Product Information
Version 1.1

ZEISS GeminiSEM Family

Your Field Emission SEMs for High Contrast, Low Voltage Images From Any Sample

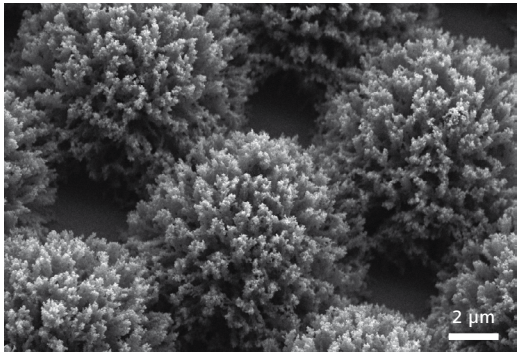
We make it visible.

Your Field Emission SEMs for High Contrast, Low Voltage Images From Any Sample

The GeminiSEM family stands for effortless imaging with sub-nanometer resolution and high detection efficiency, even in variable pressure mode.

GeminiSEM 500 combines proven Gemini technology with a novel electron optical design to deliver better resolution all around, especially at low voltage. With 20 times greater in-lens detection signal, you will always acquire crisp images fast and with minimum sample damage. The new variable pressure mode of the GeminiSEM family makes you feel like you're working in high vacuum.

Get a flexible and reliable field emission SEM for your research, industrial lab or imaging facility. With the GeminiSEM family you always acquire excellent images from any real world sample.



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

Animation

Simpler. More Intelligent. More Integrated.

More Detail at Low Voltage

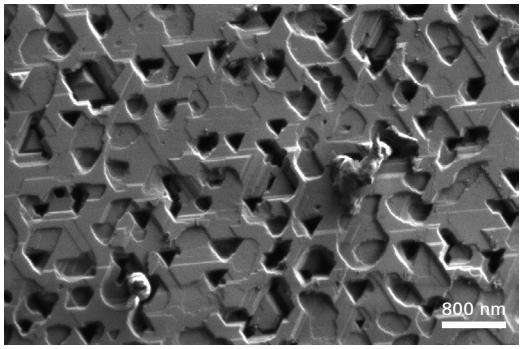
With GeminiSEM 500 you achieve high resolution at low voltages. Thanks to renowned Gemini technology your time-to-image is short. You easily resolve nanoscale details with high contrast at low beam voltages. At 500 V you can resolve 1.2 nm with perfect image quality, without requiring sample bias. At 1 kV you can image at 1.1 nm resolution.

More Signal at All Times

Image resolution means nothing without sufficient signal. That's why GeminiSEM 500 comes with significantly improved detection efficiency. Its new lens design boosts in-lens SE signal up to 20 times compared to classic SEM designs. By detecting electrons – exactly the right electrons – you will get maximum information from your sample. Depending on your individual experiment, use this advantage either to reduce time to image – or to work with very low currents to avoid sample damage.

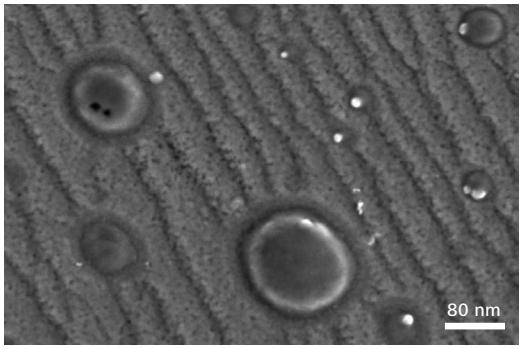
More Flexibility With Variable Pressure

With the GeminiSEM family, working in variable pressure (VP) mode feels like working in high vacuum. Now, for the first time, you can use true in-lens detection of secondary and backscattered electrons at pressures of up to 150 Pa with high resolution, contrast and signal-to-noise ratio. Acquire crisp images from even your most challenging, non-conductive samples.



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

Nano-twin lens for improved resolution at low beam voltages.

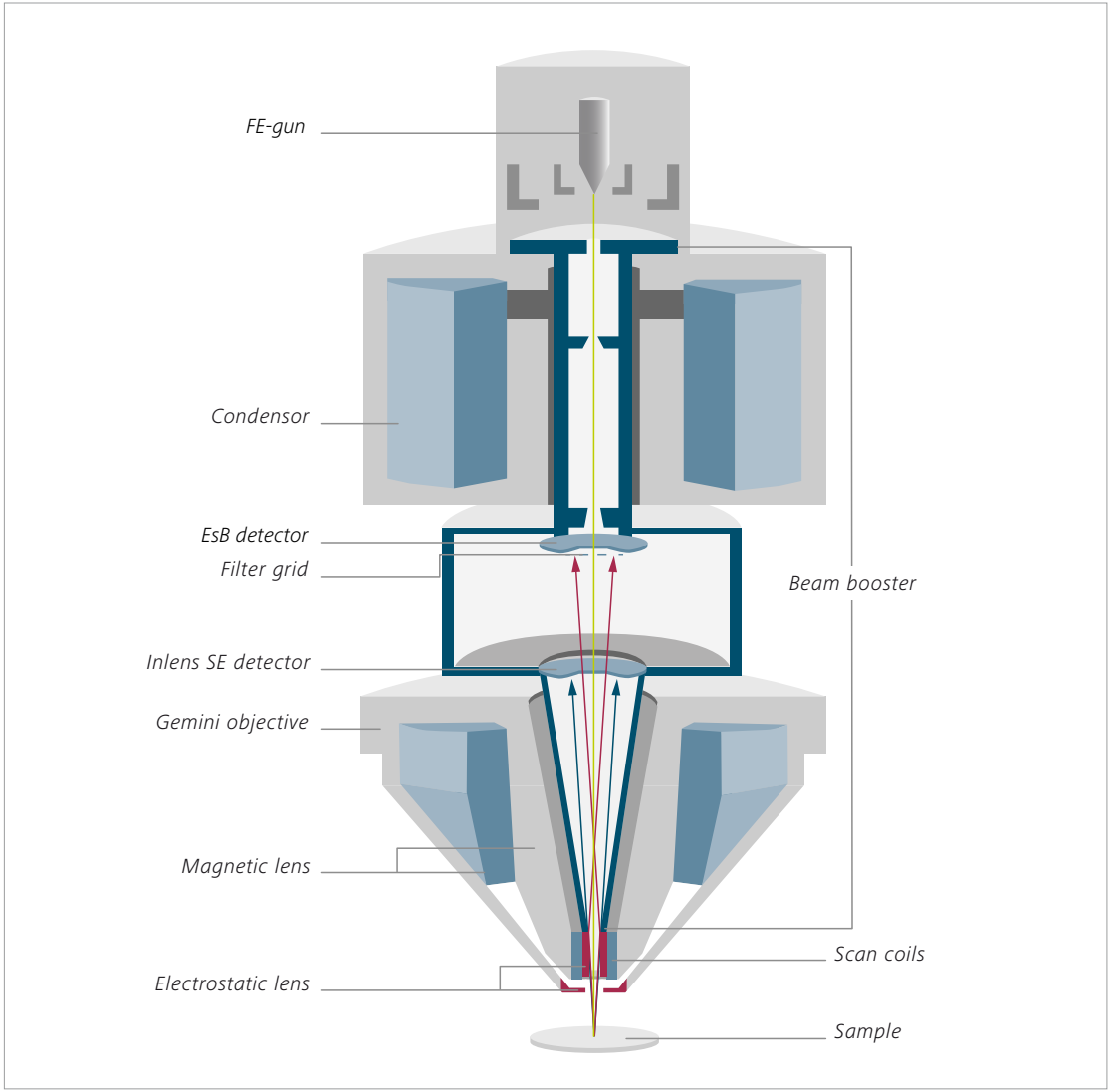


High resolution image of steel surface inclusions. The sample is highly ferromagnetic. Imaged at 1 kV with GeminiSEM 500 and Inlens SE detector.

Your Insight into the Technology Behind It

Based on Proven Gemini Technology

The GeminiSEM family is based on more than 20 years of perfecting Gemini technology. You can count on complete and efficient detection, excellent resolution and unsurpassed 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. The Gemini detection concept ensures efficient signal detection by detecting secondary (SE) and backscattered (BSE) electrons in parallel. These so-called 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 ultra-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.

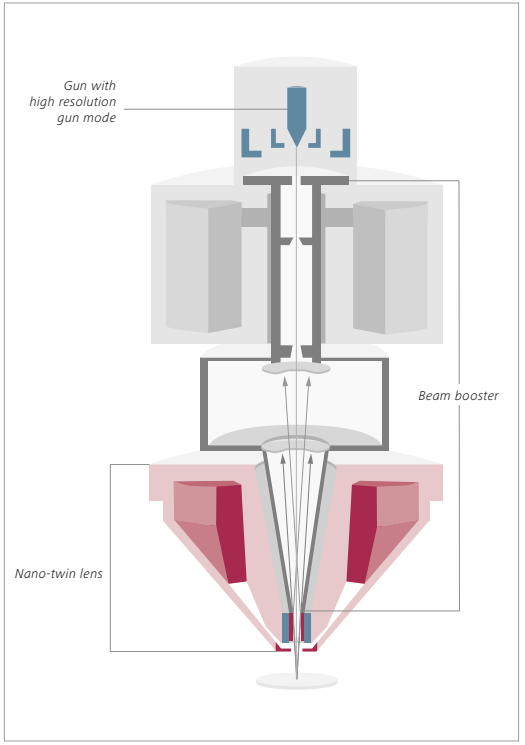


Gemini technology. Schematic cross-section of Gemini optical column with beam booster, Inlens detectors and Gemini objective.

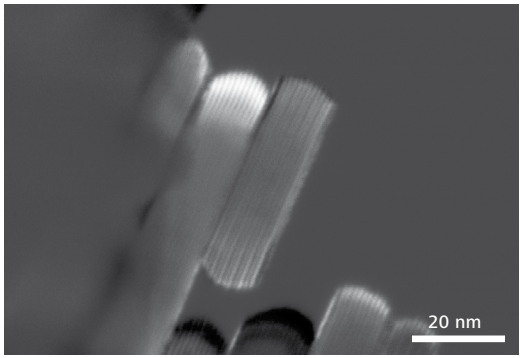
Your Insight into the Technology Behind It

More Detail. More Signal.

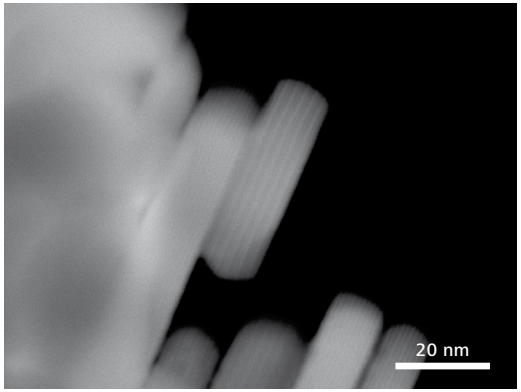
GeminiSEM 500 comes with an improved electron optical design. This lets you achieve outstanding resolution at low voltages with unprecedented signal detection efficiency. The newly designed Nano-twin lens further improves resolution at low and ultra-low beam voltages by optimizing geometry and electrostatic and magnetic field distributions. At the same time the in-lens detector signal is boosted by up to 20 times 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. 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.



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



$BaFe_{12}O_{19}$ nanoparticles with 1.1 nm (002) lattice spacing imaged with annular STEM, oriented darkfield, at 22 kV. Sample: courtesy of H. Romanus, TU Ilmenau, Germany.

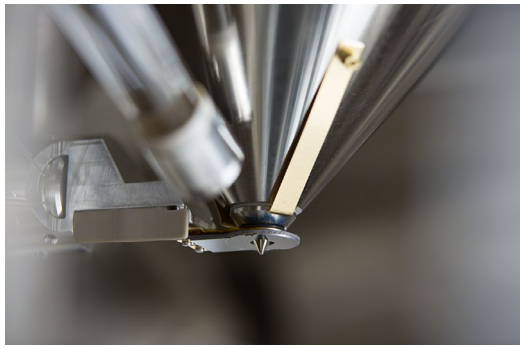


$BaFe_{12}O_{19}$ nanoparticles with 1.1 nm (002) lattice spacing imaged with annular STEM at 22 kV. High angle annular darkfield image showing mass thickness contrast between Ba and Fe with lattice resolution. Sample: courtesy of H. Romanus, TU Ilmenau, Germany.

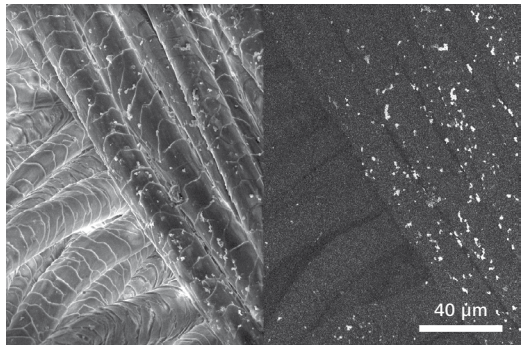
Your Insight into the Technology Behind It

More Detail. More Flexibility.

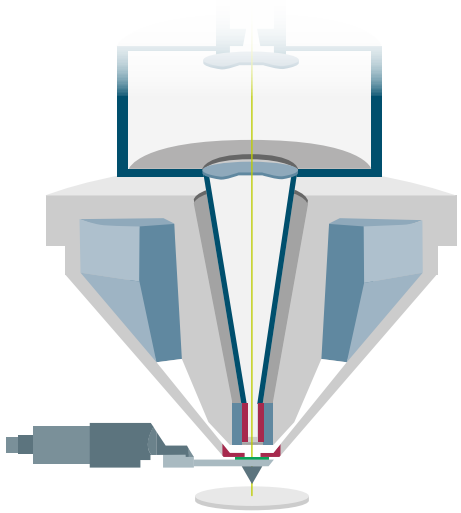
NanoVP technology offers you the best way to reduce charging on non-conductive samples without compromising in-lens detection capabilities and resolution. By inserting a differential pumping aperture below the objective lens, the path length of the incident beam in the gas is significantly shortened. This reduces beam broadening and thus enables both imaging of high resolution details and true in-lens detection up to 150 Pa. Hence Inlens SE and EsB detectors can be used simultaneously in VP mode for high resolution surface and materials contrast imaging. Pressure can even be elevated up to 500 Pa using chamber VPSE detection.



Retractable NanoVP differential pumping aperture and Nanotwin lens inside the SEM chamber, GeminiSEM 500.



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.



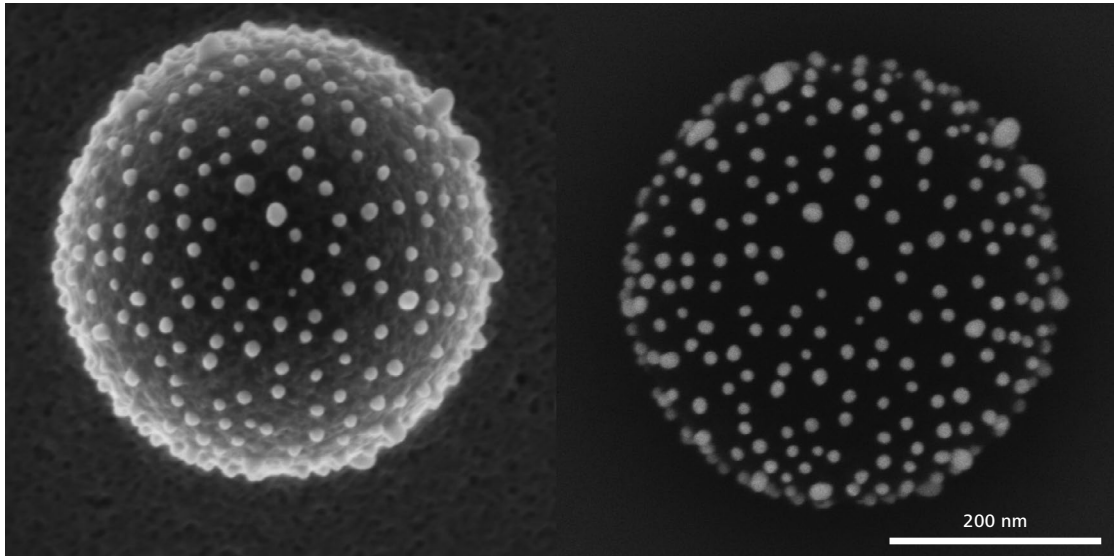
Schematic illustration of NanoVP differential pumping aperture with insulating o-ring underneath the Gemini objective lens in the SEM chamber.

Tailored Precisely to Your Applications

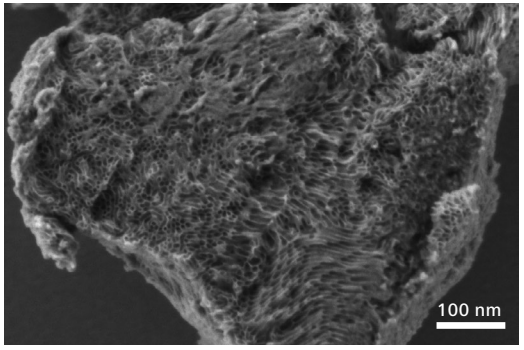
Typical Applications, Typical Samples	Task	ZEISS GeminiSEM Family Offers
Nano Science	High resolution characterization of carbon nanostructures, engineered and self organized nanosystems, and nanocomposite materials.	The GeminiSEM 500 Nano-twin lens lets you image beam-sensitive, nanoscale structures 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.
Imaging Facilities	Offering cutting edge imaging performance and maximum sample flexibility to a broad variety of users with a wide range of different fields of research.	The combination of high performance, high resolution imaging and variable pressure capabilities of up to 500 Pa makes the GeminiSEM family the ideal choice for maximum sample flexibility. With 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.
Industrial Applications	Semiconductor failure analysis	With its Nano-twin lens, GeminiSEM 500 enables rapid, reliable and damage-free characterization of nanoscale defects and sensitive resist structures at low beam energies.
	Analysis of high performance steel	The Gemini complete detection system combined with the GeminiSEM 500 Nano-twin lens let you characterize inclusions at ultra-high resolution and discriminate between different phases with unparalleled contrast.
	Characterization of polymers	With NanoVP technology you can characterize challenging, charging samples with unprecedented detail and contrast.
	Understanding the aging process of batteries	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 of damage. At the same time full analytical capabilities are available for compositional analysis of electrode materials.
Bio Science	Investigation of sub-cellular ultrastructure	You achieve high resolution transmission images of resin embedded cellular ultrastructure, with optimum contrast and minimal sample damage.
	High throughput mapping of large volumes or areas of cellular tissue	GeminiSEM 300 is the ideal choice for challenging biological applications, which requires large fields of view. Choose from application specific modules for array tomography, 3View in chamber microtomy and correlative microscopy.

ZEISS GeminiSEM Family at Work

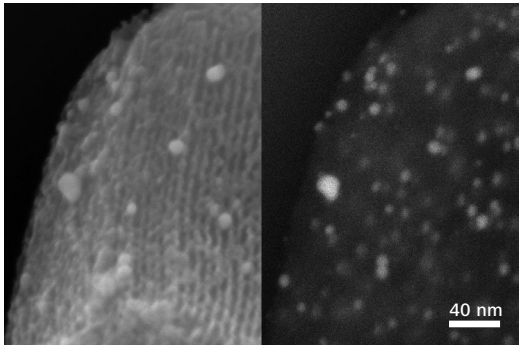
Nanosciences



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.



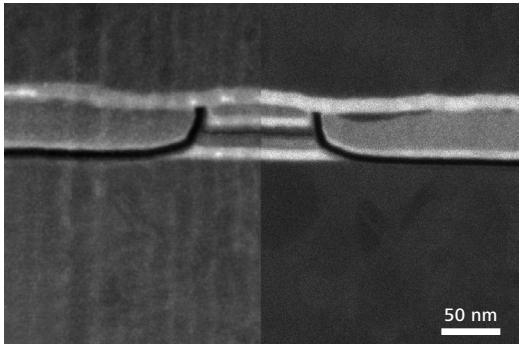
Mesoporous Silica, at 500 V, Inlens SE detector, imaged with GeminiSEM 500.



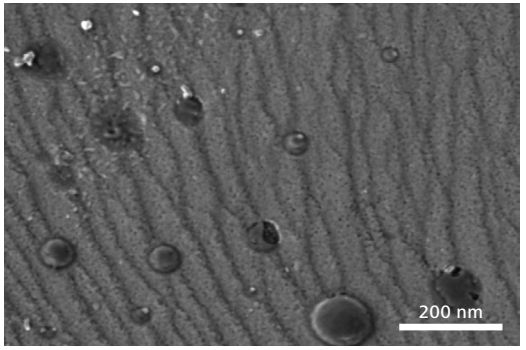
Catalysts, Zeolite with Ag nanoparticles, imaged at 5 kV using dual channel Inlens SE detector (left) and EsB detector (right).

ZEISS GeminiSEM Family at Work

Industrial Applications

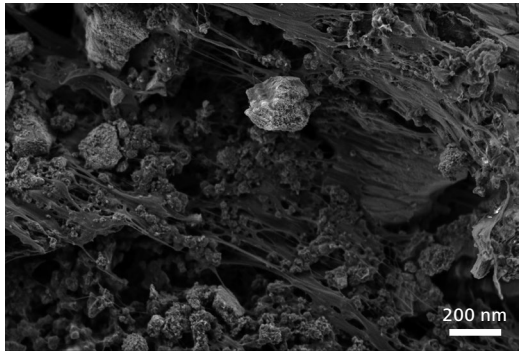


Data storage, harddisc readhead. Left: Inlens SE detector. Right: Inlens EsB detector.

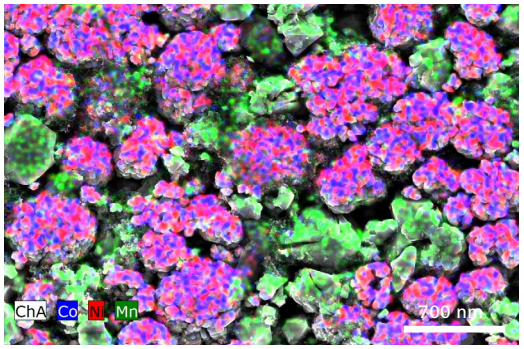


Inclusions in steel, Inlens SE detector, 500 V

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



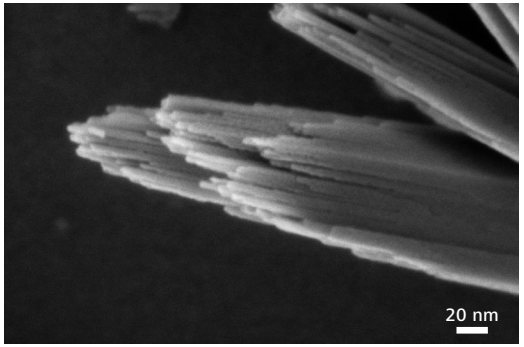
Lithium ion battery cathode, no beam damage of sensitive binder material, at 500 V. Sample: courtesy of T. Bernthaler, Materials Research Institute Aalen, Germany.



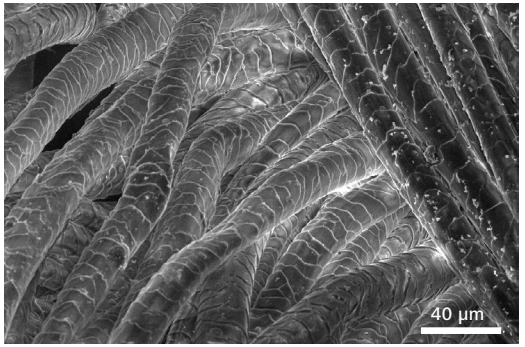
Lithium ion battery cathode, EDS compositional mapping, main constituents of the different oxides. Sample: courtesy of T. Bernthaler, Materials Research Institute Aalen, Germany.

ZEISS GeminiSEM Family at Work

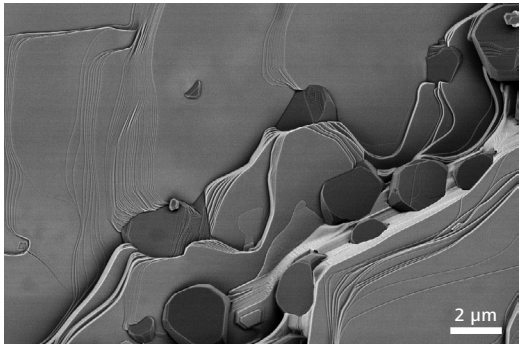
Imaging Facilities



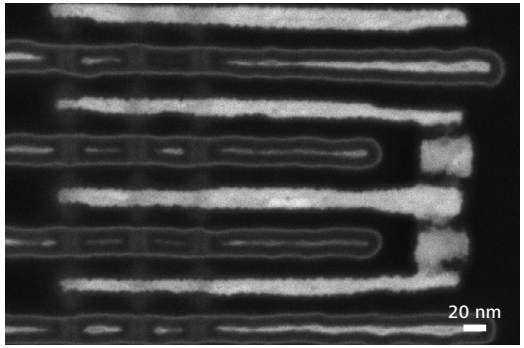
Nanometer spaced FeO(OH) crystals, at 1 kV. Sample: courtesy of L. Maniguet, INP Grenoble, France.



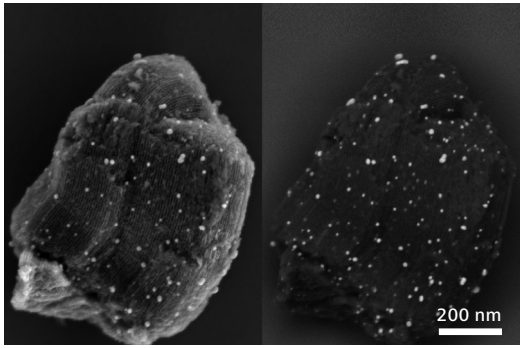
Silver nanoparticle coated natural fibers imaged with NanoVP at 80 Pa, at 10 kV. Sample: courtesy of F. Simon, Leibniz-Institute for Polymer Research Dresden e.V., Germany.



Ceramics, backscattered electron detector, at 3 kV.



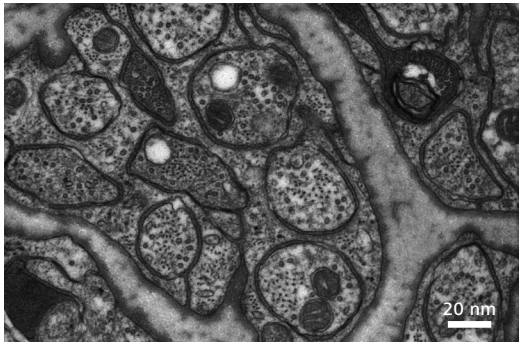
Semiconductor, computer chip, Inlens EsB detecter, at 3.5 kV.



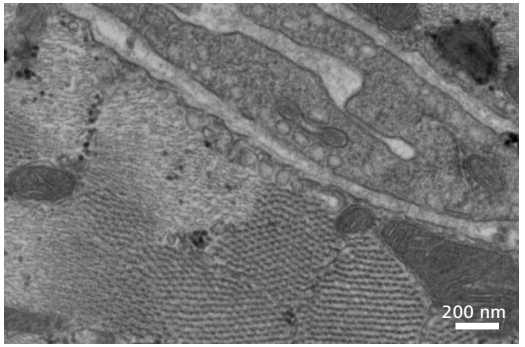
Catalyst: Silver nanoparticles embedded in Zeolite, Inlens SE detector (left) and EsB detector (right). EHT 1.5 kV. Sample: courtesy of G. Weinberg, Fritz-Haber-Institute of the Max-Planck society, Germany.

ZEISS GeminiSEM Family at Work

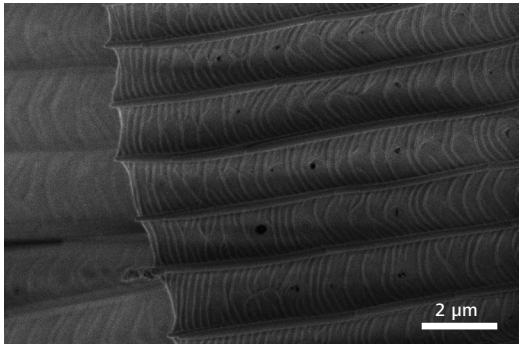
Bio Sciences



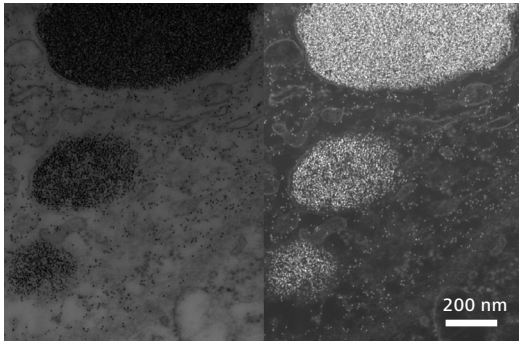
Mouse brain tissue, ultrathin section, STEM, brightfield, at 10 kV.



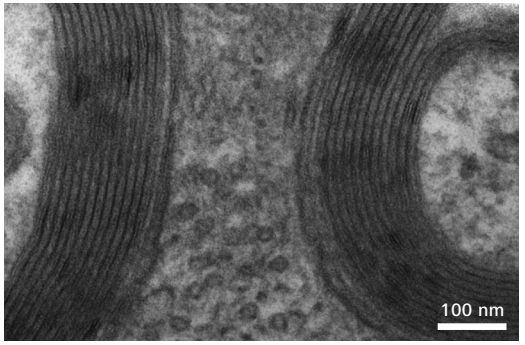
Mouse muscle tissue, ultrathin section, backscattered electron detection, contrast inverted, at 8 kV. Sample: courtesy of I. Röder, Bioquant, Heidelberg University, Germany.



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, ultrathin section, liver, 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: high angular annular darkfield, at 28 kV.



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

Expand Your Possibilities

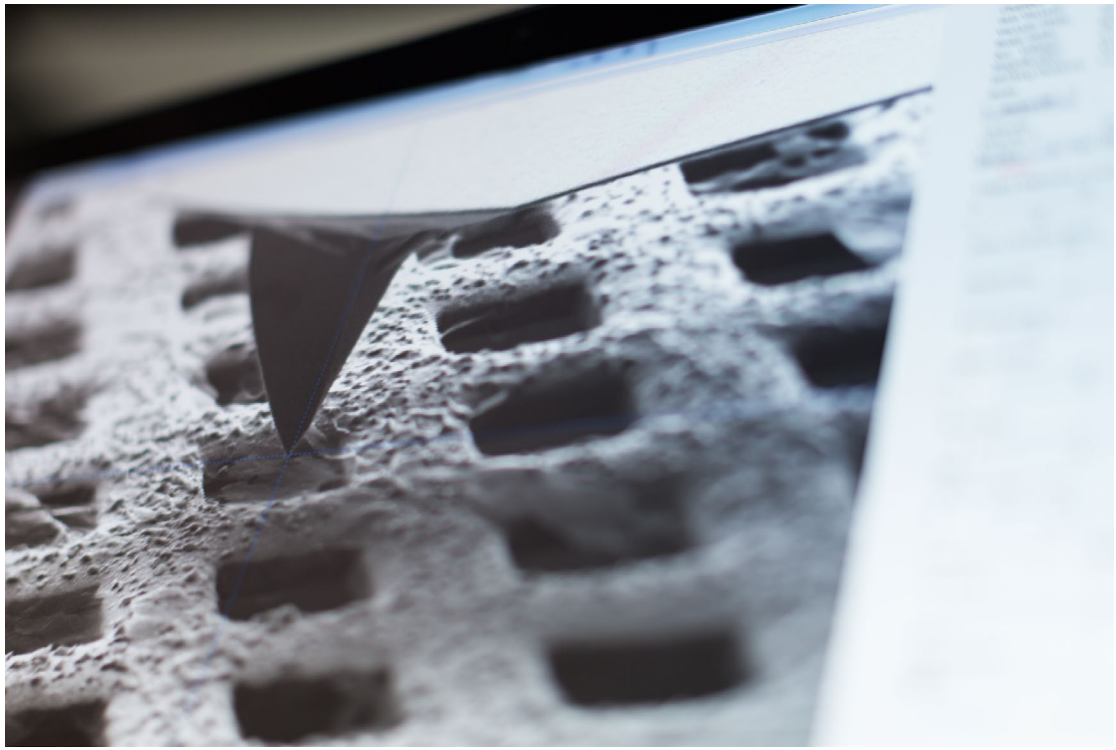
Your Integrated Solution for Atomic Force Microscopy in a SEM

Extend the possibilities of your SEM by combining it with a high end Atomic Force Microscope (AFM). Use the SEM's zoom capabilities to navigate your AFM tip directly to the region of interest. Access information about topography as well as mechanical, electrical and magnetic properties of the surface with sub-nanometer resolution. Use the AFM tip as a nanomanipulator with force feedback.

Benefit from:

- Calibrated 3D topography information with sub-nanometer resolution
- All standard and electrical scanning probe microscopy (SPM modes)
- Sample and tip exchange through load lock

By combining SEM and AFM you gain insights into a new level of information – for instance by investigating the influence of the electron beam to the potential of semiconductor samples measured by AFM.

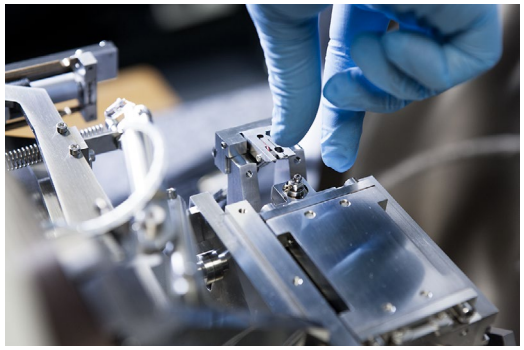


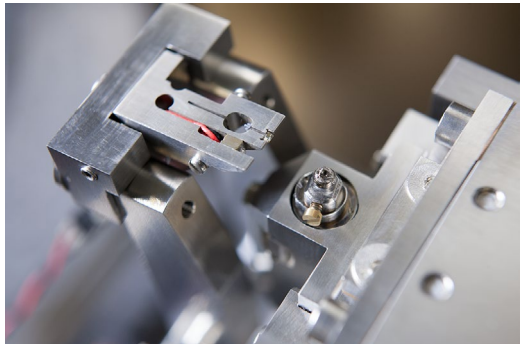
Expand Your Possibilities

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

Combine your GeminiSEM 300 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 in the most convenient way. 3View® is an ultra-microtome 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 from ZEISS is 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.

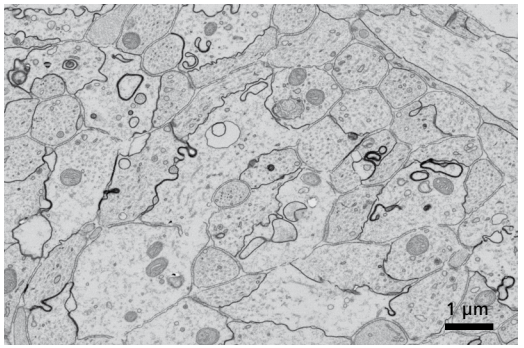




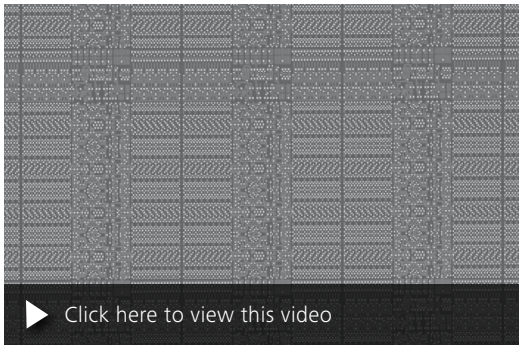
Expand Your Possibilities

ZEISS Atlas 5 – Large Area Automated Imaging

Atlas 5 turns your GeminiSEM into a solution for rapid, automated mapping of large areas. With a 16 bit scan generator and dual super-sampling signal acquisition hardware, you can acquire single images up to 32 k × 32 k pixels, with dwell times from 100 ns to >100 s, adjustable in 100 ns increments. You create large image montages resulting in a large field of view image, at SEM nanometer scale resolution. Efficient workflow-driven software guides you effortlessly through all imaging tasks while its many automated functions let you acquire data easier and faster than ever before. The optional Atlas 5 Array Tomography module is specifically designed for automated imaging of serial sections of biological tissue to enable 3D visualizations of large volumes.



Mouse, optical nerve tissue, ultrathin sections, backscatter detection. Detail of a mosaic collected with 5 nm image pixel size over 400 × 300 µm field of view. Sample: courtesy of J. Lichtman, Harvard, USA.



Computer chip, visualizing different areas. Light optical image was used for overview and navigation, automatically collected SEM images using predefined imaging protocols.

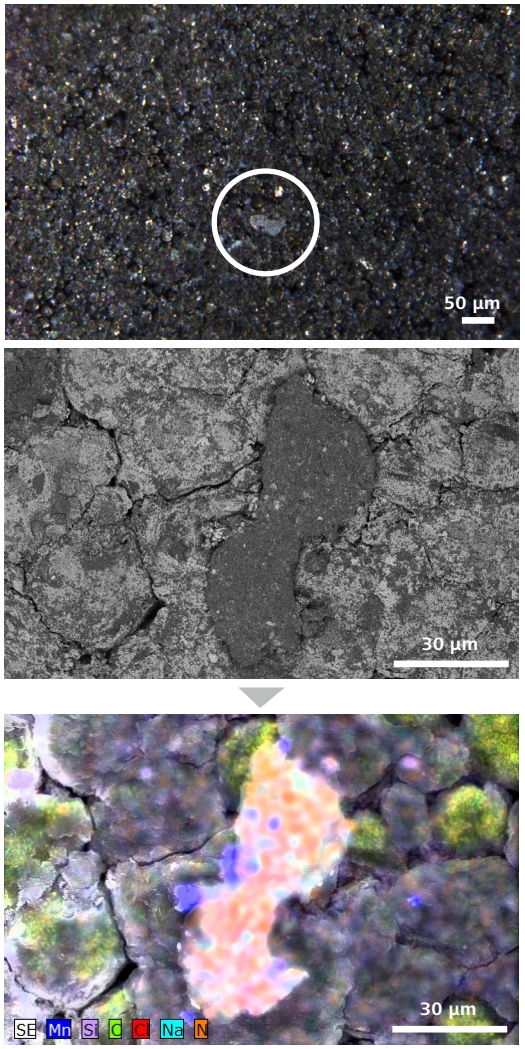
Expand Your Possibilities

Correlative Microscopy with Shuttle & Find

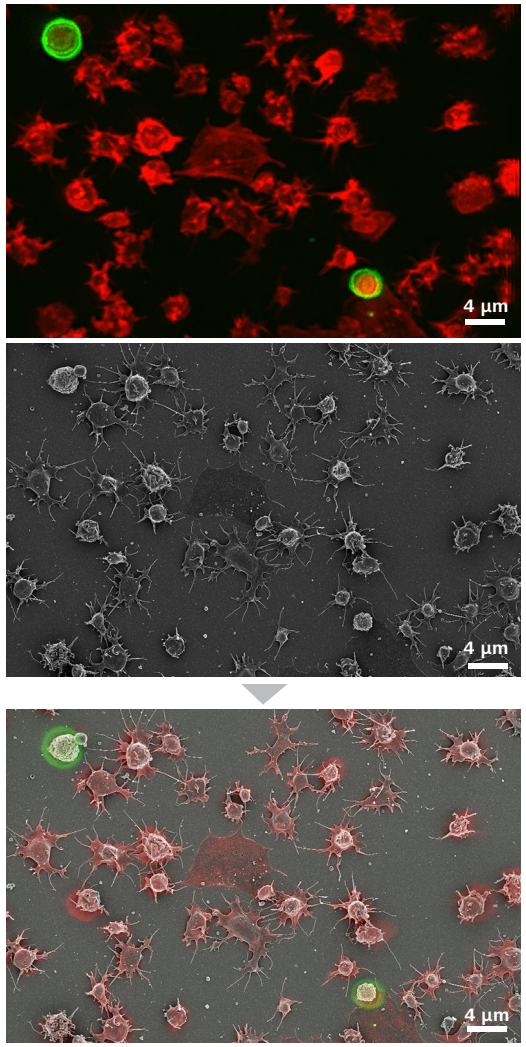
The Shuttle & Find software module allows an easy-to-use, productive workflow to overlay data from your light microscope and scanning electron microscope. Combine the optical contrast methods of your light microscope with the analytical methods of your electron microscope. Discover information about 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 continue examining the sample more extensively. Finally, correlate the images taken by the different microscopical techniques with the Shuttle & Find software.



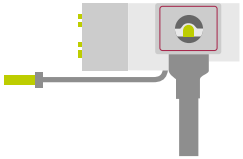
Lithium Ion battery. Top: light microscope image. Center: SEM image. Bottom: Overlay of both, combined with EDS analysis.



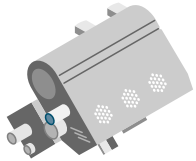
Platelets stained with AF647 (cellular platelet protein, false color: green) and AF555 – Phalloidin (false color: red). Top: Laser Scanning Microscopy fluorescence image. Center: SEM image. Bottom: Overlay. Courtesy of D. Woulfe and J. Caplan, University of Delaware, Newark, USA.

ZEISS GeminiSEM Family: Your Flexible Choice of Components

Airlock

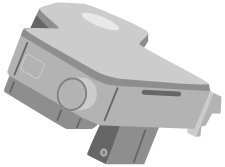


Plasma Cleaner



Stage options
(e.g. AFM, tensile, cryo, heating)

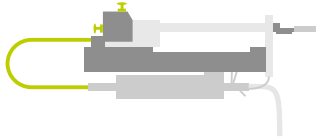
WDX



***In situ* cleaning**

EBSD

STEM



EDX

ZEISS GeminiSEM Family: Your Flexible Choice of Components

Selected Detectors and Accessories	Detectors and Accessories Offer	ZEISS GeminiSEM 500	ZEISS GeminiSEM 300
Inlens SE Detector (in-lens secondary electron)	Ultra-high resolution surface information	●	●
Inlens EsB Detector (in-lens energy selective backscatter)	Material contrast	○	○
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 modelling	–	○
BSD Detector	5 segment backscattered electron detector with up to 4 parallel channels for compositional and crystalline surface analysis, 3D surface modelling	○	○
aSTEM Detector (annular STEM)	7 segments transmission electron detection for high resolution transmission imaging	○	○
EDS Detector (energy dispersive spectroscopy)	Elemental analysis	○	○
EBSD Detector (electron backscatter diffraction)	Investigation of crystalline orientation	○	○
CL Detector	Material characterization by cathodoluminescence	○	○
WDS Detector (wavelength dispersive spectroscopy)	High energy resolution elemental analysis	○	○
3DSM (3 dimensional surface modelling)	Module for real time three dimensional surface modelling	○	○
80 mm Airlock	Sample transfer in less than 45 seconds	○	○
Plasma Cleaner	Gentle removal of sample contamination	○	○
NanoVP	Variable Pressure vacuum up to 500 Pa to reduce charging effect of non-conductive samples	○	○
Local Charge Compensation	Local gas injection to reduce charging effect of non-conductive samples	○	○
Local Charge Compensation and *In situ* oxygen cleaning	*In situ* cleaning of sample surface, reducing charging effect of non-conductive samples	○	○

● included ○ available

* in NanoVP option

Technical Specifications

Essential Specifications	ZEISS GeminiSEM 500	ZEISS GeminiSEM 300
Resolution*	0.6 nm @ 15 kV	0.8 nm @ 15 kV
	1.1 nm @ 1 kV	1.4 nm @ 1 kV
	1.2 nm @ 0.5 kV	
	1.7 nm at chamber pressure of 30 Pa and at 3 kV (with variable pressure option)	
Acceleration Voltage	0.02 – 30 kV	
Probe Current	3 pA up to 20 nA (100 nA configuration also available)	
Magnification	20 – 2,000,000 ×	12 – 2,000,000 ×
Electron Emitter	Thermal field emission type, stability better than 0,2%/h	
Detectors included in Base System	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
	Annular STEM detector (aSTEM 4)	
	High efficiency SE2 detector	
	Cathodoluminescence detector	
Frame Store	Up to 32k × 24k pixels	
Specimen Stage	5-axes motorized eucentric specimen stage	
	X = 130 mm; Y = 130 mm	
	Z = 50 mm	
	T = -3° to 70°	
	R = 360° (continuous)	
	Additional stage options available on request	

*Resolution specifications are at optimum working distance and are dependent on configuration

Count on Service in the True Sense of the Word

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.

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Carl Zeiss Microscopy GmbH
07745 Jena, Germany
microscopy@zeiss.com
www.zeiss.com/geminisem

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