Product Information

Interactive PDF

INTERNET-LINK

VIDEO/ANIMATION

Release 1.0

MERLIN Series

From Imaging to Your Complete Lab: Analytical Power for the Sub-Nanometer World

ZEISS

We make it visible.

Use Tomorrow’s Analysis Lab Today

With the MERLIN series you acquire images within seconds. Achieve atomic resolution. And measure and analyze surfaces entirely in 3D.

Whether it’s the entry level version MERLIN Compact with the proven GEMINI I electron column, or the high end version with the high resolution GEMINI II column. The MERLIN family is your solid investment in the future: the field emission scanning electron microscope that grows right alongside your challenges. With 15 ports for detectors and many analytical options, it brings you all the flexibility you will ever need.

MERLIN: Simpler. More intelligent. More integrated.

The MERLIN series grow with your needs

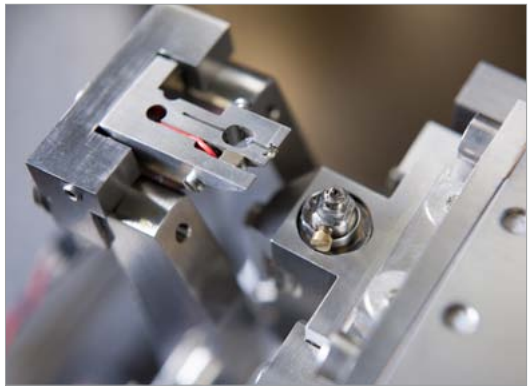
The FE-SEM of the MERLIN series allow you to capture, analyze and supplement high-resolution images to get total information out of your sample. The MERLIN sample chamber comes with 15 ports for detectors and a range of analytical options to support you from capture to complete analysis. Your options expand as your challenges grow: The MERLIN series can be comprehensively upgraded.

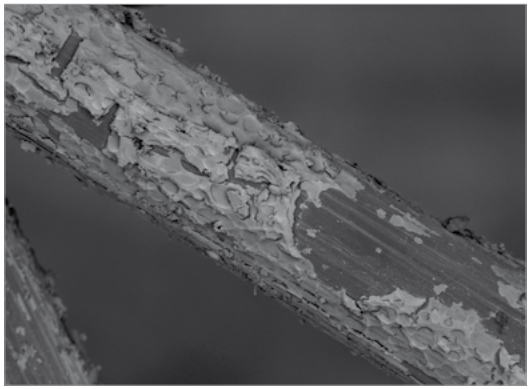
As versatile as your applications

Use the Atomic Force Microscopy option to get information on semiconductor samples at atomic resolution. Add the ultramicrotome 3View to achieve 3D reconstructions of large biological samples. The platform concept and Smart Detector Technology of the MERLIN series make it easy to upgrade your system with plug & play extensions - any time you wish. You quickly integrate all the latest analysis solutions on the market, thanks to the open programming interface of the system software.

Analyze your samples comprehensively and conveniently

The Complete Detection System of the MERLIN series combines different detectors:
the in-lens SE-Detector for high resolution images, the in-lens Energy selective Backscatter Detector (EsB) for impressive material contrast, the in-lens duo detector for combined SE and BSE imaging or Angle selective Backscatter Detector (AsB) for crystalline surface structure analysis. You cover all types of materials and analyze the information individually. Or link the detector signals together and gain even more insights. Simply select and configure the detector combination you need for your application.





Your Insight into the Technology Behind It.

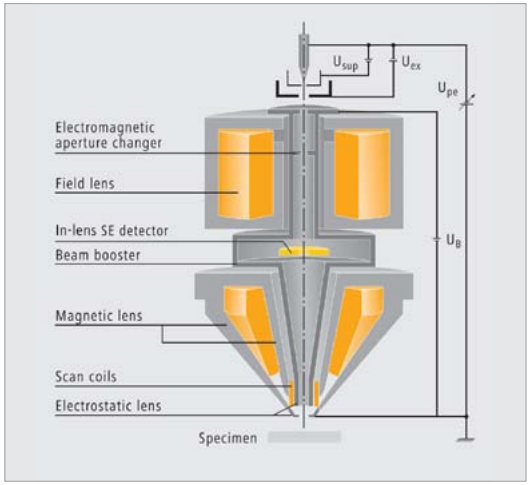
The Complete Detection System: separate electrons according to energy and angle of incidence

The MERLIN series offer a complete detection system with a large variety of different detectors. By combining EsB- (Energy selective Backscatter), in-lens SE- or in-lens Duo- as well as AsB- (Angle selective Backscatter) detectors the system delivers complete information of material, topography or crystalline from your sample.

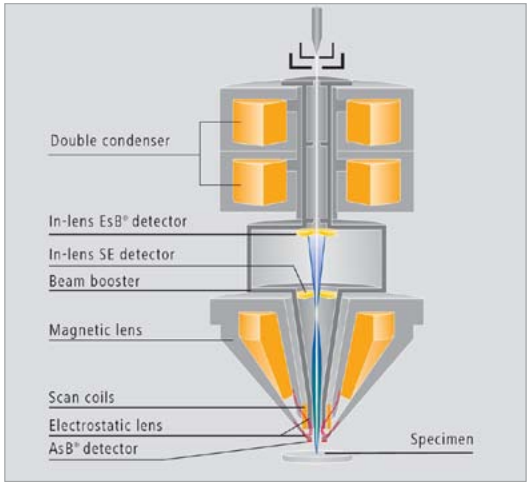
The primary electron beam generates secondary electrons (SE) and backscattered electrons (BSE). The SEs precipitate directly from the topmost nanometers of your sample with energy of less than 50 eV and show the topography of the surface. These SEs are accelerated back into the column due to the unique Beam Booster concept and the excitation lens directs them to the annular in-lens SE Detector. Depending on the surface condition of your sample, the MERLIN series detects the SEs over a wide angular range.

The BSEs are generated below the surface and provide highly specific information about the material characteristics of your sample. Their energy level is close to that of the primary electrons hitting the sample. The BSEs typically appear conically at a 15 degree angle to the primary electron beam. They are attracted by the Beam Booster of the GEMINI column and projected into the column. Due to the different energies of SE and BSE they are following different trajectories within the Beam Booster and the BSEs can pass the in-lens SE detector and are collected by the EsB detector.

Additionally the EsB detector enables an energy selection of the BSEs. If the angle is larger than 15 degree, the BSEs cannot make their way into the column, but are stopped and detected by the AsB-Detector mounted at the lower pole piece of the lens. The large-angle BSEs provide highly specific information about the material and crystalline information of your sample.



GEMINI I column (MERLIN Compact)



GEMINI II column (MERLIN)

Expand Your Possibilities

Atomic Force Microscopy: A new depth of information

SEM is your technology of choice if you want to image surfaces on the nm scale. However these information often suffer from the lack of missing additional information: How is the surface 3D structure and which information will be additionally possible below nm on atomic scale?

The integrated AFM option within the MERLIN series gives the answer to these questions. By the stage exchange option the AFM system is ready within minutes delivering atomic surface topographical resolution in 3D. Due to the AFM techniques these information are already calibrated on atomic scale level opening the next resolution dimension to SEM users.

Compared to stand alone AFM systems, the combination of AFM/SEM offers even more: Thanks to the high resolution large area overview provided by the SEM you profit from fastest navigation of the cantilever system directly to the region of interest. Easy to use and with high throughput.

By combining those two methods 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.

The AFM option offers:

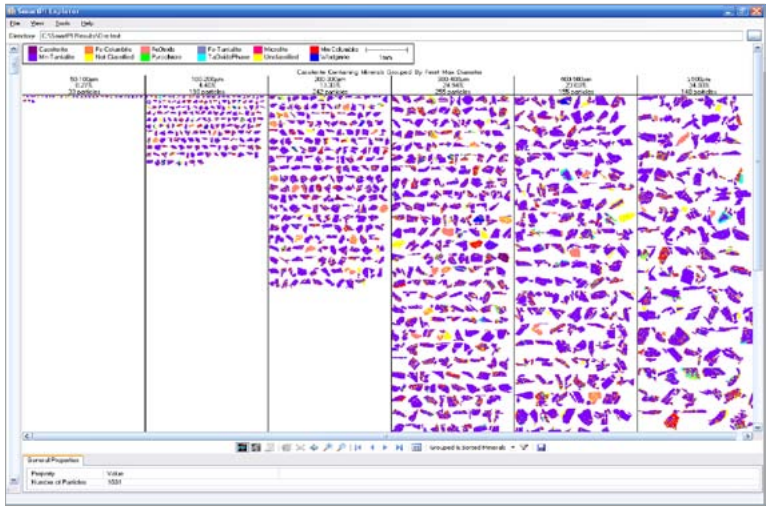
- Scan range (X x Y x Z) 10 µm x 10 µm x 1 µm
- Subatomic resolution in three dimensions
- Laser detection of cantilever deflection
- All standard and electrical SPM modes
- Load-lock based cantilever and sample exchange

Expand Your Possibilities

Particle Analysis
From manufacturing cleanliness to steel production and the optimization of natural resources; particle analysis solutions from Carl Zeiss automate your workflow for increased reproducibility.

SmartPI
SmartPI (Smart Particle Investigator) is a powerful particle analysis tool for your scanning electron microscope (SEM) from Carl Zeiss. Automatically detect, investigate and characterize particles of interest in your sample.

Application specific plug-ins provide pre-built recipes and report templates tailored specifically to the industry you are working in.



Data from automated SmartPI analysis displayed on SmartExplorer. Image of application shows particle size distribution including number per group and volume percentage contribution. Colours are representative of different mineralogy.

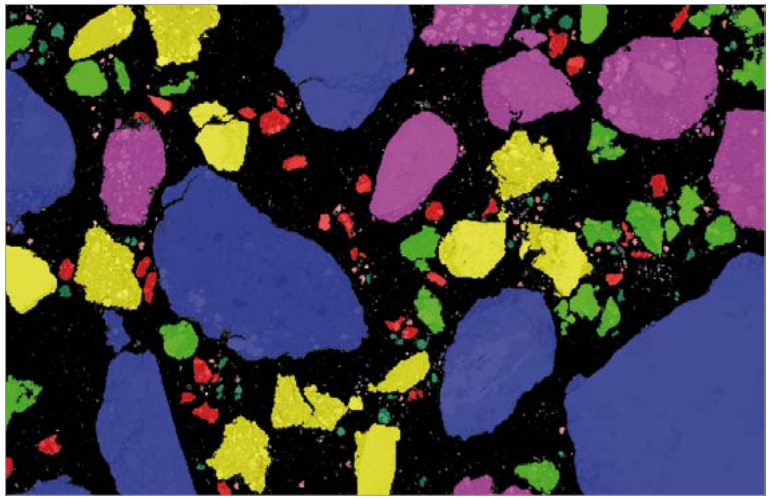
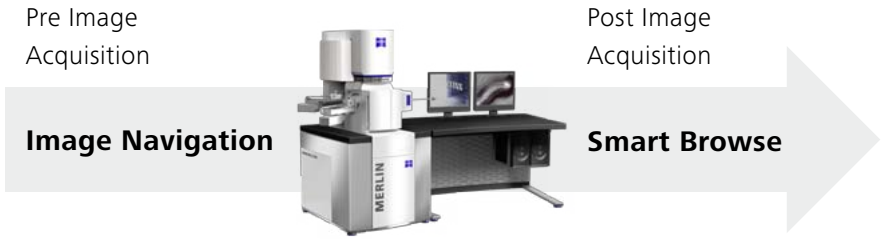


Image from SmartPI Image Analysis, displaying particles of different size ranges; in which the size range is defined by a unique colour

Expand Your Possibilities

SmartSEM Image Navigation
Image Navigation is an integrated software and hardware tool enabling users to navigate between sample stubs and specific areas of the sample using a digital image of the sample holder. This productivity enhancing module speeds up operator driven workflows before image acquisition.

SmartBrowse
SmartBrowse is a contextual imaging tool for post image acquisition, capable of presenting images taken with multiple detectors at different magnifications in a single, interactive image.



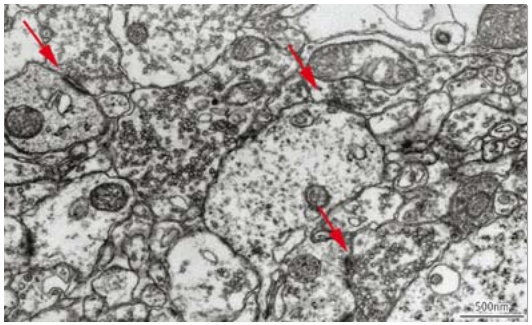
Expand Your Possibilities

ATLAS - Large Area Imaging

ATLAS combines a 16 bit scan generator and dual super-sampling signal acquisition hardware with image processing and control software for your electron microscope from Carl Zeiss. Acquire images with up to 32 k x 32 k pixels, with dwell times from 100 ns to > 100 s, adjustable in 100 ns increments. Save your images with eight or sixteen bits of intensity. With the ATLAS Mosaic Tool you create large image montages, automatically moving from image tile to tile, and mosaic site to site, resulting in an Extreme Field of View image, at SEM nanometer scale resolution.

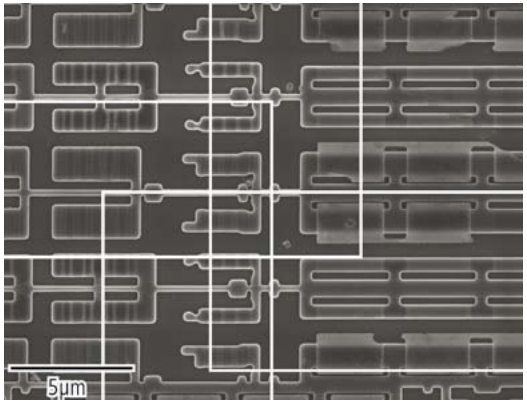
ATLAS provides:

- A reduced number of tiles to acquire, reducing stage motion delay and areal fraction of each image lost to overlap
- A reduced number of overlap seams, leading to less beam damage and degradation of the sample
- A reduced computational complexity

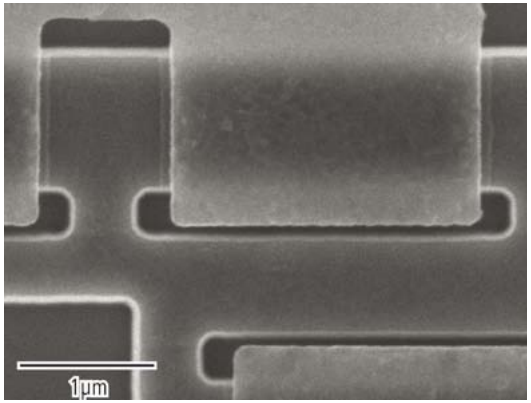


Single 30 nm thick section of mouse brain imaged with backscattered electrons at 8 kV using ΣIGMA/ Results courtesy of Dr. Bobby Kasthuri, Harvard University Center for Brain Science.

A 65 nm technology node graphics processor integrated circuit, stripped to its silicon substrate with HF acid etching. The mosaic consists of 49 images, each ~ 500 Megapixels, automatically stitched by the VE-Viewer into a ~ 1/3 mm x 1/3 mm mosaic.



A magnified view of the junction between four tiles as shown above, with tile boundaries displayed in white, as otherwise the boundaries between tiles are virtually seamless.



A sample of the high resolution detail visible across the entire Extreme Field of View mosaic.

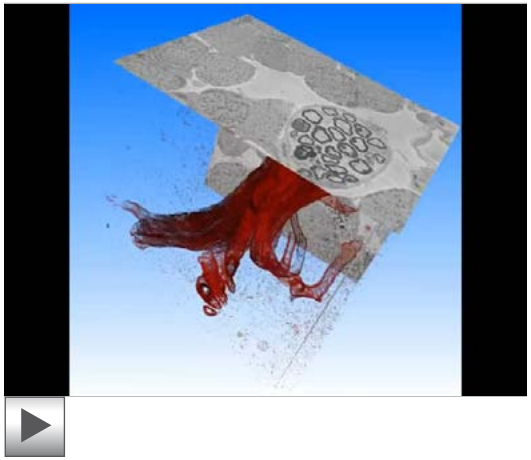
Expand Your Possibilities

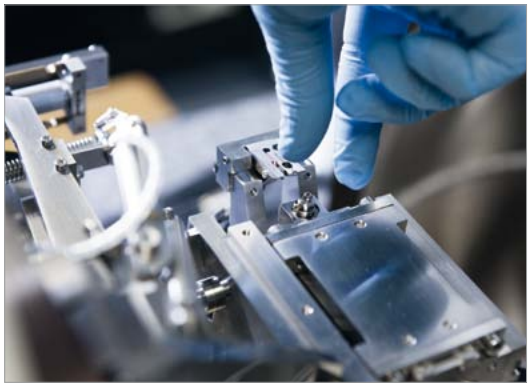
Fast and Convenient 3D Imaging for Tissue Samples in the FE-SEM

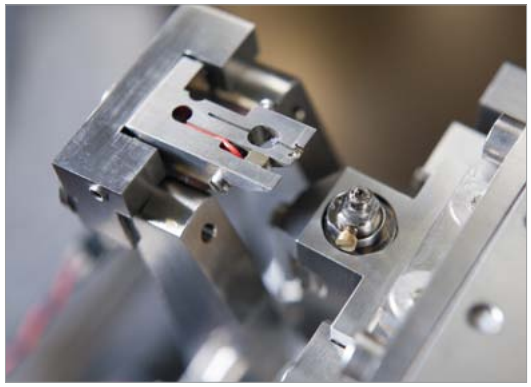
Combine your MERLIN with 3View® technology from Gatan Inc. to acquire high resolution 3D data from resin embedded cell and tissue samples. In the shortest possible time and in the most convenient way.

3View® is an 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.

MERLIN from Carl Zeiss is ideally suited to support this application. The unique GEMINI column technology delivers images with TEM-like quality and allows fields of view of hundreds of microns at nanometer resolution.







Expand Your Possibilities

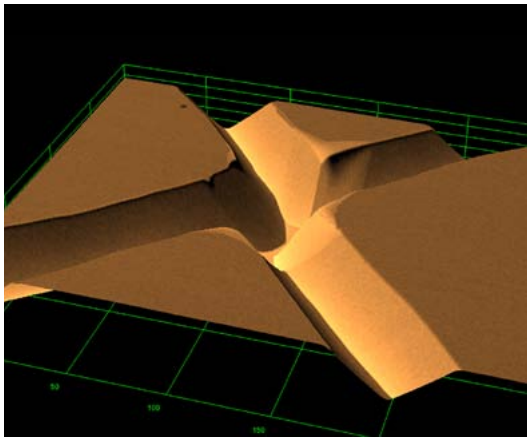
3DSM software package: Reconstruct images in 3D

Your scanning electron microscope is ideally suited for 2D inspection and metrology of a wide variety of samples. However, their 3D capabilities are still limited, especially when it comes to qualitative surface characterization. Here, simply use 3DSM to perform 3D surface reconstruction. 3DSM is a PC-based application capable of providing topographical information of your samples. The application works on basis of individual AsB detector signals, visualizing the resulting 3D model in real time.

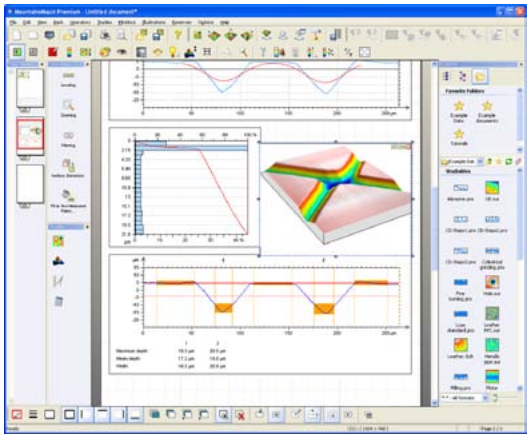
3DSM Metrology: Take automatic measurements and documentation

Use the 3DSM Metrology software powered by Mountains® Technology along with 3DSM of the MERLIN series. Visualize and analyze surfaces and generate complete metrology reports.
The package includes:

- Full characterization of surfaces and profiles with parameters such as step heights, distances, nano-contour, surface texture (roughness & waviness), particle- & grains analysis
- Fast report creation with full metrological traceability
- Automated generation of measurements and reports including parameters sets based on ISO 25178, DIN, ASME and other local standards for routine quality control
- Correlation of SEM, Light Microscopy and AFM data in 2D and 3D
- Graphical user interface in 10 different languages, including comprehensive online help



3D model of a node in a mesh grid etched in silicon re-constructed using 3DSM



Metrology analysis of etched silicon sample using 3DSM metrology software package

Expand Your Possibilities

Correlative Microscopy with Shuttle and Find
The Shuttle & Find software module allows an easy-to-use, productive workflow between your light microscope and electron microscope.

Combine the optical contrasting techniques of your light microscope with the analytical methods of your electron microscope. Discover information about the structure, function and chemical composition of your sample.

How it works:
Using a special specimen holder with three fiducial markers, a coordinate system is calibrated semi-automatically within seconds using Shuttle & Find software. Use the light microscope to capture interesting regions of your sample. Then relocate a region in the electron microscope with significantly increased resolution. Examine your sample more extensively. Achieve reproducible results.

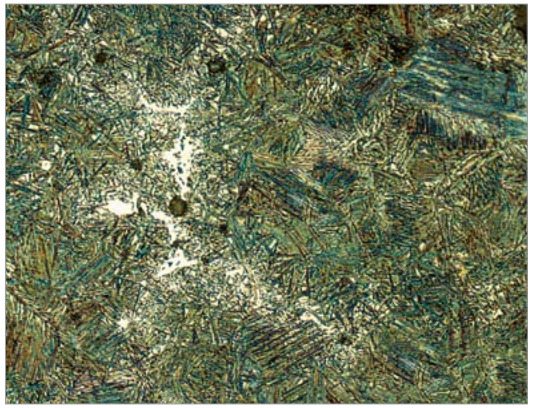
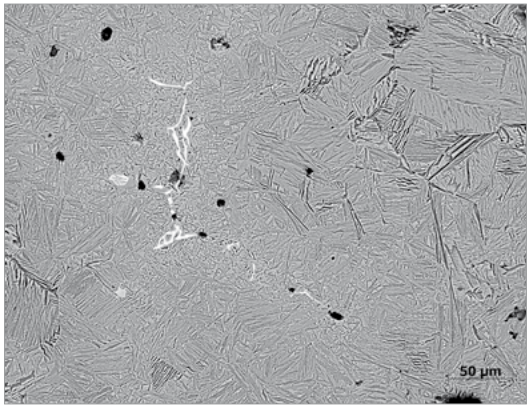


Image of an ADI sample made using a light microscope
Magnification: 400:1

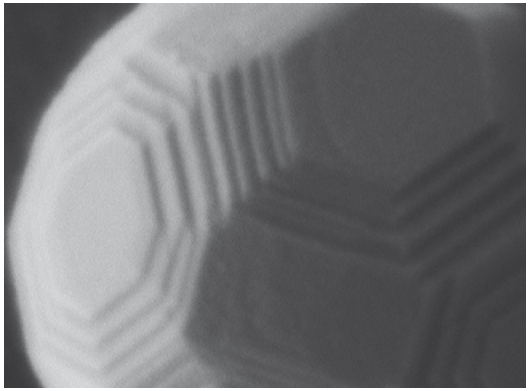


BSE image of the same region of interest:
the microstructure is clearly visible

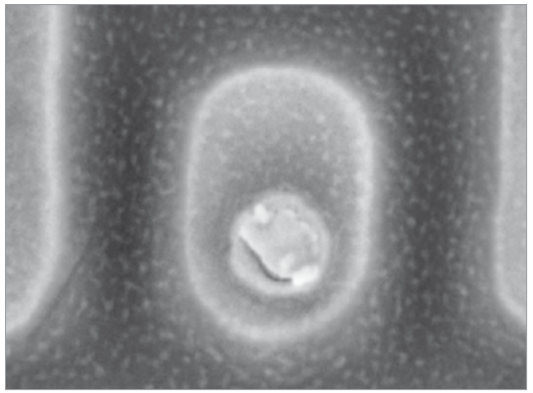
Tailored Precisely to Your Applications

Typical applications, typical samples	Task	The MERLIN series offers
Materials research	Improved nano analysis: combined analytical procedures and retrieve of maximum amount of information from your sample	High resolution at high voltages: GEMINI II column achieves high resolution even with high probe voltages. The MERLIN family is designed for quick capture of EDX, WDX, EBSD and CL signals. EsB-Detector allows you to achieve ideal material contrast. Its modular system architecture will keep you at the cutting edge for decades to come.
Quality assurance, quality control, industrial routine	Quick and comprehensive information from your samples	Complete Detection System allows you to capture topographical and crystalline data of the surface of your samples. Thr MERLIN series provides high resolution images of non-conducting materials. Your samples are cleaned in situ so the image quality is always brilliant. 3D models of the surfaces are generated in situ. Its modular system architecture will keep you at the cutting edge for decades to come.
Life Sciences	Analyze samples easily with high throughput and get large volumes of data	The MERLIN series delivers high beam voltage, allowing you to capture high resolution, large area images of cell structures quickly. The column adjusts automatically to create the best conditions for your imaging every time: even less experienced users will achieve excellent results. You capture up to four different detector signals simultaneously and compare the images without making further adjustments. The MERLIN series 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 below the nano boundary and benefit from achieving sample transfers in less than 60 seconds. Its modular system architecture will keep you at the cutting edge for decades to come.

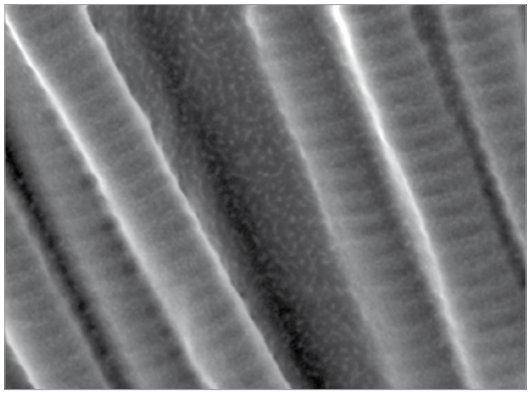
MERLIN at Work



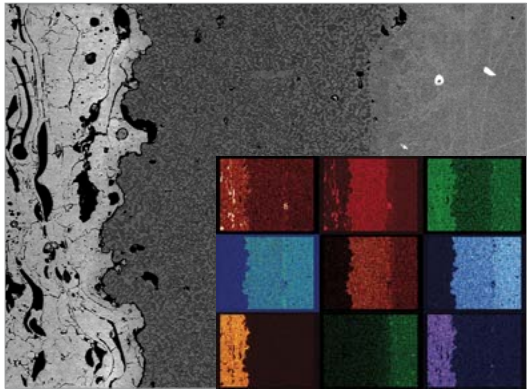
High-resolution, low kV, in-lens SE image of an aluminum-oxide (Al2O3) sphere. The MERLIN series offers high-resolution examinations under extremely low kV conditions (< 500 V) as is typical of semiconductor examinations.



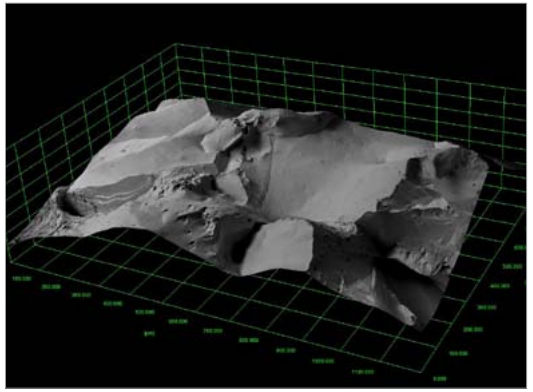
Detail of the same semiconductor device, 2 kV, 57 pA: even at high magnifications no charging is observed due to low beam current.



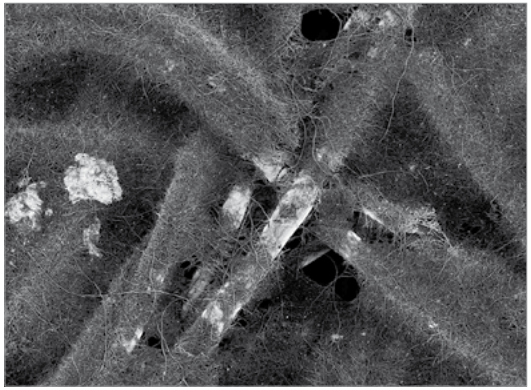
Bovine scleral collagen fibrils with D-periodicity and matrix with nanostructure of ~5 nm in diameter (bright color), 500 V, 30 pA: details that were never seen with an SEM before.



Material analysis of an airplane turbine. In-lens SE image showing different material components. Fastest EDX mappings showing detailed material contributions of different regions of the background image.
Courtesy of Dr. Penkalla, Research Center Juelich, Germany.



3DSM animation of a fracture plane acquired with AsB4 detector



Carbon nanotubes investigated at 30 V, 250 pA, in-lens detector: the bright areas are thin layers of polymer. Detailed imaging is possible even at lowest energies.

MERLIN: Your Flexible Choice of Components.

MERLIN® Compact
The GEMINI® I column enables high resolution and high probe current. Ideal for analytic applications. High resolution imaging with in-lens SE detector. Unique material contrast possible with optional InlensDuo detector.

MERLIN® VP Compact
The GEMINI® I column enables high resolution and high probe current. VP mode and optional CC mode for non-conductive samples. Ideal for analytic applications. High resolution imaging with in-lens SE detector or unique material contrast with optional InlensDuo.

MERLIN®
The GEMINI® II column enables high resolution even at low voltage and even at high probe current. Maximum analytical possibilities. Unique material contrast with EsB Detector combined with simultaneous high resolution imaging with in-lens SE detector.

www.zeiss.com/merlin-configurator

MERLIN: Your Flexible Choice of Components.

Detectors and accessories	Detectors and accessories offer	MERLIN Compact	MERLIN VP Compact	MERLIN
In-lens SE Detector	Highest resolution information	○	○	○
In-lens Duo Detector (replaces in-lens SE Detector)	Combination of In-lens SE and In-lens BSE imaging	●	●	X
In-lens EsB Detector	Material contrast	X	X	●
Chamber SE Detector	Topographical information	○	○	○
HE-SE2 Detector (replaces chamber SE detector)	High efficiency topographical information	●	●	●
VPSE Detector	High efficiency imaging in variable pressure mode	X	○	X
AsB Detector	Crystalline surface analysis	●	●	●
AsB4 Detector (replaces AsB Detector)	In situ 3D surface reconstruction	●	●	●
4QBSD Detector	Crystalline surface analysis	●	●	●
STEM Detector	High resolution SEM images of TEM samples	●	●	●
EDX Detector	Elemental analysis	●	●	●
EBSD Detector	Investigation of crystalline orientation	●	●	●
CL Detector	Material characterization of cathodoluminscence	●	●*	●
WDS Detector	High precision elemental analysis	●	●	●
3DSM	Threedimensional surface modelling	●	●	●
80 mm Airlock	Sample transfer in less then 30 seconds	●	●	●
Plasma Cleaner	Gentle removal of sample contamination	●	●	●
Local Charge Compensation	Undisturbed imaging of non-conductive samples	X	●	●
Local Charge Compensation and In situ cleaning	In situ cleaning of sample surface, undisturbed imaging of non-conductive samples	X	●	●
5 Axes Stepper Stage	High precision navigation	○	○	○
6 Axes Stepper Stage (replaces 5 Axes Stepper Stage)	High precision navigation with eucentric tilt	●	●	●
6 Axes DC Stage (replaces 5 Axes Stepper Stage)	High precision navigation with repeatability < 1 µm	●	●	●
3View	Threedimensional imaging of tissue samples	●	●	●
AFM	Threedimensional imaging in atomic resolution	●	●	●

○ Basic Equipment
● Option Available
X Not Available

*MERLIN VP Compact has integrated CL function in VPSE detector

Additional options are available

Technical Specifications

Essential Specifications	MERLIN Compact	MERLIN VP Compact	MERLIN
Resolution (optimal WD) **All resolution specifications are dependent on the system configuration**	0.8 nm @ 15 kV 1.6 nm @ 1 kV 0.8 nm @ 30 kV (STEM mode)	0.8 nm @ 15 kV 1.6 nm @ 1 kV 0.8 nm @ 30 kV (STEM mode)	0.8 nm @ 15 kV 1.4 nm @ 1 kV 0.6 nm @ 30 kV (STEM mode) 3.0 nm @ 20 kV at 10 nA, WD = 8,5mm
Acceleration Voltage	0.02 – 30 kV	0.02 – 30 kV	0.02 – 30 kV
Probe Current	5 pA up to 100 nA (depending on system configuration)	5 pA up to 100 nA (depending on system configuration)	10 pA up to 300 nA (depending on system configuration)
Magnification	12 – 2,000,000 x	12 – 2,000,000 x	12 – 2,000,000 x
Electron Emitter	Thermal field emission type, stability > 0,2%/h	Thermal field emission type, stability > 0,2%/h	Thermal field emission type, stability > 0,2%/h
Detectors in base tool configuration	High efficiency in-lens SE detector Everhart Thornley Secondary Electron detector	High efficiency in-lens SE detector Everhart Thornley Secondary Electron detector High efficiency VPSE detector	High efficiency in-lens SE detector Everhart Thornley Secondary Electron detector
Optional Detectors	In-lens Duo detector (replaces in-lens SE detector) AsB detector (standard or with 4-channel amplifier for live 3DSM) 4QBSD STEM Further detector options available	In-lens Duo detector (replaces in-lens SE detector) AsB detector (standard or with 4-channel amplifier for live 3DSM) 4QBSD STEM Further detector options available	EsB detector (additional in-lens BSE detector) AsB detector (standard or with 4-channel amplifier for live 3DSM) 4QBSD STEM Further detector options available
Specimen Stage	5-Axes Motorized Eucentric Specimen Stage X = 130mm Y = 130mm Z = 50mm T = - 3° to 70° R = 360° (continous) Further additional optional stage systems available	5-Axes Motorized Eucentric Specimen Stage X = 130mm Y = 130mm Z = 50mm T = - 3° to 70° R = 360° (continous) Further additional optional stage systems available	5-Axes Motorized Eucentric Specimen Stage X = 130mm Y = 130mm Z = 50mm T = - 3° to 70° R = 360° (continous) Further additional optional stage systems available

Technical Specifications

Essential Specifications	MERLIN Compact	MERLIN VP Compact	MERLIN
Chamber	330mm(Ø) x 270mm(h) 15 accessory ports for various options including STEM, 4QBSD, EBSD, EDS, WDS CCD-Camera with IR-illumination	330mm(Ø) x 270mm(h) 15 accessory ports for various options including STEM, 4QBSD, EBSD, EDS, WDS CCD-Camera with IR-illumination	330mm(Ø) x 270mm(h) 15 accessory ports for various options including STEM, 4QBSD, EBSD, EDS, WDS CCD-Camera with IR-illumination
Vacuum system	Only high vacuum mode available	High vacuum mode and variable pressure mode prepared for charge compensation with in-situ cleaning	Prepared for charge compensation with in-situ cleaning
Image Processing	Resolution: Up to 32768 x 24576 pixel A large number of integration and averaging modes available	Resolution: Up to 32768 x 24576 pixel A large number of integration and averaging modes available	Resolution: Up to 32768 x 24576 pixel A large number of integration and averaging modes available
Scan Speed	17 non-interlaced electron beam scan speeds, minimum dwell time 25 ns	17 non-interlaced electron beam scan speeds, minimum dwell time 25 ns	17 non-interlaced electron beam scan speeds, minimum dwell time 25 ns
Image Display	Single 19'' TFT monitor with SEM image displayed at 1024 x 768 pixel	Single 19'' TFT monitor with SEM image displayed at 1024 x 768 pixel	Single 19'' TFT monitor with SEM image displayed at 1024 x 768 pixel
System Control	SmartSEM with Windows® operating system, operated by mouse, keyboard, joystick, control panel	SmartSEM with Windows® operating system, operated by mouse, keyboard, joystick, control panel	SmartSEM with Windows® operating system, operated by mouse, keyboard, joystick, control panel
Special Application Solutions (optional)	3View AFM	3View AFM	3View AFM

Count on Service in the True Sense of the Word

Because the Carl 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 Carl 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 Carl Zeiss maintenance contract lets you budget for operating costs, all the while avoiding costly downtime and achieving the best results through the improved performance of your system. Choose from service contracts 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 standard preventative maintenance and repair on demand contracts also bring you distinct advantages. Carl Zeiss service staff will analyze any problem at hand and resolve it – whether using remote maintenance software or working on site.

Enhance Your Microscope System
Your Carl 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.

Please note that our service products are always being adjusted to meet market needs and may be subject to change.

Profit from the optimized performance of your microscope system with a Carl Zeiss service contract – now and for years to come.

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