destructive battery studies which reveal critical quality and safety issues over a lifetime of charging and discharging. This allows the user to acquire highest resolutions without the need to disassemble the battery. The figure shows an electronic device battery that was imaged at different length scales using ZEISS XRM RaaD capability.



Xradia Versa X-ray microscopy workflow on imaging and analyzing of a lithium ion battery.

This approach using the non-destructive power of XRM enables:

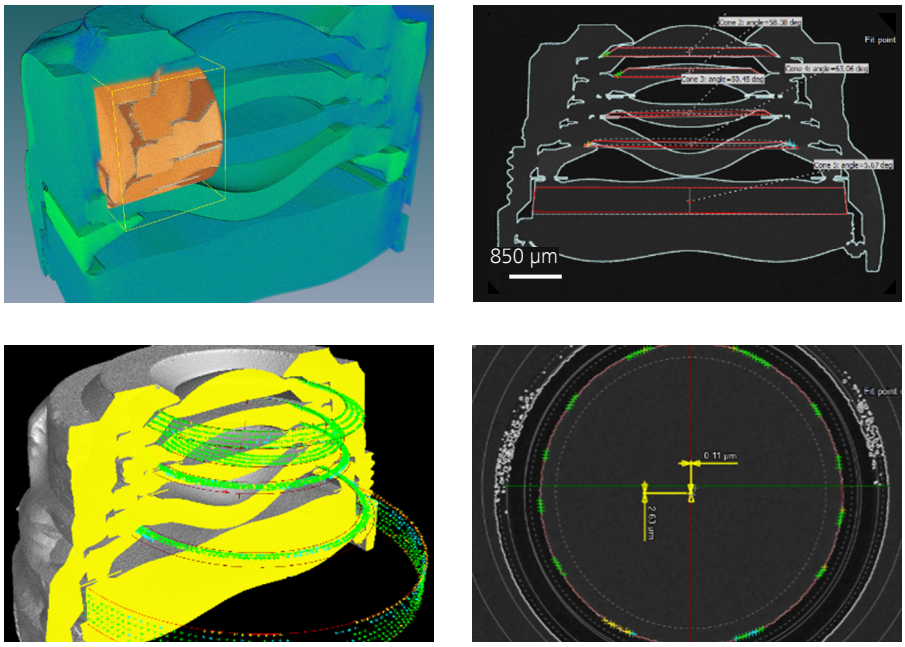
- Longevity studies of aging effects
- Identification of debris, particle formation, burrs at the electrical contact, or damage to the polymer separator
- Inspection of intact samples for effective supplier control, revealing changes in recipe or cost savings that may affect performance or longevity

Smartphone Camera Lenses

The accuracy and precision of the optical path in the camera lens play an important role for camera module packaging and assembly. A ZEISS Xradia Versa 3D XRM workflow measures the critical dimensions of the optical lens assembly found in a smartphone camera module. With the unique RaaD, Xradia Versa can measure critical physical dimensions non-destructively and repeatably, such as:

- Non-destructively characterize lens assembly structures, replacing physical cross sections
- High-resolution interior tomography to visualize and examine structural integrity of the interfaces between lens components
- Generate tomographic dataset for measurements: lens thickness, gap, lens tilt and de-centricity in a highly repeatable workflow

The figure below shows 3D images obtained by Xradia Versa of a camera module optical lens assembly. The high-resolution image (inset) was acquired at 1.5 µm/voxel to focus on the interlock mechanism of lens stacking. The basic construction information such as lens thickness, gap, and 3D parameters like lens tilt and de-centricity were extracted from the full field of view (FFOV) image. Repeatability of <3 µm (6 sigma) was achieved through the repeated measurements of lens tilt and de-center, as well as other important assembly metrics such as lens thickness and gap between layers.



High-resolution tomography images and measurement workflow developed by Xradia Versa X-ray microscopy.

ZEISS X-ray microscopes are designed to be upgradeable with future innovations and developments so that your initial investment is protected. This ensures your microscope's capabilities evolve with technological advancements. New modules are continuously developed that will enhance your instrument to provide new imaging modalities and productivity-enhancing workflows. Periodic software releases enhance and extend the capabilities of your X-ray failure analyses.

Contact us to learn about how X-ray microscopy, related technologies, and correlated workflows with ZEISS Crossbeam Laser FIB-SEM can address your challenging failure analysis needs.

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