Product Information

Version 3.1

ZEISS GeminiSEM Family

Your Field Emission SEMs for the Highest Demands in Imaging and Analytics from Any Sample

Your Field Emission SEMs for the Highest Demands in Imaging and Analytics from Any Sample

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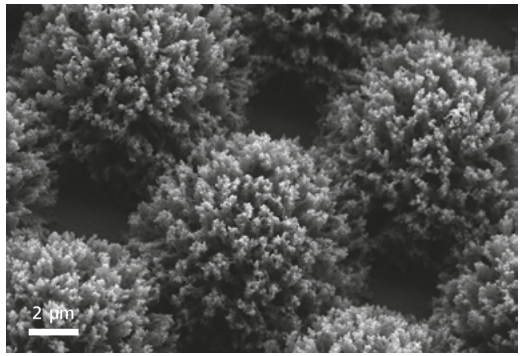
The GeminiSEM family stands for effortless imaging with sub-nanometer resolution and high detection efficiency. You can rely on its surface sensitive analysis and profit from the highest sample flexibility.

GeminiSEM 500 comes with a novel design of Gemini 1 electron optics to deliver all-round better resolution, especially at low voltage. GeminiSEM 450 with its Gemini 2 double condenser guarantees flexibility and ease-of-use, combined with reliable, excellent imaging and analytics. GeminiSEM 300 delivers in surface sensitive imaging so you will experience high contrast, high resolution and extremely large fields of view. That makes it especially good for novice users.

Choose these flexible and reliable field emission SEMs for your research, industrial lab, imaging facility or educational organization. With the GeminiSEM family you will always get excellent images and get reliable analyses from any real-world sample.



Platinum nanostructures sputtered on nickel dendrites, imaged with GeminiSEM 500. Sample: courtesy of L. Schlag, TU Ilmenau, Germany.

Simpler. More Intelligent. More Integrated.

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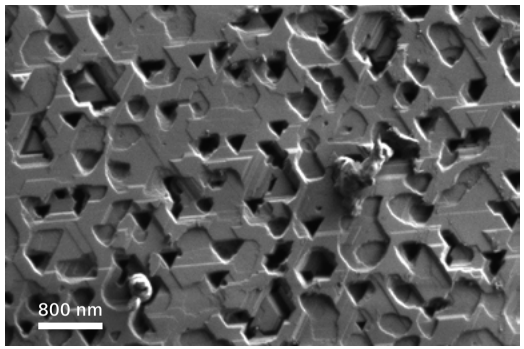
More Detail and Signal at Low Voltage
GeminiSEM 500 lets you achieve high resolution at low voltages. The novel optical design of its Gemini 1 technology introduces the Nano-twin lens, making your time-to-image even shorter. It's easy to acquire sub-nanometer resolved images with high contrast at low beam voltages. At 500 V you can resolve 1.0 nm with perfect image quality, without requiring beam deceleration. Or use the Tandem decel option to apply beam deceleration and achieve even up to 0.8 nm at 1 kV. The choice is yours.
The GeminiSEM 500 comes with significantly improved detection efficiency. Depending on your individual experiment, use this advantage either to reduce time-to-image—or to work with very low currents and thus avoid sample damage.

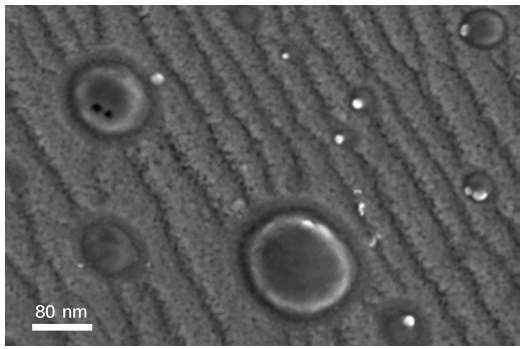
More Surface Sensitivity for Your Analysis
GeminiSEM 450 brings you the advantage of highest resolution and surface sensitivity for your EDS or EBSD analysis, especially when working with low voltages. Simultaneously, Gemini 2 optics let you switch seamlessly between high resolution imaging—at low beam currents—and analytical modes—at high beam currents. No need for complicated or time-consuming realignments as you work. And no need for compromise either, whether on the speed or the quality of your images and analyses.

More Sample Flexibility
GeminiSEM 300, like the whole family makes working in variable pressure (VP) mode feels like working in high vacuum. Now, for the first time, you can use true Inlens detection of secondary and backscattered electrons at pressures of up to 150 Pa—with high resolution, high contrast and high signal-to-noise ratio. Acquire crisp images and get reliable analyses even from your most challenging, non-conductive samples.
Explore the benefits of the Gemini objective's field-free design. You will achieve distortion-free images and EBSD patterns to meet the highest demands in imaging and analytics—and execute experiments in real *in situ* environments, e.g. when performing pinpoint electrical and magnetic measurements using integrated AFM.



Etched silicon nanostructures at 50 V, no sample biasing. Imaged with GeminiSEM 500. Sample: courtesy of A. Charai, Aix Marseille University, France.


GeminiSEM 500 offers a nano-twin lens for improved resolution at low beam voltages.



High resolution image of steel surface inclusions. The sample is highly ferromagnetic. Imaged at 1 kV with GeminiSEM 500 and Inlens SE detector.

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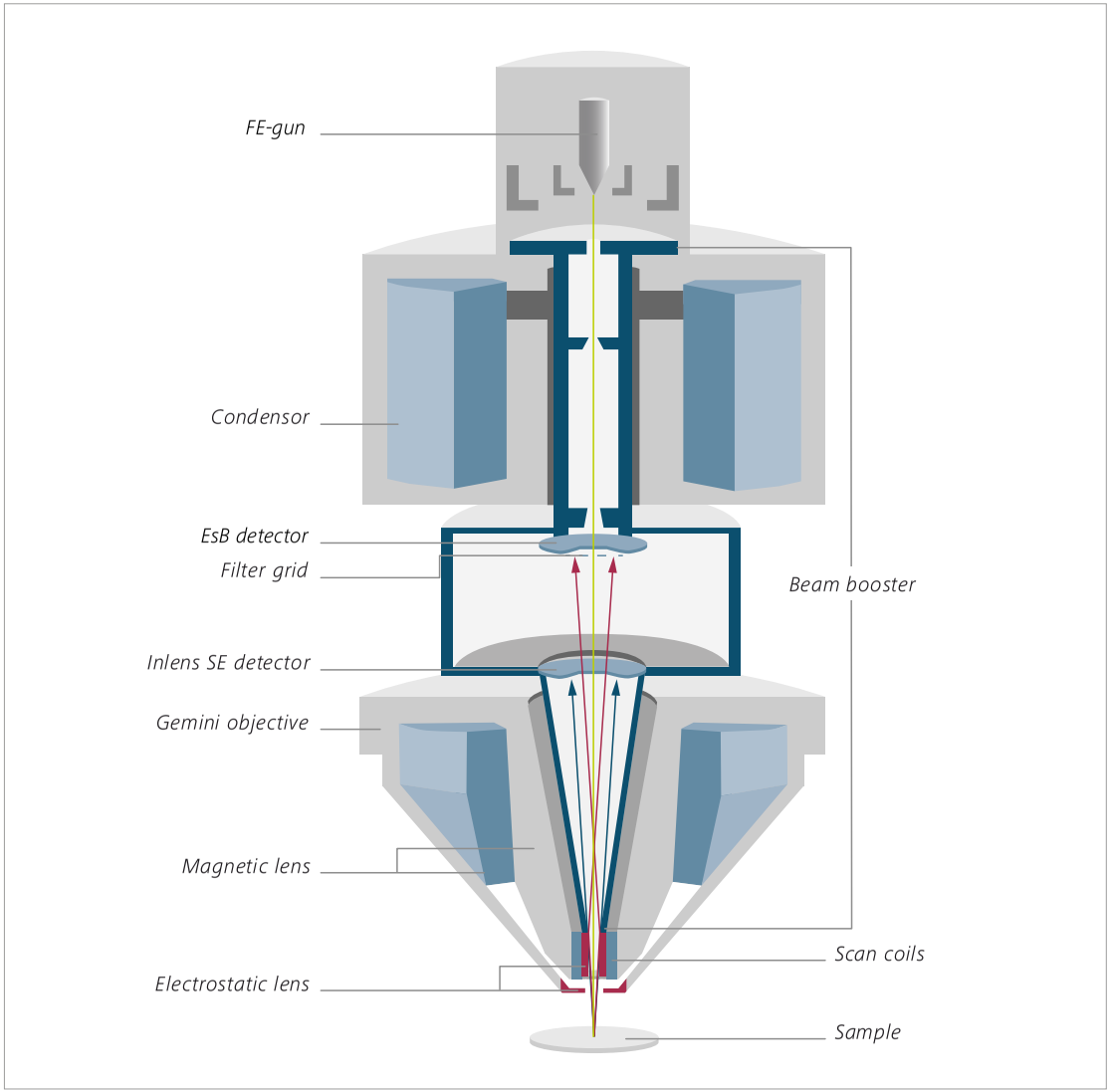
Capitalize on Gemini Optical Design

The GeminiSEM family is based on more than 20 years spent perfecting ZEISS Gemini technology. That means you can count on total and efficient detection, excellent resolution and superb ease-of-use.

The Gemini objective lens design combines electrostatic and magnetic fields to maximize optical performance while reducing field influences at the sample to a minimum. This enables excellent imaging, even on challenging samples such as magnetic materials. Inlens—the Gemini detection concept—ensures efficient signal detection by detecting secondary (SE) and backscattered (BSE) electrons in parallel. Inlens detectors are arranged on the optical axis, which reduces the need for realignment and thus minimizes time-to-image. Gemini beam booster technology guarantees small probe sizes and high signal-to-noise ratios, right down to very low accelerating voltages. It also minimizes system sensitivity to external stray fields by keeping the beam at high voltage throughout the column until its final deceleration. These advanced features —the Gemini objective, Inlens detection and beam booster technology— are shared by GeminiSEM 300, GeminiSEM 450 and GeminiSEM 500.



The Gemini optical column consitsts a beam booster, Inlens detectors and a Gemini objective.

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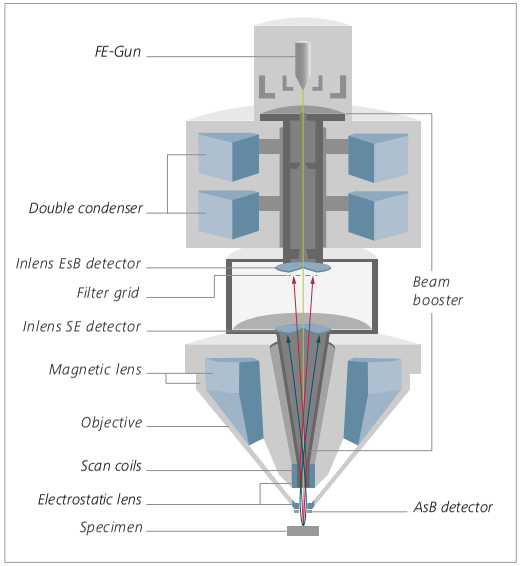
The Complete Detection System: Separate electrons exit from the sample according to the take-off energy and angle.

The GeminiSEM family offers a complete detection system with a large variety of detectors. By combining Inlens EsB- (Energy selective Backscatter), Inlens SE- or aBSD- (annular Backscatter Detector) detectors, the system delivers information about the material, topography or crystallinity of your sample. The primary electron beam generates secondary electrons (SE) and backscattered electrons (BSE). The SEs precipitate directly from the topmost nanometers of your sample with energy of less than 50 eV and show the topography of the surface. As a result of the unique beam booster concept, these SEs are accelerated back into the column and the Gemini objective lens directs them to the annular Inlens SE detector. Depending on the surface condition of your sample, GeminiSEMs detect the SEs over a wide angular range.

BSEs are generated below the surface and provide highly specific information about the material compositions of your sample. Their energy level is close to that of the primary electrons hitting the sample. BSEs appear conically at a 15 degree angle to the primary electron beam and will be attracted by the beam booster of the Gemini column and projected into the column. Because of the different energies of SE and BSE, they are following different trajectories within the beam booster and most of the BSEs can pass the Inlens SE detector and will be collected by the EsB detector. Additionally the Inlens EsB detector enables an energy selection of the BSEs. If the angle is larger than 15 degrees, the BSEs cannot make their way into the column, but can be stopped and detected by the retractable aBSD detector. The aBSD detector delivers compositional, topographical and 3D surface information. Both chamber backscattered (BSD) and transmitted electron detectors have been improved for high efficiency at low beam voltages and ultra-fast imaging. The annular STEM (aSTEM) detector brings maximum flexibility so you can exploit all contrast mechanisms in transmission imaging, even in parallel.



ZEISS GeminiSEM 450 with Gemini 2 optical column including beam booster, Inlens detectors and Gemini objective lens. The double condenser is unique to the Gemini 2 optics.

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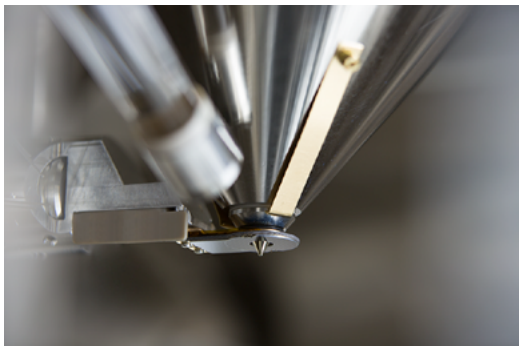
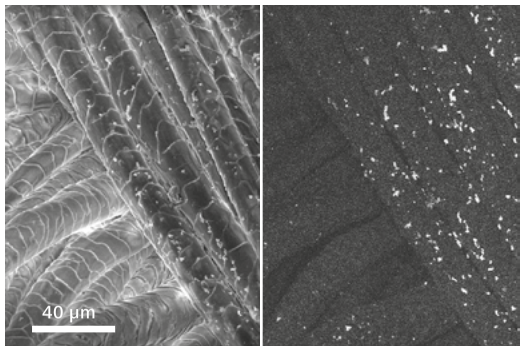
More Detail. More Flexibility.

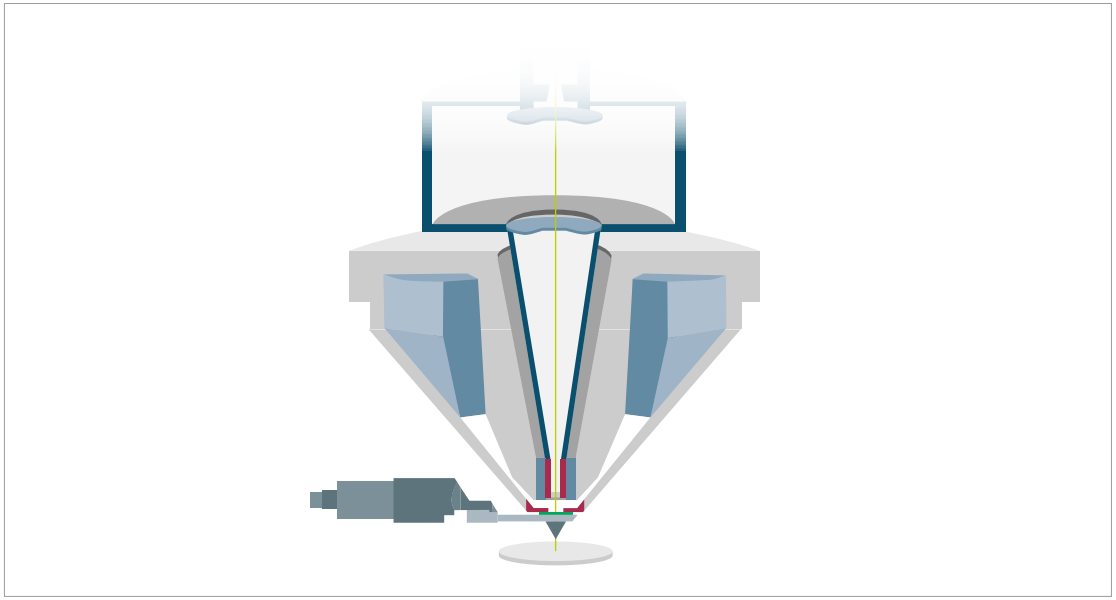
NanoVP technology, available in all GeminiSEM models, offers you the best way to reduce charging on non-conductive samples without compromising Inlens detection capabilities and resolution. By inserting a differential pumping aperture below the objective lens, you will significantly shorten the path length of the incident beam in the gas. This reduces beam broadening and thus enables both imaging of high resolution details and true Inlens detection up to 150 Pa. That means you can use Inlens SE and EsB detectors simultaneously in VP mode for high resolution surface and materials contrast imaging. You can even elevate the pressure up to 500 Pa and using chamber VPSE detection for high contrast imaging.



Retractable NanoVP differential pumping aperture inside the SEM chamber.



Silver nanoparticle coated natural fibers, imaged with NanoVP at 80 Pa, at 10 kV. Left: Inlens SE, surface detail. Right: Inlens EsB, silver particles. Both images acquired in parallel. Sample: courtesy of F. Simon, Leibniz-Institute for Polymer Research, Dresden e.V., Germany.



Schematic illustration of NanoVP differential pumping aperture with insulating o-ring underneath the Gemini objective lens in the SEM chamber.

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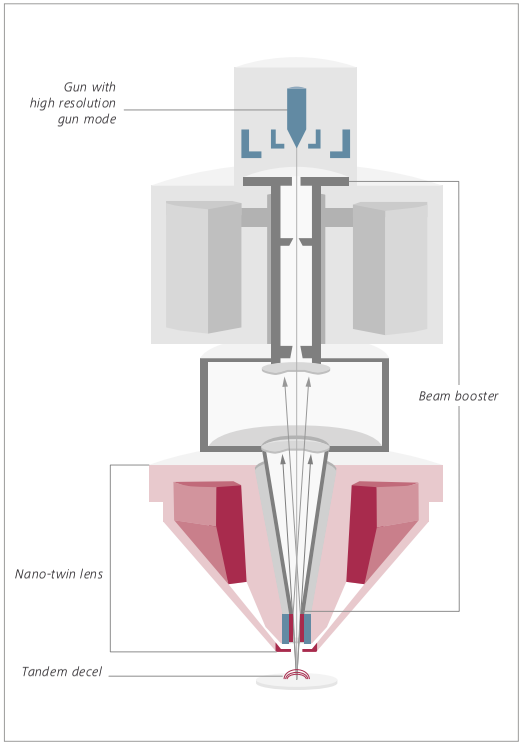
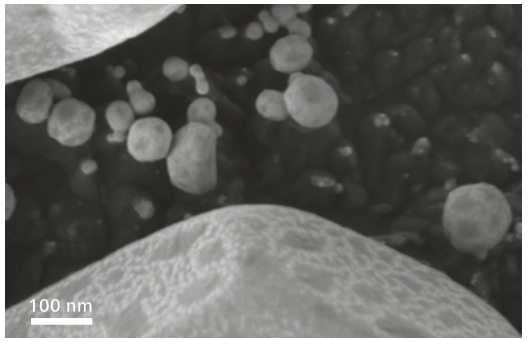
More Detail. More Signal.

GeminiSEM 500 comes with the improved electron optical design of the Gemini 1 column. This lets you achieve sub-nm resolution at low voltages with excellent signal detection efficiency. The newly-designed Nano-twin lens further improves resolution at low and ultra-low beam voltages by optimizing the geometry and the electrostatic and magnetic field distributions. At the same time the Inlens detector signal is boosted significantly under low voltage imaging conditions. In high resolution gun mode, the reduced energy spread of the primary beam minimizes the effect of chromatic aberration to allow even smaller probe sizes. In Tandem decel mode, a deceleration voltage is applied to the sample. Use this to further improve resolution below 1 kV and boost the detection efficiency of backscattered diode detectors.



Novel optical design of Gemini. Schematic cross-section of GeminiSEM 300 and GeminiSEM 500. High resolution gun mode, Tandem decel and Nano-twin lens as part of the novel optical design (highlighted). Nano-twin lens only available in GeminiSEM 500 (highlighted in red).



Gold on carbon sample imaged using Tandem decel, Inlens EsB image at 1 kV landing energy with 5 kV deceleration voltage applied.

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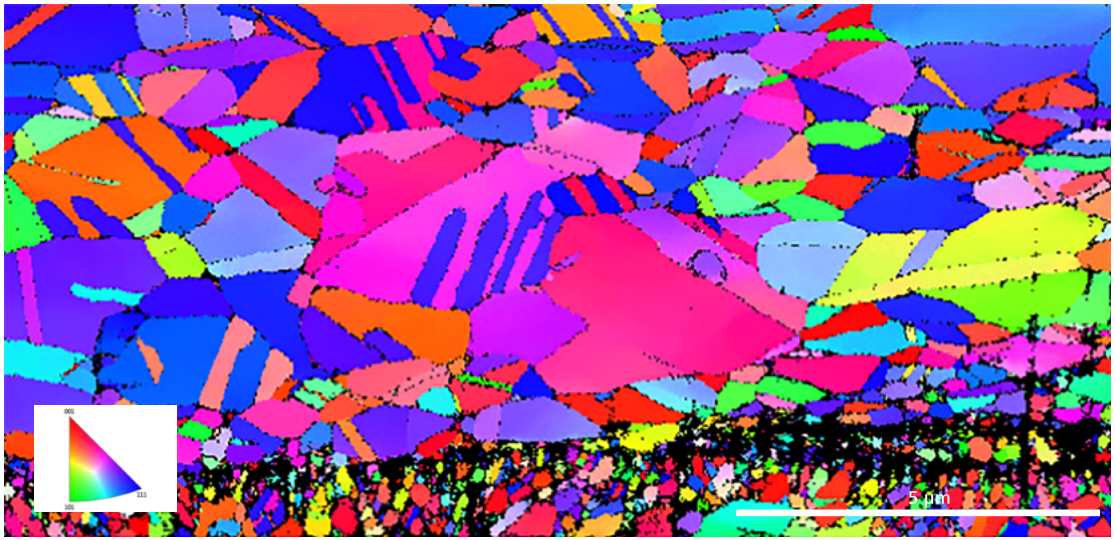
Capitalize on Gemini 2 Optics

GeminiSEM 450 is equipped with a specialty: The main feature of its Gemini 2 optics is the double condenser arrangement which enables continuous beam current adjustment simultaneously with optimized beam spot size. This ensures the highest beam current density for high resolution imaging and analysis at both low and high beam current, independently of which beam energy you select. You can also switch seamlessly between different imaging modes or change imaging parameters. It's fast and effortless because there's no need to realign the beam after changing imaging parameters and the SEM alignment remains stable in the long term.

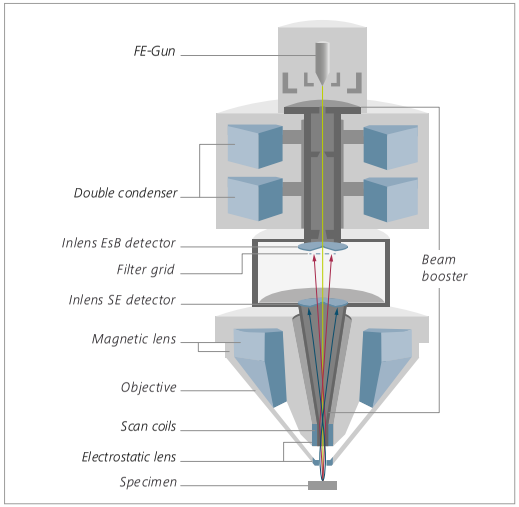
The Gemini 2 column makes GeminiSEM 450 ideal for high resolution imaging at high beam current and for fast analytics, too. What's more, it builds on all the other advantages of previous Gemini optics. For example, Gemini optics won't expose your specimen to a magnetic field so you will achieve a distortion-free EBSD pattern and high resolution imaging over a large field of view.

You can also tilt the specimen without influencing the electron optical performance. Even magnetic samples can be imaged easily.

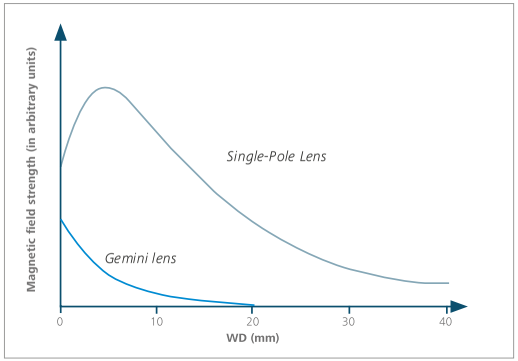
GeminiSEM 450 offers the best overall flexibility for a whole range of diferent applications.



EBSD analysis of a cross-section of Canadian coin at 20 kV and 5 nA. The total characterization of 185 thousand points takes just 20 minutes. GeminiSEM 450 lets you achieve high current and high density simultaneously.



ZEISS GeminiSEM 450: Gemini 2 column with double condenser, two Inlens detectors and NanoVP or local charge compensation.



Magnetic field leakage of the Gemini lens compared to a traditional single-pole lens design. The minimum magnetic field on the sample allows highest electron beam performance on a tilted sample, enables undistorted EBSD pattern as well as high resolution imaging of magnetic materials.

Tailored Precisely to Your Applications

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Typical Applications, Typical Samples	Task	ZEISS GeminiSEM Family Offers
Materials Sciences	Serve a variety of users in imaging facilities by offering cutting edge imaging performance and maximum sample flexibility for a wide range of research fields.	■ Combining high performance, high resolution imaging with variable pressure capabilities of up to 500 Pa makes every GeminiSEM tool ideally suited for a wide range of options, application-specific modules and workflows. You can satisfy a growing range of application requirements on a single system, now and in the future. ■ The Nano-twin lens of GeminiSEM 500 lets you image beam-sensitive, nanometer-scale structures with minute detail at low beam energy. The efficient detection allows you to operate at low currents for minimum beam damage while enjoying excellent materials contrasts. ■ GeminiSEM 450 is your ideal tool for getting high resolution imgages at speed: the Gemini 2 column achieves high resolution even with high probe currents. This also guarantees speed in analytics for quick capture of EDX, WDX, EBSD and CL signals. Additionally the optional Inlens EsB detector allows you to achieve ideal material contrast. ■ Use the optional NanoVP mode to image almost any kind of sample, no matter whether it is beam-sensitive, uncoated or outgassing.
	Characterize nanomaterials such as carbon nanostructures, engineered and self organized nanosystems, and nanocomposite materials with the highest resolution.	
	Characterize nanomaterials by combining analytical procedures with imaging performance for highests demands and retrieve a maximum amount of information from your sample.	
Industrial Applications	Analyze failures in semiconductor materials.	■ With its Nano-twin lens, GeminiSEM 500 enables rapid, reliable and damage-free characterization of nanometer-scale defects and sensitive resist structures at low beam energies. ■ The Gemini complete detection system, combined with the distortion-free GeminiSEM 500 Nanotwin lens, allows characterization of both steel and inclusion microstructure, chemistry, crystal phases and strain, using multiple accessories in parallel at high resolution with unparalleled contrast. ■ With NanoVP technology you can characterize challenging, charging samples with unprecedented detail and contrast. ■ GeminiSEM 500 enables comprehensive characterization for battery development on one system. Thanks to its low voltage and low current imaging capabilities, you can observe sensitive binder and separator materials free from damage. At the same time full analytical capabilities are available for compositional analysis of electrode materials. ■ High strength, chemically resistant or low clinker cement formulations, including beam-sensitive and hydrated phases, can be characterized in high resolution at low voltage, requiring minimal image processing, while simultaneously analyzing porosity, composition and crystal phases which determine cement durability
	Analyze high performance steel.	
	Characterize polymers.	
	Understand the aging process of batteries.	
	Perform advanced cement formulation.	

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Typical Applications, Typical Samples	Task	ZEISS GeminiSEM Family Offers
Life Sciences	Analyze samples easily with high throughput and achieve large volumes of data.	■ GeminiSEM 450 delivers high beam current, allowing you to capture high resolution, large area images of cell structures quickly. ■ The prealigned column offers the best conditions for your imaging every time: even less experienced users will achieve excellent results. ■ You can capture up to four different detector signals simultaneously, with individually-adjusted detector channels. ■ GeminiSEM 450 provides high resolution images of non- conducting biological samples. The image quality is always brilliant because your samples are cleaned *in situ*. ■ Image your samples in or below the nanometer range and benefit from achieving sample transfers in less than 60 seconds. Its modular architecture will keep your system at the cutting edge for decades to come.
	Investigate sub-cellular ultrastructure.	■ You will achieve high resolution transmission images of resin embedded cellular ultrastructure, with optimum contrast and minimal sample damage.
	Map large volumes or areas of cellular tissue with high throughput.	■ GeminiSEM 300 or 450 are the ideal choice for challenging biological applications that require large fields of view. Choose from application- specific modules for array tomography, 3View® in chamber microtomy and correlative microscopy.

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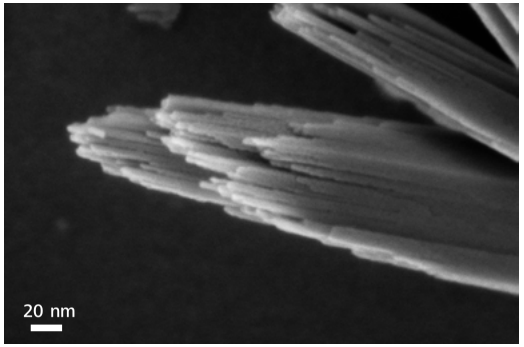
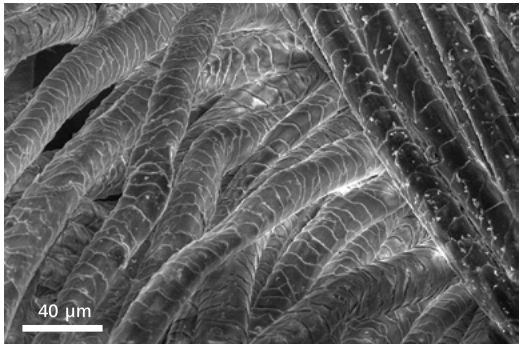
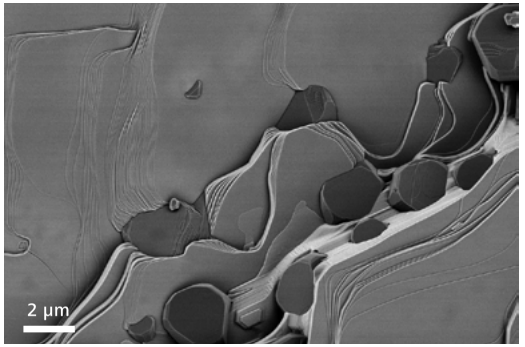
Imaging Facilities



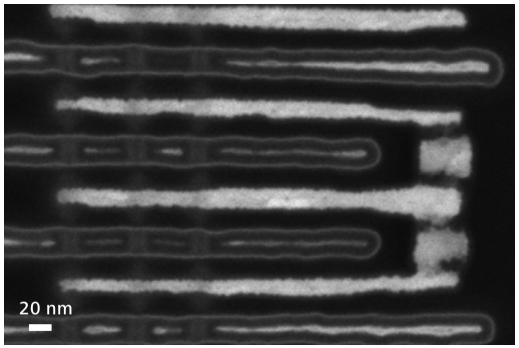
Nanometer spaced FeO(OH) crystals, at 1 kV. Sample: courtesy of L. Maniguet, INP Grenoble, France.



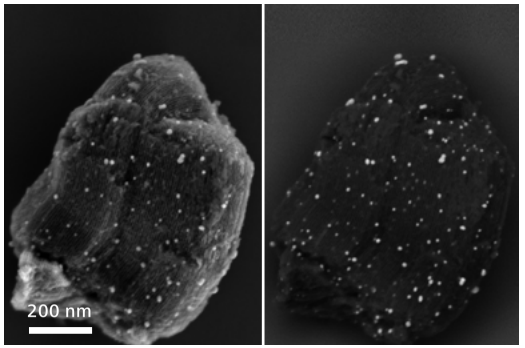
Silver nanoparticle coated natural fibers imaged with NanoVP at 80 Pa, at 10 kV. Sample: courtesy of F. Simon, Leibniz-Institute for Polymer Research Dresden e.V., Germany.



Ceramics, backscattered electron detector, at 3 kV.



Semiconductor, computer chip, Inlens EsB detector, at 3.5 kV.



Catalyst: Silver nanoparticles embedded in Zeolite, Inlens SE detector (left) and EsB detector (right). EHT 1.5 kV. Sample: courtesy of G. Weinberg, Fritz-Haber-Institute of the Max-Planck Society, Germany.

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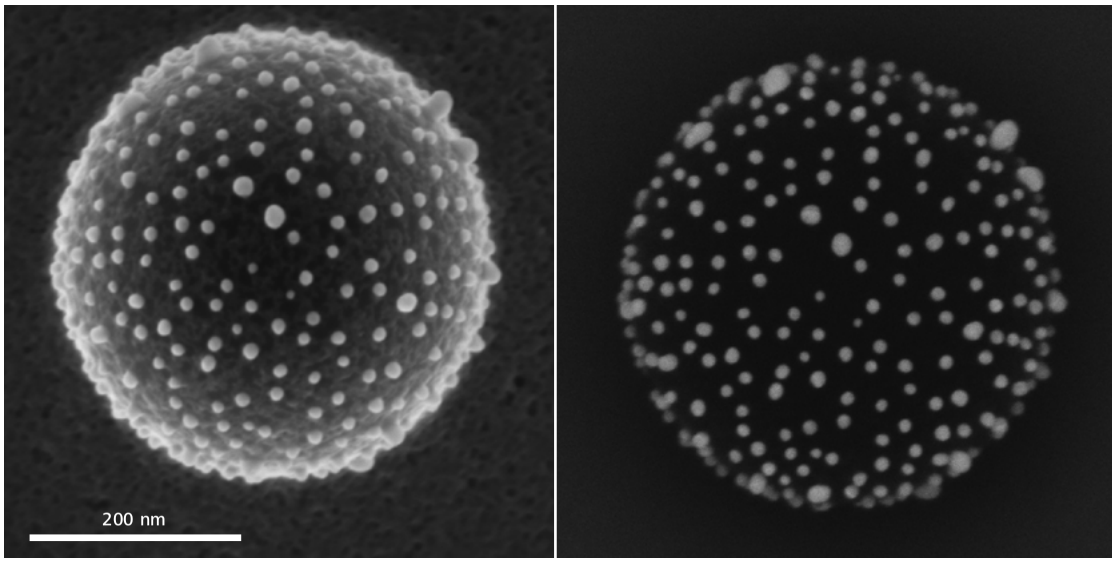
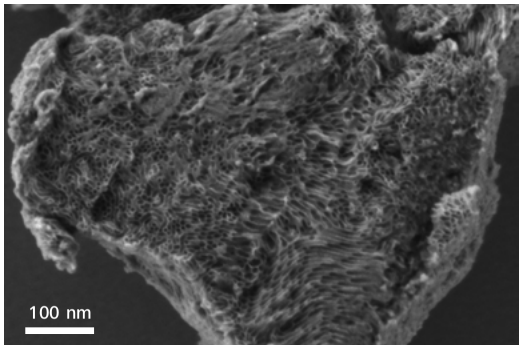
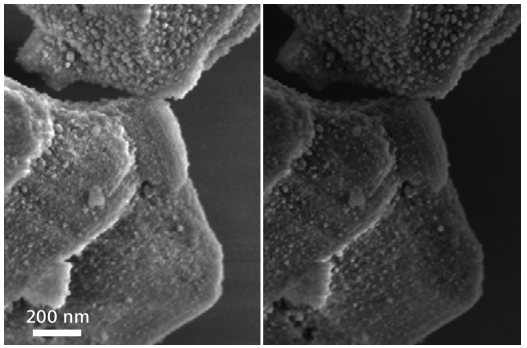
Nanoscience



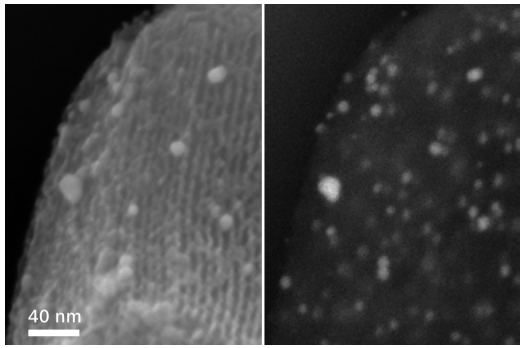
Precursor material for functional surface, gold nanoparticles on polystyrol sphere, imaged with GeminiSEM 500, at 3 kV. Left: Inlens SE image, surface topography. Right: EsB image, material contrast. Sample: courtesy of N. Vogel, University Erlangen-Nuremberg, Germany.



Mesoporous Silica, at 500 V, Inlens SE detector, imaged with GeminiSEM 500.



Catalysts, Zeolite with Ag nanoparticles, imaged with Tandem decel at 2 kV landing energy using 3 kV beam deceleration. Left: Inlens EsB for SE detection, Right: Inlens SE



Catalysts, Zeolite with Ag nanoparticles, imaged at 5 kV using dual channel Inlens SE detector (left) and EsB detector (right). Sample: courtesy of G. Weinberg, Fritz Haber Institute of the Max Planck Society, Germany.

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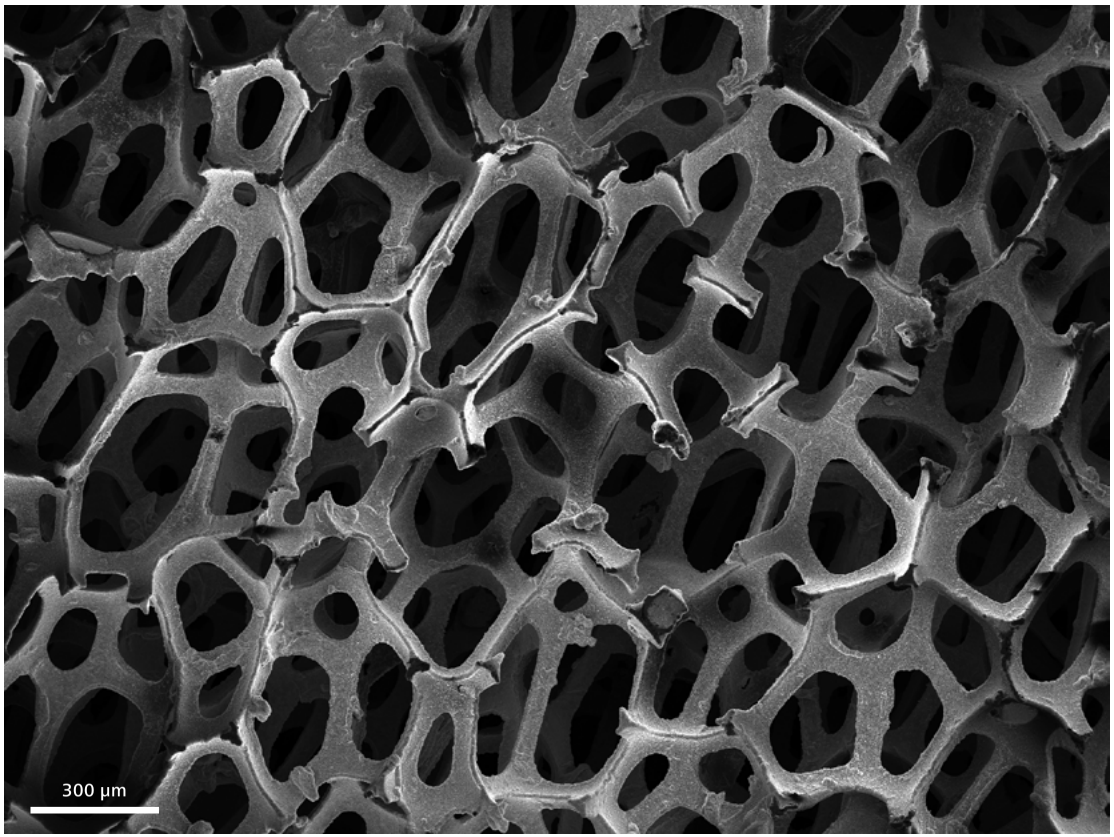
Functional Materials



Metal foams like this open cell nickel foam are widely used as cathode substrate in batteries or super-capacitors. This highly topographic foam is characterized with large depth of focus (DOF) using the Inlens SE detector in a GeminiSEM 450 at 8 kV.

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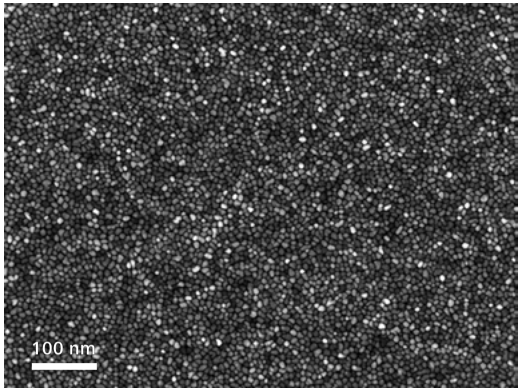
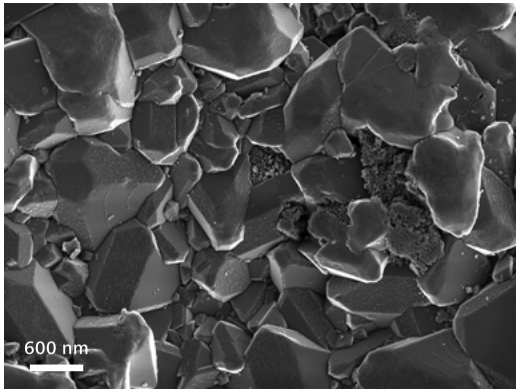
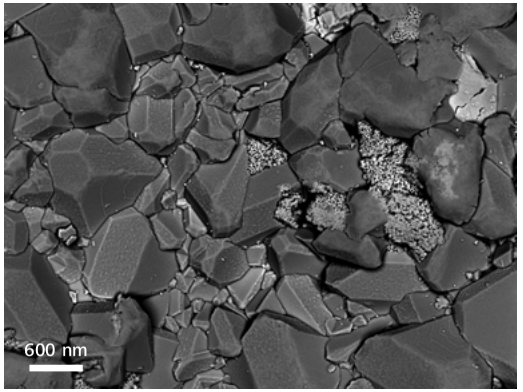
Nanomaterials

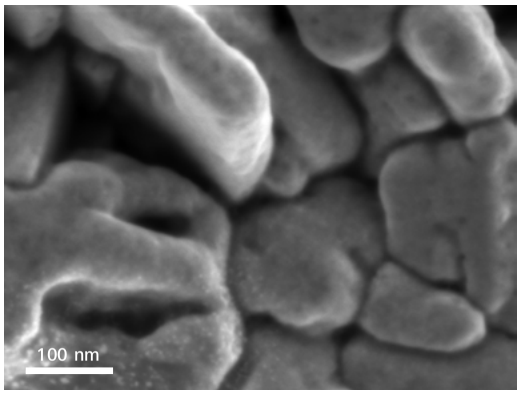


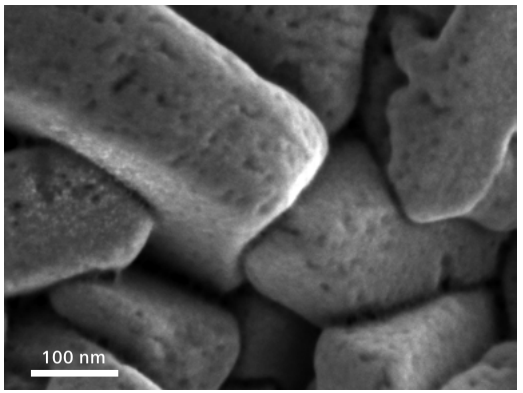
The magnetic grains of a hard disk platter, a magnetic data storage medium, are only a few nanometers in scale, which affects the bit density and thus the data capacity of the hard disk. The different gray levels of the grains are the effect of channeling contrast that provides information on how the nanocrystals are differently oriented. Image taken with the aBSD detector at 20 kV in GeminiSEM 450.





Fe_2O_3/ZrO_2, a composite nanomaterial that is used as a catalyst for chemical-looping hydrogen production processes, can be characterized comprehensively by combining the information from images of the Inlens SE (left) and the Inlens EsB detector (right). Images taken with GeminiSEM 450 at 2 kV.





Copper nanocrystals imaged at 1 kV landing energy, (left) without bias, and (right) using the Tandem decel option and applying a bias of -3 kV. This enables you to get images of enhanced contrast and resolution. Image is taken with GeminiSEM 450.

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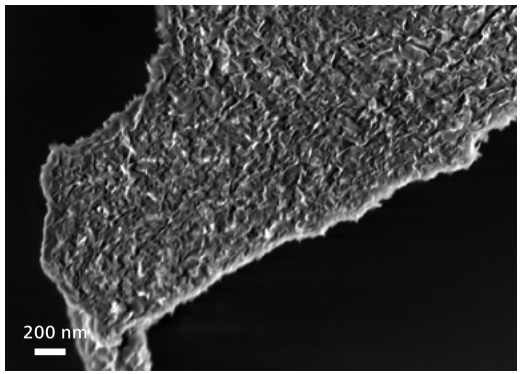
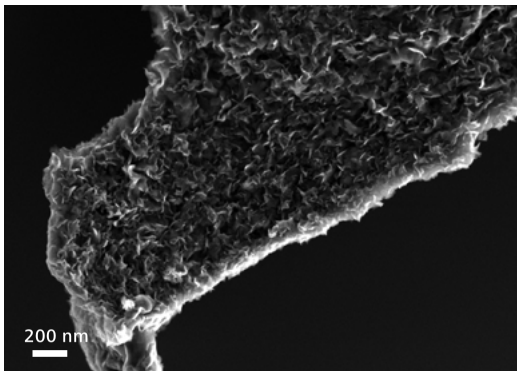
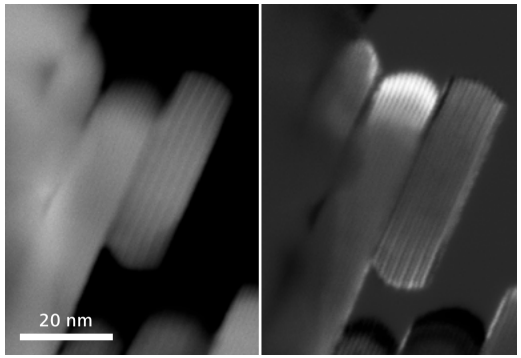
Nanomaterials

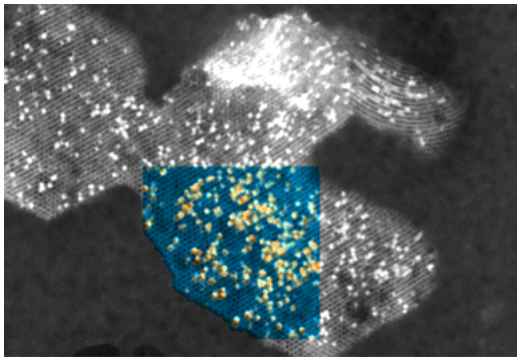




To characterize nanometer-scaled particles of montmorillonite, take advantage of reduced sample charging by imaging with Tandem decel. Both images were collected at 2 kV landing energy. No bias was applied to the sample on the left, which resulted in charging artifacts and loss of surface detail. However, after applying a bias of -5 kV the Inlens SE detector collected more backscattered electrons than low energetic secondary electrons, the latter being sensitive to charging. The overall effect was that charging artifacts were suppressed and surface details became visible at once (right).



$BaFe_{12}O_{19}$ nanoparticle with 1.1 nm (002) lattice spacing imaged with the annular STEM, at 22 kV with GeminiSEM 500: (left) oriented darkfield and (right) high angle annular darkfield images show mass thickness contrast between Ba and Fe with lattice resolution. Sample: courtesy of H. Romanus, TU Ilmenau, Germany.



Silica-supported Cobalt catalyst is characterized by means of high resolution imaging and EDS analysis at 25 kV using GeminiSEM 450. Cobalt nanoparticles of about 10 nm in size embedded in meso-porous silica are shown in high resolution, imaged with aSTEM detector overlayed with the EDS map. In the Fischer–Tropsch synthesis, the 10 nm supported Co catalyst proved to be the most active and selective catalyst for hydrocarbon formation.

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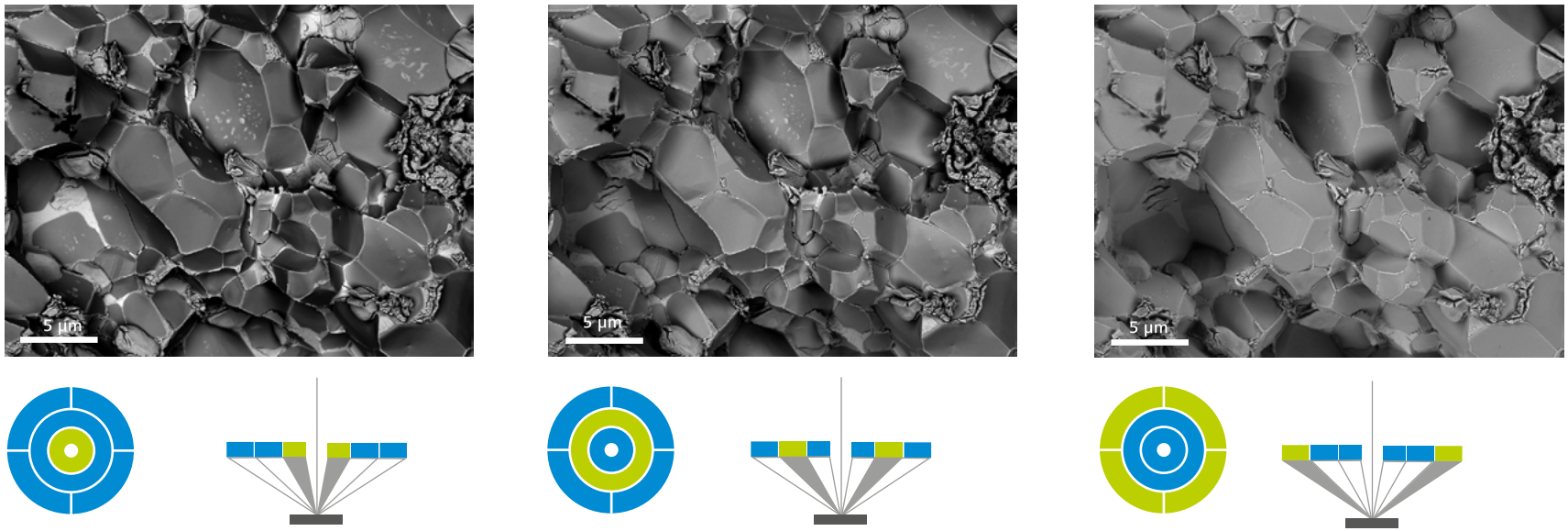
Magnetic Materials



Investigation of the fractured surface of an NdFeB magnet (demagnetized) with GeminiSEM 450. Images are acquired using the annular Backscatter Detector (aBSD) in GeminiSEM 450 at 3 kV without bias, taking advantage of the 6-segmented aBSD detector having angle selective BSE detection. Left: The BSEs with a high scattering angle contain more compositional surface information and are detected by the inner ring of the aBSD detector. This results in images with high material contrast. Center: The BSEs are detected by the middle ring, providing images with a mixture of surface topographical and compositional information. Right: The BSEs with a low scattering angle contain mainly topographical surface information and are detected by the outer ring, which is divided into four individual segments. (The segments of the detector that were active during imaging are highlighted in green, respectively.)

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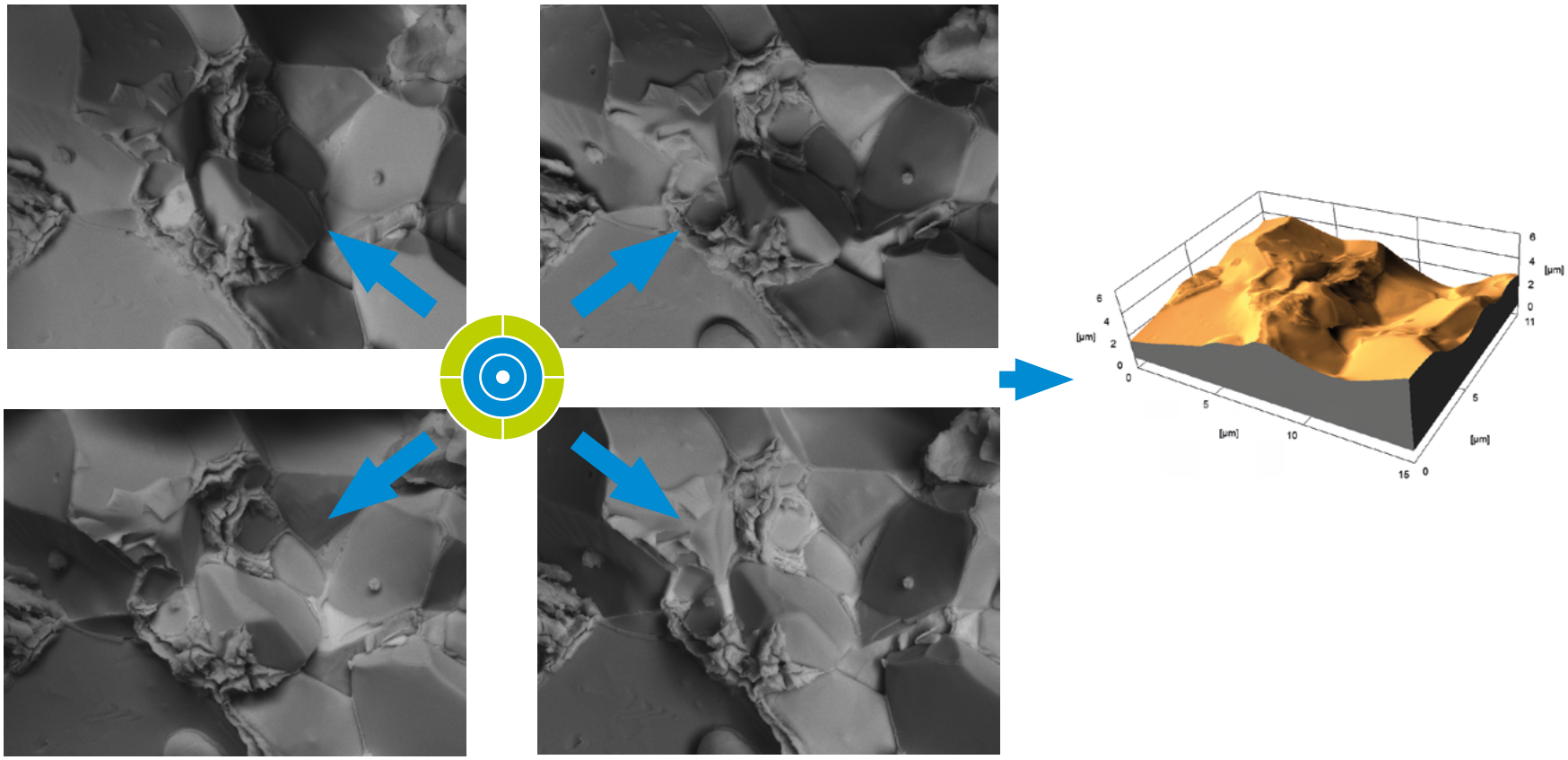

NdFeB magnet: Visualization of surface topography with the aBSD detector and the 3DSM software module for 3D surface modeling. Images collected with the outer, segmented ring of the aBSD diode are used by 3DSM to create a model of the fractured surface. The module provides surface topography visualizations as well as numerous functions for quantifications and measurements. Above: Four topography images taken with corresponding diode segments. Right: surface model created with 3DSM. (GeminiSEM 450)

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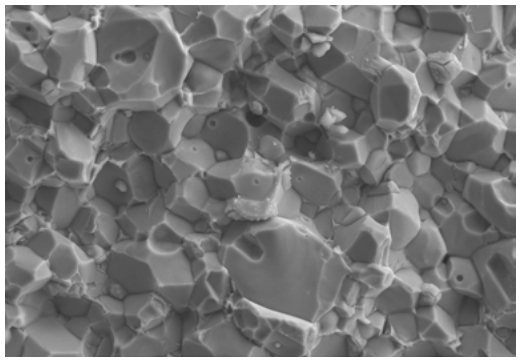
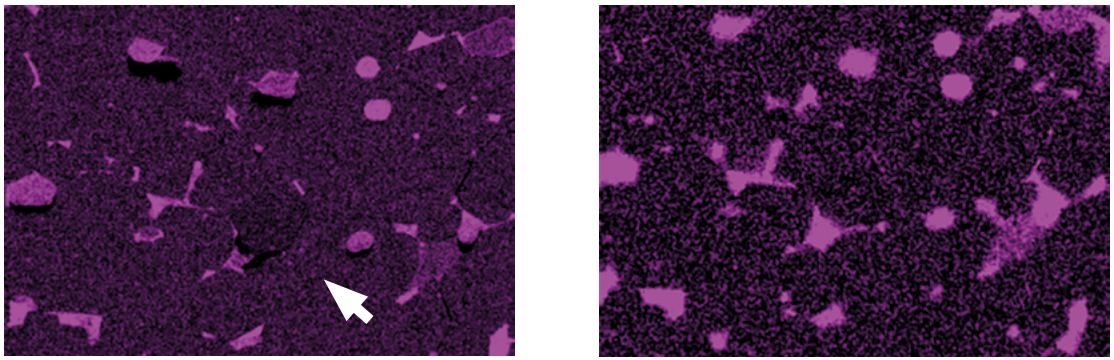
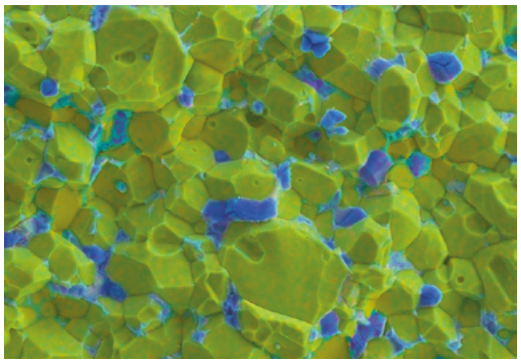


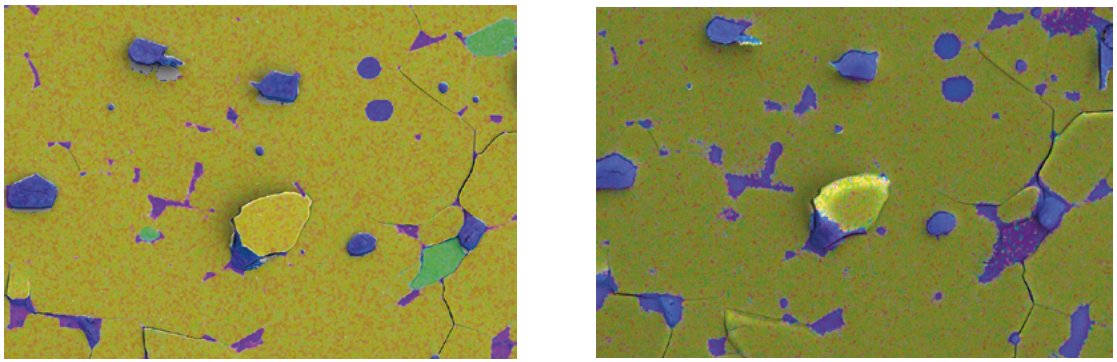
Topography image of the fractured surface of the NdFeB magnetic material, imaged with GeminiSEM 450 at 15 kV with the SE detector. (Overlay with EDS map below.)



A comparison of elemental maps at 3 kV (left) and at 15 kV (right) shows the advantage of low voltage EDS mapping when aiming for high spatial resolution (Nd in pink). The low voltage map taken at 3 kV shows more details when characterizing the Nd distribution in the material, even nanometer sized particles within the matrix (arrow). EDS analytics done with GeminiSEM 450.



Fractured surface of a NdFeB magnet: overlay of the SE image at the top with a color-coded elemental map (pink: Neodymium, turquoise: Praseodymium, yellow: Iron, blue: Oxygen, gray: SEM image), collected with GeminiSEM 450 at 15 kV. (SE topography image above.)



After Boron (in green) is added to the results shown in the elemental map, it is easy to resolve the fine distribution of B against Nd (pink) on the map taken at 3 kV (left)—whereas the map taken at 15kV (right) shows fewer details (Oxygen in blue). EDS analytics done with GeminiSEM 450.

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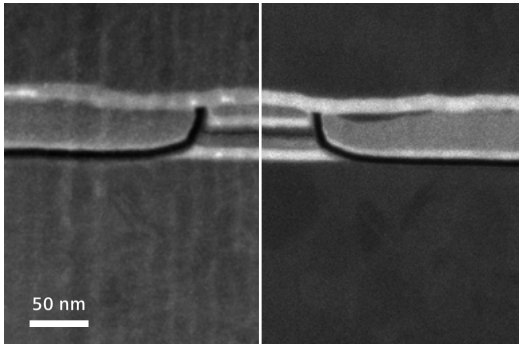
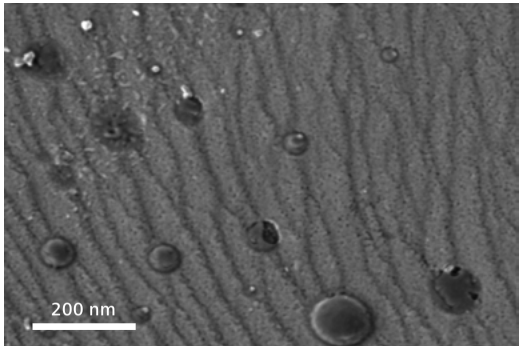
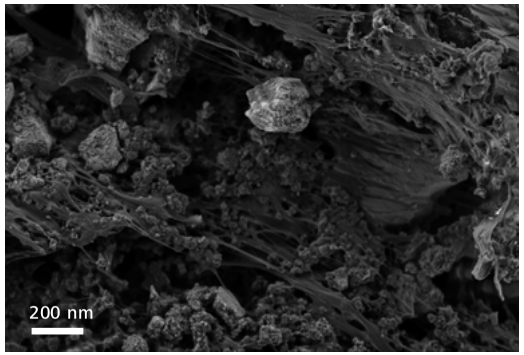


Data storage, hard disk read head. Left: Inlens SE detector. Right: Inlens EsB detector.

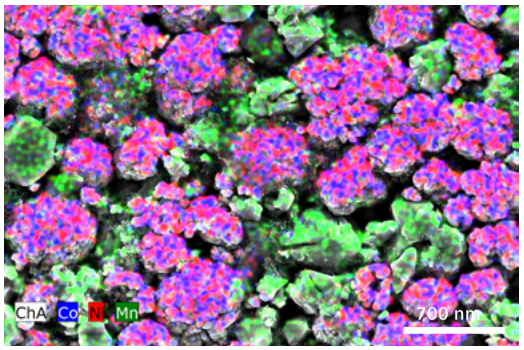


Inclusions in steel, Inlens SE detector, 500 V.

FinFET transistor, top view, 22 nm technology, 3 kV, pure BSE imaging using EsB, high material contrast.



Lithium ion battery cathode shows no beam damage of sensitive binder material at 500 V. Sample: courtesy of T. Bernthaler, Materials Research Institute Aalen, Germany.



Lithium ion battery cathode. EDS compositional mapping shows main constituents of the different oxides. Sample: courtesy of T. Bernthaler, Materials Research Institute Aalen, Germany.

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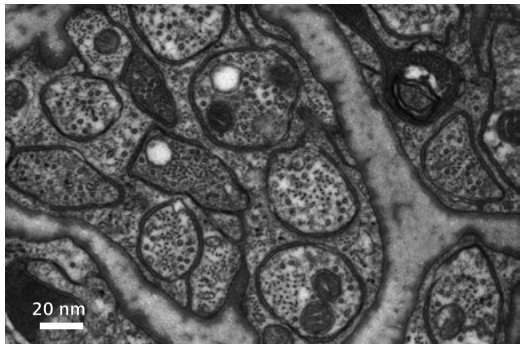
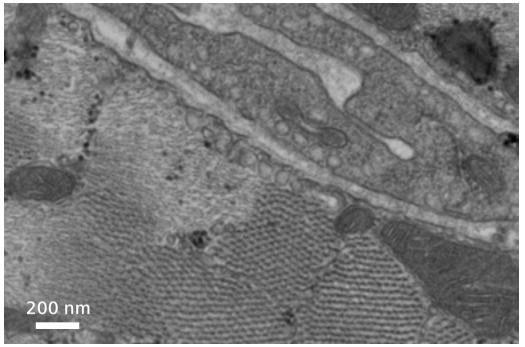
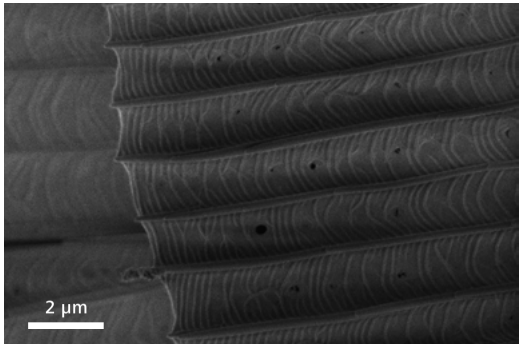


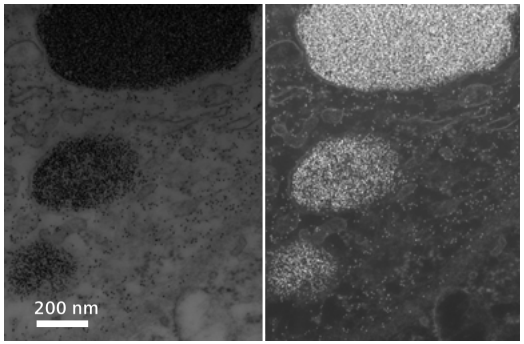
Mouse brain tissue, ultrathin section, STEM, brightfield, at 10 kV.



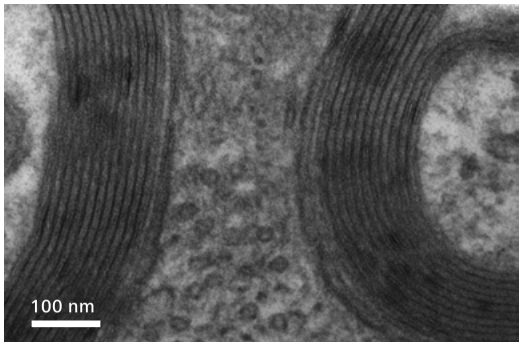
Mouse muscle tissue, ultrathin section, backscattered electron detection, contrast inverted, at 8 kV. Sample: courtesy of I. Röder, Bioquant, Heidelberg University, Germany.



Moth wing, Inlens SE detector, at 50 V, in high vacuum. No charging effect if ultra-low voltage like 50 V is applied.



Guinea pig liver, ultrathin section, hemosiderosis, fixed with osmium tetroxide in araldite. No further poststaining with additional heavy-metal salts was performed. Single ferritin molecule (diameter approximately 8 nm) can be clearly identified in STEM. Left: brightfield. Right: HAADF image (high angular annular darkfield), at 28 kV.



Mouse brain tissue, ultrathin section, detail of Myelin sheats, STEM, brightfield, at 28 kV.

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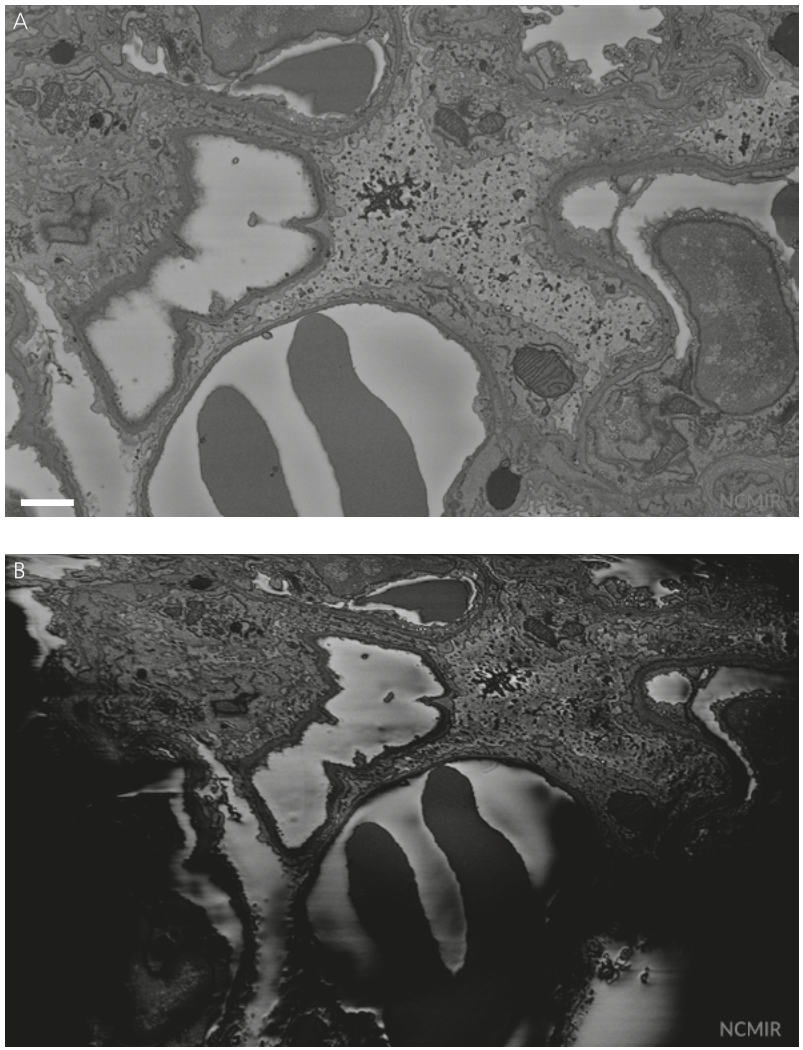
Turn your ZEISS GeminiSEM 300 or GeminiSEM 450 into a super-quick high resolution 3D imaging system with 3View® technology from Gatan, Inc. 3View® is an ultramicrotome inside the SEM chamber that lets you acquire high resolution 3D data from resin-embedded cell and tissue samples—in the shortest possible time and the most convenient way. The sample is continuously cut and imaged so you can produce thousands of serial images in a single day. Unique ZEISS Gemini column technology makes the GeminiSEMs ideally suited to support this application. Now you can also enhance your GeminiSEM with Focal Charge Compensation to eliminate charging effects. ZEISS has released this gas injection system in collaboration with the National Center for Microscopy and Imaging. With Focal Charge Compensation, the result is spectacular image quality. When performing 3D nanohistology, electron microscopic investigation of tissue samples such as liver, kidney and lung by block-face imaging is extremely valuable for pathological research. By using Focal Charge Compensation to eliminate charging, these charge-prone tissue samples can be imaged with high resolution and speed in three dimensions.



Block-face images of mouse lung tissue (A) with Focal Charge Compensation and (B) without Focal Charge Compensation. Scale bar: 1 micron. Images: courtesy of NCMIR.

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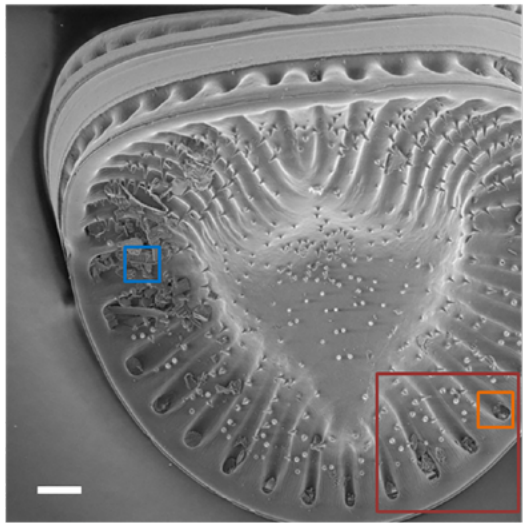

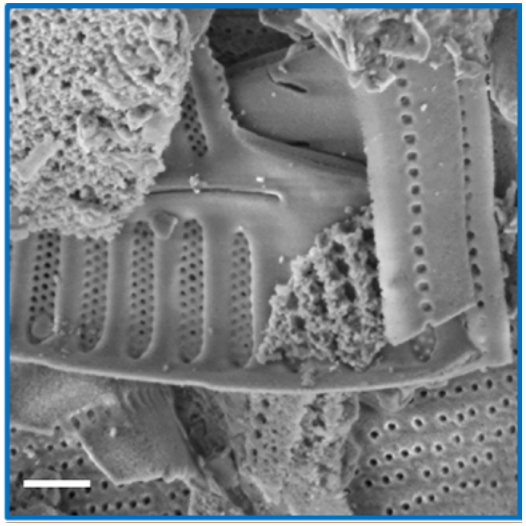

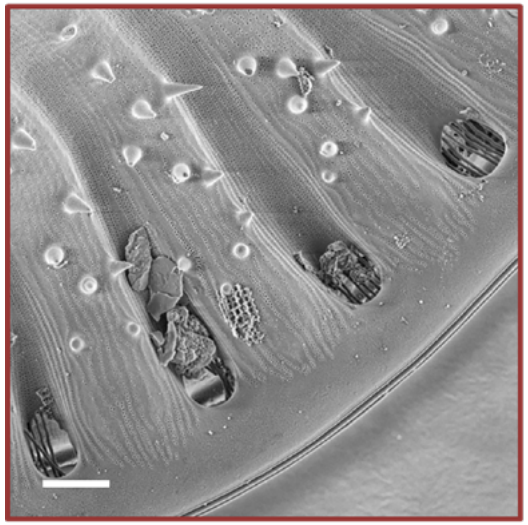

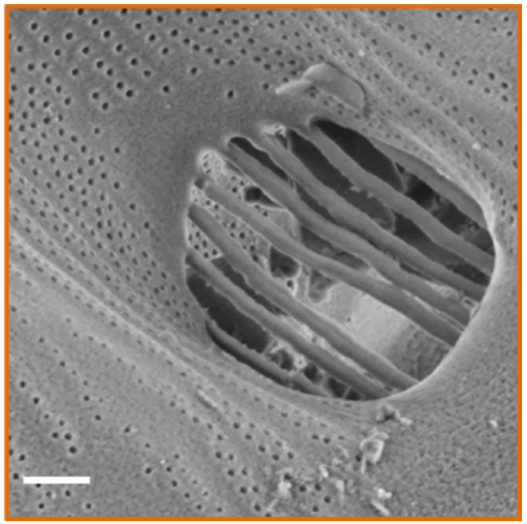

NanoVP brings you the unique advantage of being able to use your Inlens SE detector in combination with variable pressure. This enables high resolution structural imaging of samples prone to charging. Typically higher resolution requires a higher probe current and so the probability of charging is elevated. Now, using NanoVP, you can image the delicate features of an uncoated diatom at 2 kV with a resolution of 4 nm/pixel under variable pressure conditions. Nevertheless, in this close-up view the surface as well as deeper lying structures can be visualized artefact-free and without loss of resolution, thanks to NanoVP. The detailed ultrastructure of the diatom cytoskeleton are visualized in the pictures. Imaged with GeminiSEM 500.

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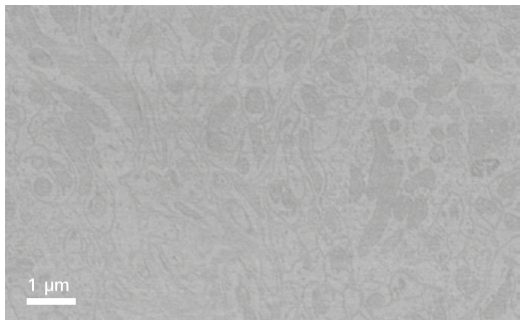
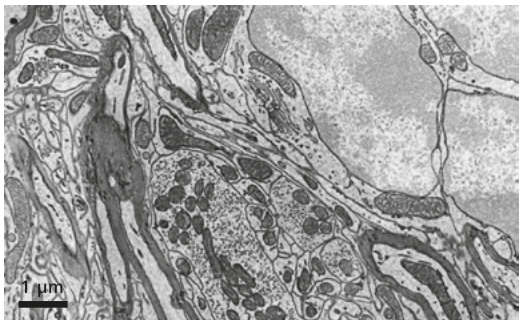
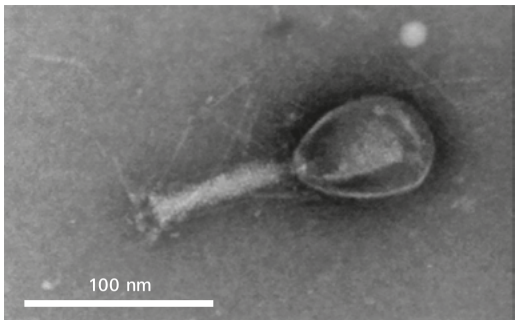




Life sciences often deal with low contrast samples and approaches such as correlative microscopy are especially lacking features rich in contrast. With Tandem decel you can introduce an electrical deceleration or bias between the sample and objective lens and achieve a dramatic increase in contrast. The figure shows a low contrast brain section imaged without the Tandem decel option (left). Applying Tandem decel (right) increases contrast to such an extent that all cell organelles are clearly visible at high resolution. Imaged with GeminiSEM 500.



The high sensitivity of the STEM detector allows the use of low voltage electrons with high scan speeds, thus enabling fast STEM imaging with the highest resolution. The picture shows a negative stained T4-Phage imaged with a STEM detector. Notice structural details such as the helical tail as well as the tail fibers associated with the virus. Image: courtesy D. Frey, S. Modla & J. Caplan, University of Delaware, USA. Imaged with GeminiSEM 500.

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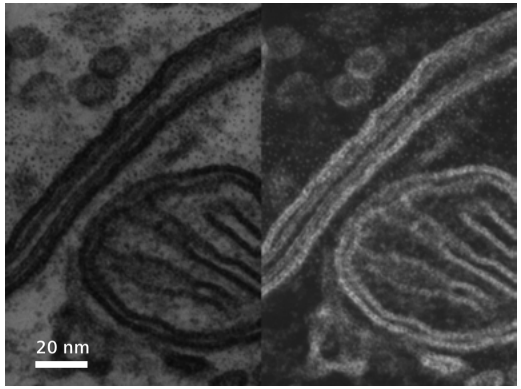
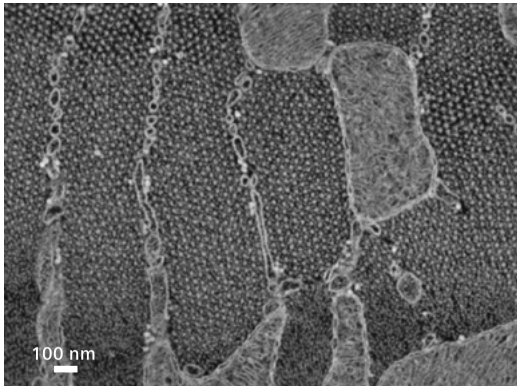
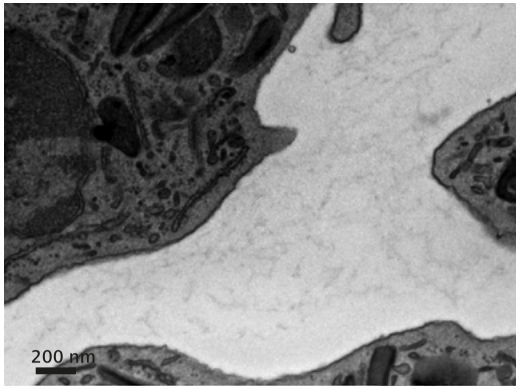


The advanced capabilities of GeminiSEM 500 combined with the STEM detector allow you to image ultastructural details to such an extent that lipid bilayers become visible in biological specimens such as brain cells. Mouse brain: courtesy of Marco Cantoni, EPFL Lausanne, Switzerland. Imaged with GeminiSEM 500.



Ultrastructural details are clearly visible in muscles imaged with Tandem decel applied and a backscattered electron detector. Mouse brain: courtesy I. Wacker & R. Schroeder, University of Heidelberg, Germany. Imaged with GeminiSEM 500.



Neurophile granulocytes offer a perfect example of how features such as the the Nano-twin lens of GeminiSEM 500 allow imaging under low voltage conditions and provide the best possible contrast. Coatomers of vesicles are clearly visible. Image: courtesy of I. Wacker; University of Heidelberg. Germany. Imaged with GeminiSEM 500.

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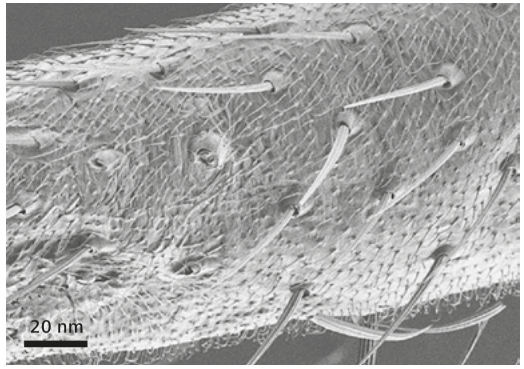
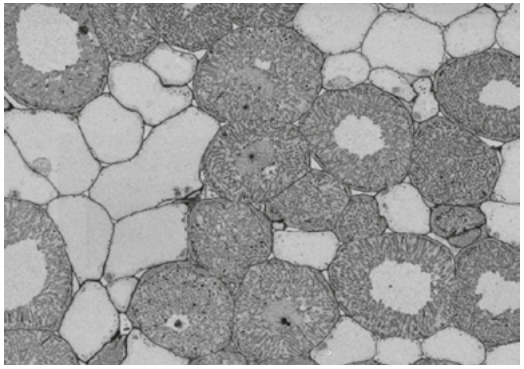
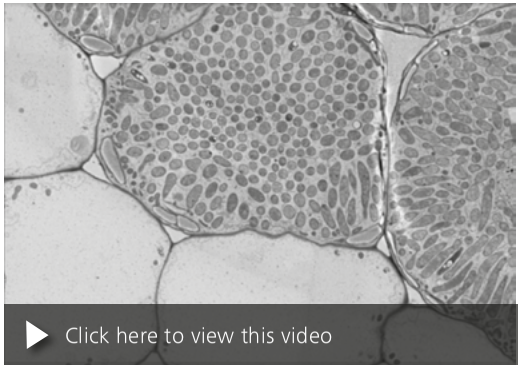
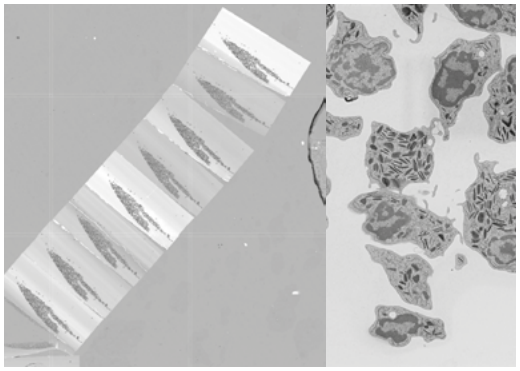


GeminiSEM 300 enables scientists to analyze large fields of view of a sample, even under low voltage conditions. When combined with the Variable Pressure mode, sputter coating is not necessarily needed to analyze the topology of biological samples. This insect leg was imaged at 1 kV with GeminiSEM 300.

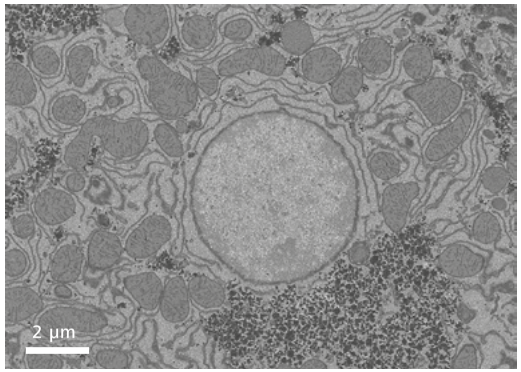




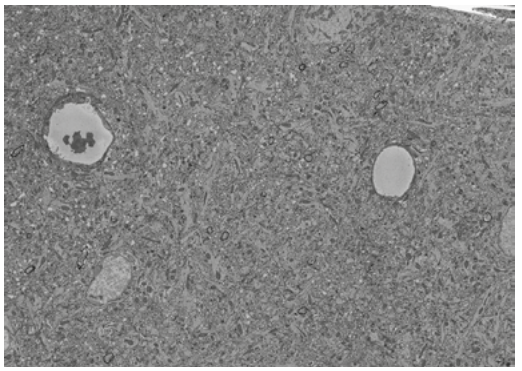
Root nodules of Fabaceae beans. The large field of view is also an important feature for analyzing rare events in section ribbons or for statistical analysis of infections, as in these root nodules that are infected with root nodule bacteria (left). Imaged with GeminiSEM 300. The Array Tomography module of Atlas 5 allows you to build 3D volumes out of serial sections. The movie (right) shows 78 sections out of a section ribbon of infected root nodules. Imaged with GeminiSEM 300.



Statistical analysis of large fields of view in 3D is important in life science. Here, this is done using the Array Tomography module of Atlas 5 on serial sections of granulocytes, with different populations of granulocytes being analyzed. Left: overview on a ribbon of nine sections. Right: detail. Imaged with GeminiSEM 300.



Here, one section out of a Gatan 3View® data set is imaged with the GeminiSEM 300. VP capabilities combined with serial block-face technology allow you to section and image large fields of view without charging artefacts, thus providing optimal contrast. Typical hepatocytes with a large number of mitchrondia are visible. Imaged with GeminiSEM 300.



Large field of view of a brain section imaged using 3View® in combination with GeminiSEM 300. Even large unsputtered samples up to 1 mm² can be imaged artefact-free using a combination of variable pressure and low voltage imaging to eliminate charging artefacts. Imaged with GeminiSEM 300.

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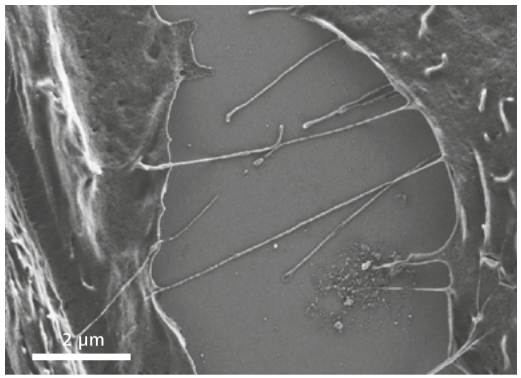
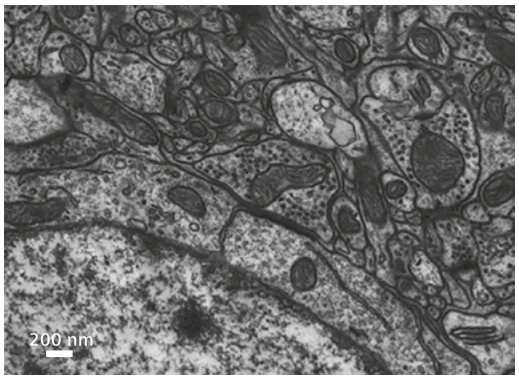
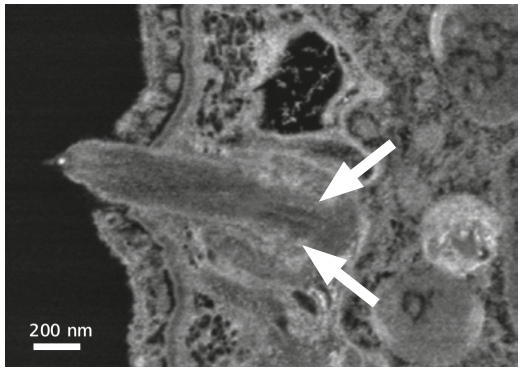
Life Sciences



GeminiSEM 450 offers the best possibilities for imaging structural details on samples with low contrast. Fibroblasts were imaged showing connections between the cells.



Ultrathin section of the upper brain cortex. GeminiSEM 450 provides the best possible resolution combined with fast image acquisition. Structural details such as vesicle coatings are clearly visible in this STEM image.



Cilia, imaged with the BSD detector in GeminiSEM 450. Centrins are special proteins in the cilia of eurkaryotes. The centrin-rich region of the basal apparatus is clearly visible (arrow). The new BSD detector used here illustrates the smallest differences in heavy contrast. Sample: courtesy of P. Purschke, University of Osnabrück. Germany.

The movie shows an image stack acquired from a block-face sample with a 3View® in a GeminiSEM with a double condenser system. Notice the rhodopsin discs and the insertion points. Image: courtesy of Christel Genoud, FMI Basel. Imaged with GeminiSEM 450.

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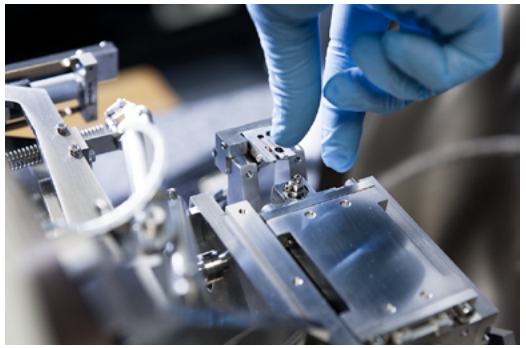
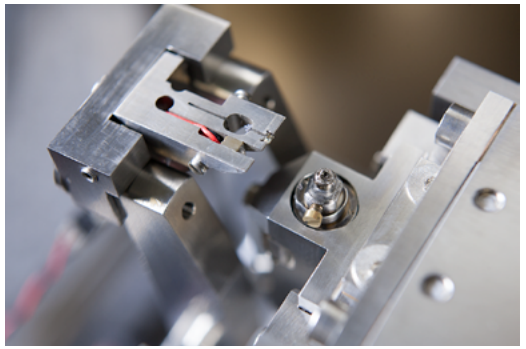
Fast and Convenient 3D Imaging for Tissue Samples in the FE-SEM

Combine your GeminiSEM 300 or GeminiSEM 450 with 3View® technology from Gatan Inc. to acquire high resolution 3D data from resin-embedded cell and tissue samples in the shortest possible time and most convenient way. 3View® is an ultramicrotome inside the SEM chamber. The sample is continuously cut and imaged to produce thousands of serial images in a single day—each perfectly aligned because they are all generated from one fixed block.

GeminiSEM 300 and GeminiSEM 450 from ZEISS are ideally suited to support this application. The unique Gemini column technology delivers high resolution transmission images and allows fields of view of hundreds of microns at nanometer resolution.





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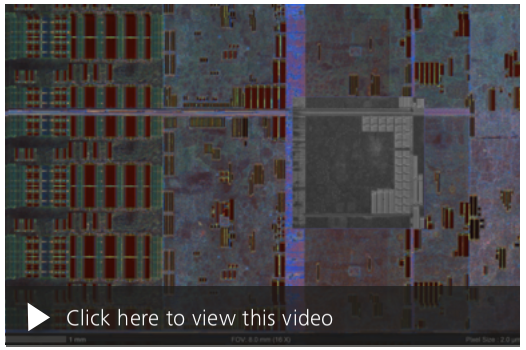
ZEISS Atlas 5 –
Master Your Multi-scale Challenge

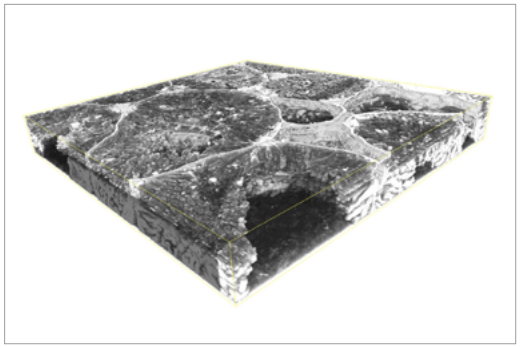
Atlas 5 makes your life easier by creating comprehensive multi-scale, multi-modal images with a sample-centric correlative environment. This powerful yet intuitive hardware and software package extends the capacity of your GeminiSEM.

Use its efficient navigation and correlation of images from any source. Take full advantage of high throughput and automated large area imaging. Unique workflows will help you gain a deeper understanding of your sample. Its modular structure lets you tailor Atlas 5 to your everyday needs in materials or life sciences research. Extend your possibilities even further with modules—e.g. for nanopatterning or array tomography.

Easy-to-use, workflow-oriented GUI for automated imaging.



Light microscope and SEM images of an integrated circuit are merged in the Atlas 5 correlative workspace.



Medicago root nodules. SEM images by Atlas 5 Array Tomography. Sample: courtesy of J. Sherrier, J. Caplan & S. Modla, University of Delaware, USA.

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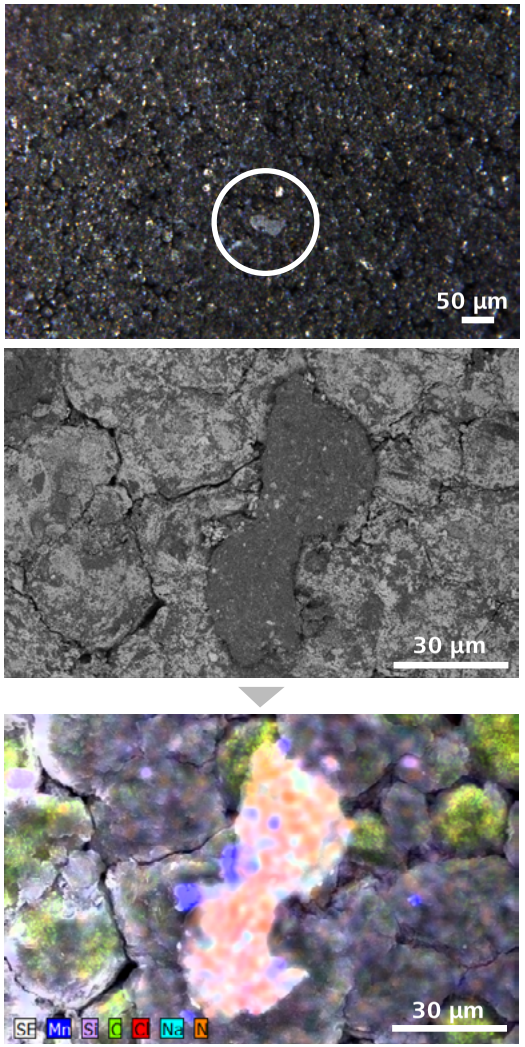
Correlative Microscopy with Shuttle & Find

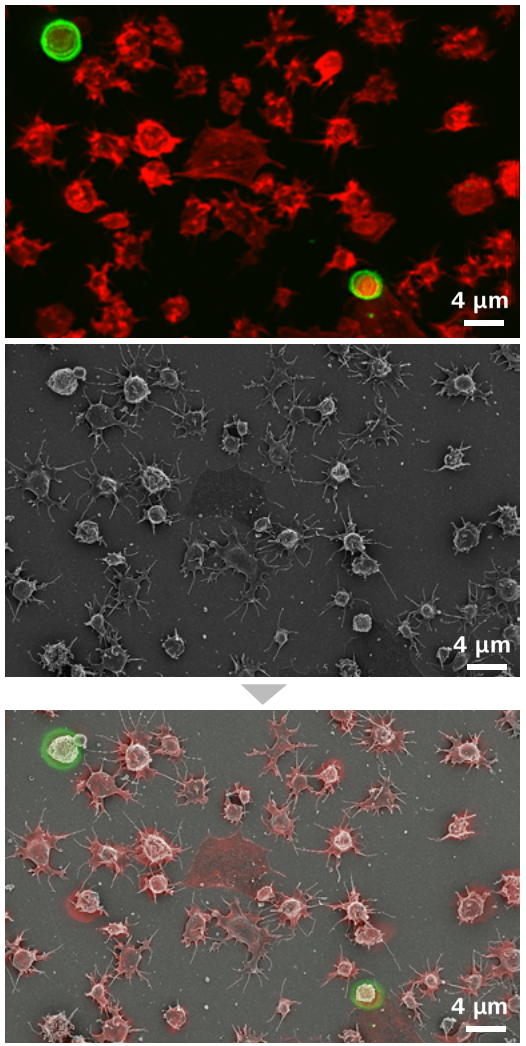
The Shuttle & Find software module allows an easy-to-use, productive workflow to overlay data from your light microscope and scanning electron microscope. By combining the optical contrast methods of the light microscope with the analytical methods of your electron microscope, you will discover information about the function, structure and chemical composition of your sample.

How it works:

Using a special specimen holder with three fiducial markers, a coordinate system is generated within seconds. Use the light microscope to define interesting regions in your sample. Then relocate the defined regions in the electron microscope where you will be able to improve the resolution by several orders of magnitude. Now you can continue examining the sample more extensively. Finally, use the Shuttle & Find software to correlate the images taken by the different microscopical techniques.



Lithium Ion battery. Top: light microscope image. Center: SEM image. Bottom: Overlay of both, combined with EDS analysis.



Platelets stained with AF647 (cellular platelet protein, false color: green) and AF555 – Phalloidin (false color: red). Top: Laser Scanning Microscopy fluorescence image. Center: SEM image. Bottom: Overlay. Courtesy of D. Woulfe & J. Caplan, University of Delaware, USA.

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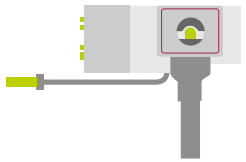
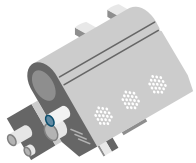
Airlock

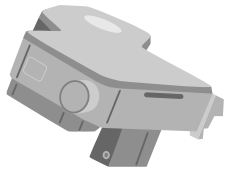


Plasma Cleaner

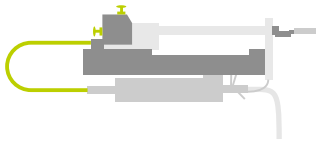


***In situ* cleaning /**
Local Charge Compensation

WDS



STEM



EBSD

EDS

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Selected Detectors and Accessories	Detectors and Accessories Offer	ZEISS GeminiSEM 500	ZEISS GeminiSEM 450	ZEISS GeminiSEM 300
Inlens SE Detector (Inlens secondary electron)	Ultra-high resolution surface information	●	●	●
Inlens BSE Detector (Inlens energy selective backscatter)	Material contrast	O	O	O
Chamber SE Detector	Topographical information	●	●	●
VPSE Detector	High efficiency imaging in variable pressure mode	●*	●*	●*
AsB4 Detector (angular selective backscatter)	Compositional and crystallographic contrasts, 3D surface modeling	–	O	O
aBSD Detector	6 segment backscattered electron detector with up to 4 parallel channels for compositional and crystalline surface analysis, 3D surface modeling	O	O	O
aSTEM Detector (annular STEM)	7 segments transmission electron detection for high resolution transmission imaging	O	O	O
EDS Detector (energy dispersive spectroscopy)	Elemental analysis	O	O	O
EBSD Detector (electron backscatter diffraction)	Investigation of crystalline orientation	O	O	O
CL Detector	Material characterization by cathodoluminescence	O	O	O
WDS Detector (wavelength dispersive spectroscopy)	High energy resolution elemental analysis	O	O	O
3DSM (3 dimensional surface modeling)	Module for real time three dimensional surface modeling	O	O	O
80 mm Airlock	Sample transfer in less than 45 seconds	O	O	O
Plasma Cleaner	Gentle removal of sample contamination	O	O	O
NanoVP	Variable Pressure vacuum up to 500 Pa to reduce charging effect of non-conductive samples	O	O	O
Local Charge Compensation	Local gas injection to reduce charging effect of non-conductive samples	O	O	O
Local Charge Compensation and *In situ* Oxygen Cleaning	*In situ* cleaning of sample surface, reducing charging effect of non-conductive samples	O	O	O
Tandem decel	Beam deceleration of up to 5 kV for resolution and contrast enhancement at low landing energies	O	O	O

● included O optional

*included in NanoVP option

Technical Specifications

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Essential Specifications	ZEISS GeminiSEM 500	ZEISS GeminiSEM 450	ZEISS GeminiSEM 300
Resolution*	0.4 nm @ 30 kV (STEM)	0.6 nm @ 30 kV (STEM)	0.6 nm @ 30 kV (STEM)
	0.5 nm@ 15 kV	0.7 nm @ 15 kV	0.7 nm @ 15 kV
	0.9 nm @ 1 kV	1.1 nm @ 1 kV / 500 V	1.2 nm @ 1 kV
	0.8 nm @ 1 kV TD	1.0 nm @ 1 kV / 500 V TD	1.1 nm @ 1kV TD
	1.0 nm @ 500 V	1.5 nm @ 200 V	–
Analytical Resolution	–	2.0 nm @ 15 kV, 5 nA, WD 8.5 mm	–
Inlens BSE Resolution	1.0 nm @ 1 kV	1.2 nm @ 1 kV	1.2 nm @ 1 kV
Resolution in Variable Pressure mode (30 Pa)	1.4 nm @ 3 kV	1.4 nm @ 3 kV	1.4 nm @ 3 kV
		1.0 nm @ 15 kV	1.0 nm @ 15 kV
Acceleration Voltage		0.02 - 30 kV	
Probe Current	3 pA - 20 nA (100 nA configuration also available)	3 pA - 40 nA (100 nA or 300 nA configuration also available)	3 pA - 20 nA (100 nA configuration also available)
Magnification	50 – 2,000,000	12 – 2,000,000	12 – 2,000,000
Electron Emitter		Thermal field emission type, stability better than 0.2 %/h	
Detectors available in basic configuration		Inlens Secondary Electron detector	
		Everhart Thornley Secondary Electron detector	
		High efficiency VPSE detector (included in variable pressure option)	
Selected Optional Detectors	–	Angular selective backscattered detector (AsB4)	
		Annular STEM detector (aSTEM4)	
Store Resolution		Up to 32k × 24k pixels	
Specimen Stage		5-axes motorized eucentric specimen stage	
		X = 130 mm; Y = 130 mm	
		Z = 50 mm	
		T = -4° to 70°	
		R = 360° (continuous)	
		Additional stage options available on request	

* Upon final installation, the resolution is proven in the systems acceptance test at 1 kV and 15 kV in high vacuum

Count on Service in the True Sense of the Word

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Because the ZEISS microscope system is one of your most important tools, we make sure it is always ready to perform. What's more, we'll see to it that you are employing all the options that get the best from your microscope. You can choose from a range of service products, each delivered by highly qualified ZEISS specialists who will support you long beyond the purchase of your system. Our aim is to enable you to experience those special moments that inspire your work.

Repair. Maintain. Optimize.
Attain maximum uptime with your microscope. A ZEISS Protect Service Agreement lets you budget for operating costs, all the while reducing costly downtime and achieving the best results through the improved performance of your system. Choose from service agreements designed to give you a range of options and control levels. We'll work with you to select the service program that addresses your system needs and usage requirements, in line with your organization's standard practices.

Our service on-demand also brings you distinct advantages. ZEISS service staff will analyze issues at hand and resolve them – whether using remote maintenance software or working on site.

Enhance Your Microscope System.
Your ZEISS microscope system is designed for a variety of updates: open interfaces allow you to maintain a high technological level at all times. As a result you'll work more efficiently now, while extending the productive lifetime of your microscope as new update possibilities come on stream.

Profit from the optimized performance of your microscope system with services from ZEISS – now and for years to come.

>> www.zeiss.com/microservice

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