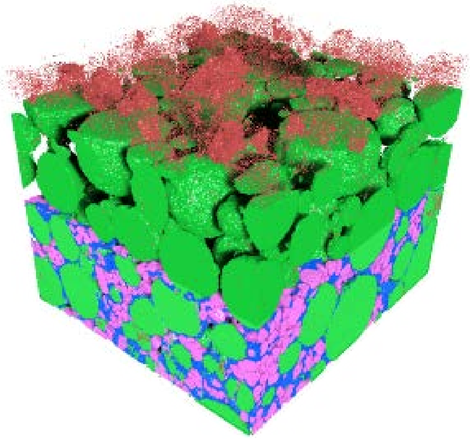
ZEISS eMobility Solutions

Battery Material High Resolution 3D Imaging by FIB

Seeing beyond



Take a closer look →

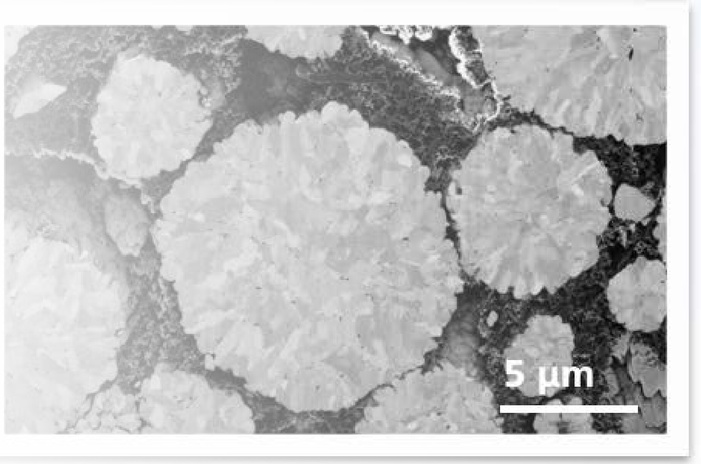
Powerful imaging & superior processing ability

High throughput 3D analysis and sample preparation

Power battery is a crucial component of new energy vehicles (NEV), directly impacting the safety, performance, and production costs of the entire vehicle. Comprising primarily of cathode and anode materials, separators, electrolytes, the development direction of batteries primarily revolves around the exploration of cathode and anode materials that offer high specific capacity, superior safety, low cost, and environmental friendliness.

To develop new-generation battery materials, a series of characterizations and analyses must be conducted throughout the research and development (R&D) process. ZEISS provides Focused Ion Beam-Scanning Electron Microscope (FIB-SEM) as research tools for battery microstructure analysis.

> Learn more about the process and applications



In-depth explore 3D structures

Evaluation with FIB-SEM & Laser-FIB

The battery production process encompasses material R&D, the electrode manufacturing, cell assembly, and module packaging. Among these steps, the quality of battery materials, including three-dimensional (3D) structure of materials, pore connectivity and other structural characteristics, is directly linked to the overall vehicle performance and safety. We can utilize the high-resolution FIB method to first obtain two-dimensional (2D) continuous slices of battery materials, and conduct 3D reconstruction to acquire the 3D volume data of the materials. In addition, femtosecond laser FIB can also help us quickly cut the specific area, significantly improving the efficiency of sample preparation.

Battery production process →

R&D and production process evolution of NEV battery

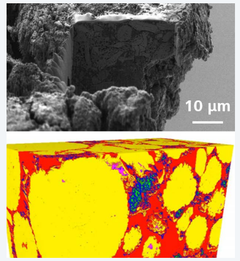
Step 1
New material demand

It is necessary to develop new battery materials with enhanced electrochemical performance, higher safety, and cost-effectiveness to fulfill societal demands.

Step 2
Material synthetic methods

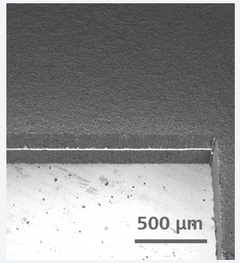
Step 3
Single material evaluation

FIB-SEM & Laser-FIB



FIB-SEM

1. Cross-sectioning
2. FIB-SEM tomography
3. 3D analytics
4. TEM sample preparation



Laser-FIB

1. Laser-assisted sample preparation
2. Sample-in-volume analysis

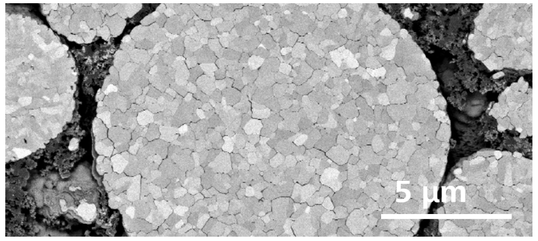
Step 4
Small cell performance

Step 5
NEV cell performance

Step 6
Commercialization

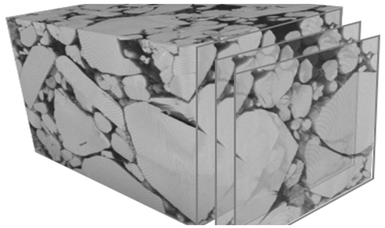
> See more details of the application areas

Application areas of FIB



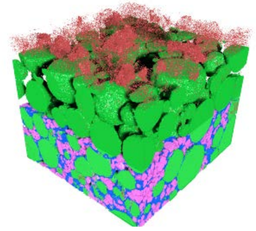
Cross-sectioning

- Acquire high resolution images of cross-sections to obtain sub-surface information



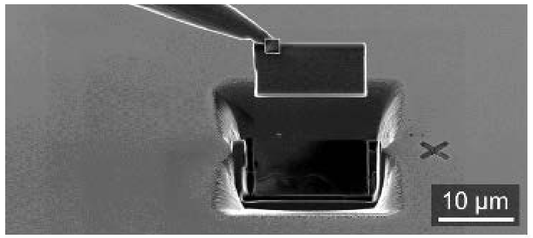
FIB-SEM tomography

- Perform serial cross-sectioning to image and reconstruct volumes of the sample



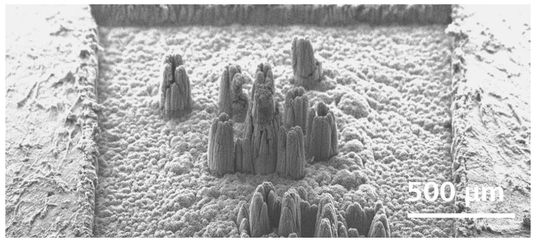
3D analytics

- Study the chemical and crystallographic microstructure of the sample



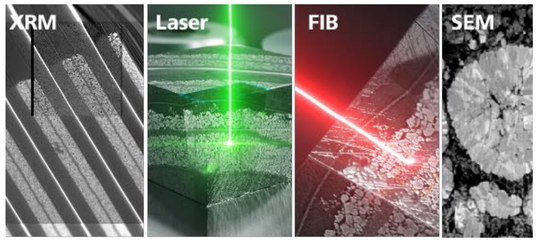
TEM sample preparation

- Prepare thin lamellae for their analysis in TEM or STEM



Laser-assisted sample preparation

- Prepare large area samples rapidly with laser assistance

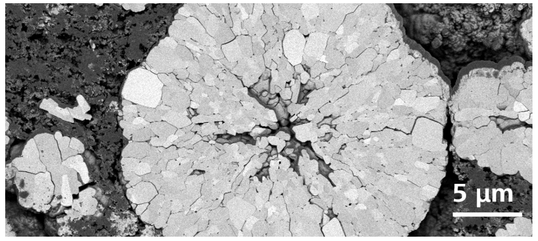


Sample-in-volume analysis

- Carry out multi-scale correlative workflow: 3D X-Ray microscope (XRM) and laser-FIB correlation

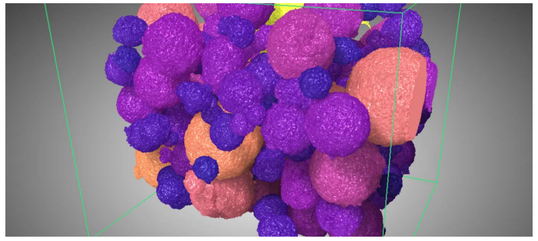
> Have a look into the value proposition

Value proposition of ZEISS solution



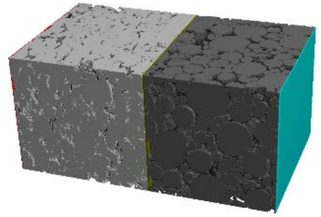
Excellent imaging results

- High imaging resolution and signal-to-noise ratio up to very low accelerating voltages
- Trackable voxel sizes and automated routines for active control of image quality



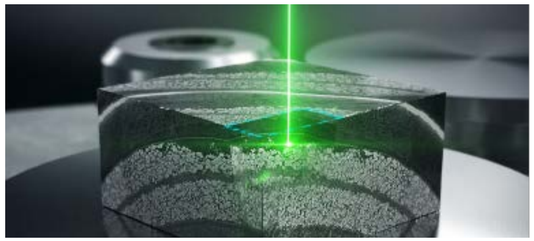
Best 3D resolution

- Best 3D resolution and leading isotropic voxel size
- Enable probe and image less than 3 nm in depth



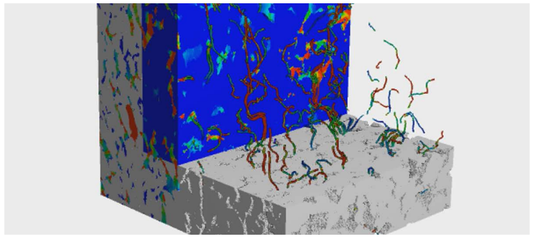
High accuracy

- Precise and reliable results in FIB-SEM tomography
- High repeatability of imaging and material study



High R&D efficiency

- One-step research progress via site-specific sample preparation
- Time-saving large-volume removal via fs-laser



Intuitive & visual data

- Visualization of 2D and 3D data & simulation analysis results
- Mature analysis and statistics workflow

Mature multi-scale correlative workflow

- Accurately identify and access a region of interest
- Prepare high-quality observation area and conduct analysis

> See more details of recommended portfolio

Recommended portfolio

FIB-SEM for high-throughput 3D analysis and sample preparation
ZEISS Crossbeam

Resolution	3 nm @ 30 kV 120 nm @ 1 kV
Magnification	300x to 500,000x
Probe current	1 pA to 100 nA
Current stability	Stable over extended periods Automated emission recovery
Acceleration voltage	500 V to 30 kV

Benefits:

- Best imaging and highest throughput
- High resolution 3D tomography and analytics
- Easy correlation of XRM/FIB/SEM/LM data

> Explore ZEISS Crossbeam

Access the battery inner structure withing seconds
ZEISS Crossbeam Laser

Wavelength (λ)	515 nm (green)
Ablation rate	>15 Mio. $\mu m^3/s$ (>0.9 mm^3/min) for Silicon
Focal length	100 mm (telecentric)
Pulse duration	< 350 fs
Safety	Laser class 1
Pulse repetition rate	0.1 kHz to 1 MHz
Average laser power	10 W @ 1 MHz
Focus diameter	< 15 µm
Rayleigh length	150 µm
Focus tracking length	6 mm (±3 mm)
Scan field	40 x 40 mm^2

Benefits:

- Fast and precise access to deeply buried structures
- Artefact free imaging without contamination
- Easy sample shuttling under Ar atmosphere or vacuum

> Explore Crossbeam laser

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Sales & Service Organizations

63
Quality Excellence Centers

11
Locations

245
Sales Partners Worldwide

Global Metrology Network

Our global service network provides easy access to ZEISS expertise around the world. We use local teams to ensure a swift response and reduced downtime. Make your operations even more secure and reliable with ZEISS.

Get in contact

Find your perfect solution today.
Contact our global experts.

metrology@zeiss.com