



Electron and Ion Beam Microscopes

Carl Zeiss Microscopy



We make it visible.

The moment curiosity becomes innovation.
This is the moment we work for.

// CAPTIVATION
MADE BY CARL ZEISS



Carl Zeiss Microscopy

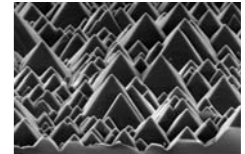
More than 160 years of experience in optics has laid the foundation for pioneering light, electron and ion beam microscopes from Carl Zeiss. Superior integration of imaging and analytical capabilities provides information beyond resolution, unlocking the best kept secrets of your sample.

With a broad technology portfolio Carl Zeiss provides instruments both tailored to your requirements and adaptable to your evolving needs. With our highly versatile application solutions we endeavor to be your partner of choice.

Regional demo centers provide you with access to our applications expertise developed in collaboration with world-class partners in industry and academia. Global customer support is provided by the Carl Zeiss Group together with an extensive network of authorized dealers.

Visualization and Inspection

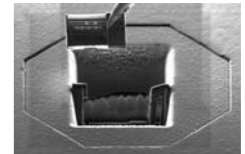
Making structures with nanoscopic dimensions far below the wavelength of light visible is the domain of imaging using electrons or ions. Intelligent detector technologies enable this technology to also analyse the structural, physical and chemical composition of materials.



Si Solarcell (using ULTRA).

Nano-Structuring and Nano-Machining

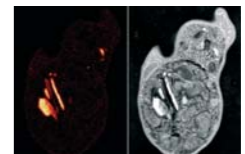
Unprecedented capabilities for cutting edge nanoscopic imaging, structuring and analysis are achieved by combining our core competencies in electron beam, focused ion beam (FIB) and gas injection systems (GIS) into one instrument.



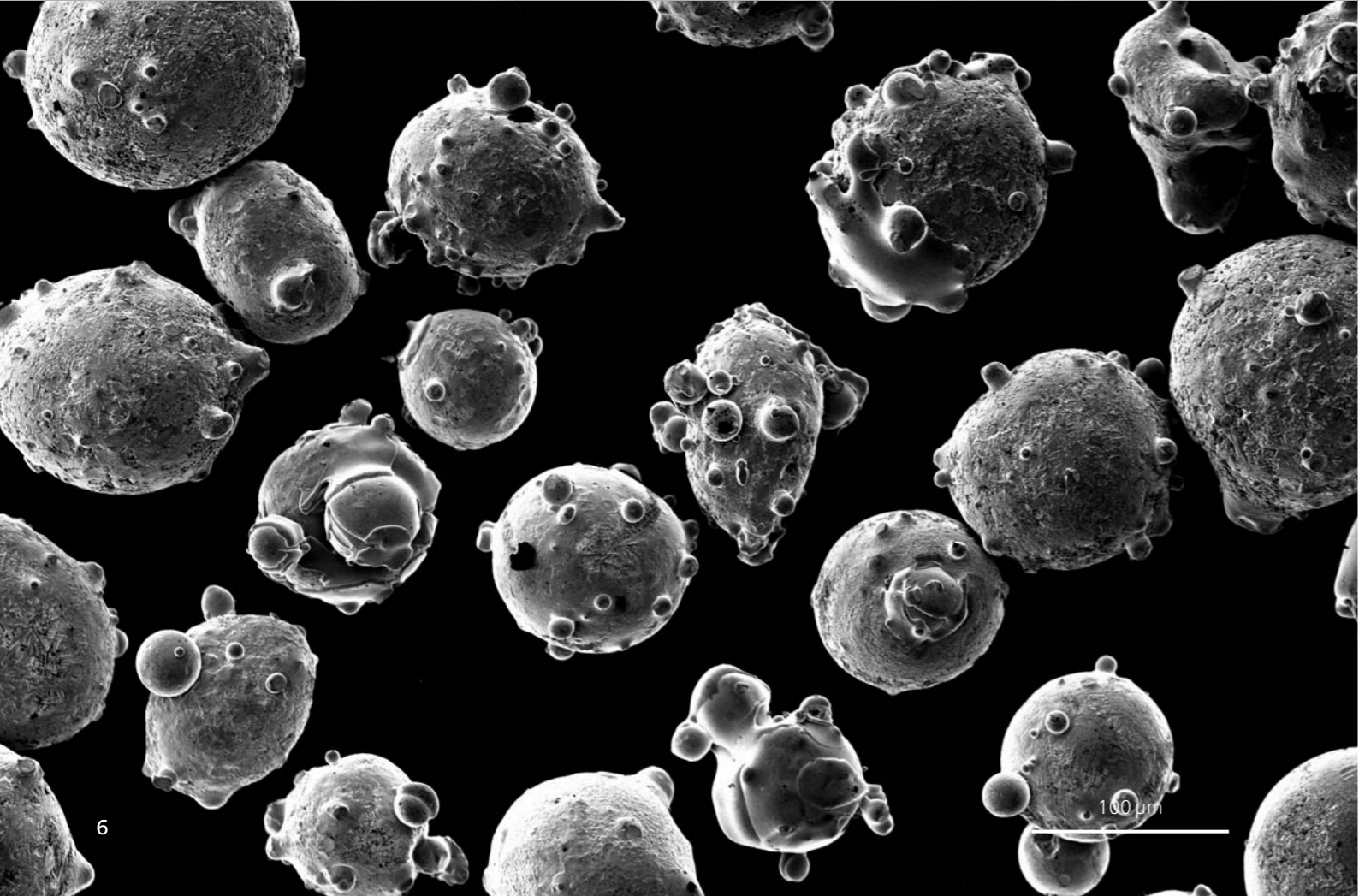
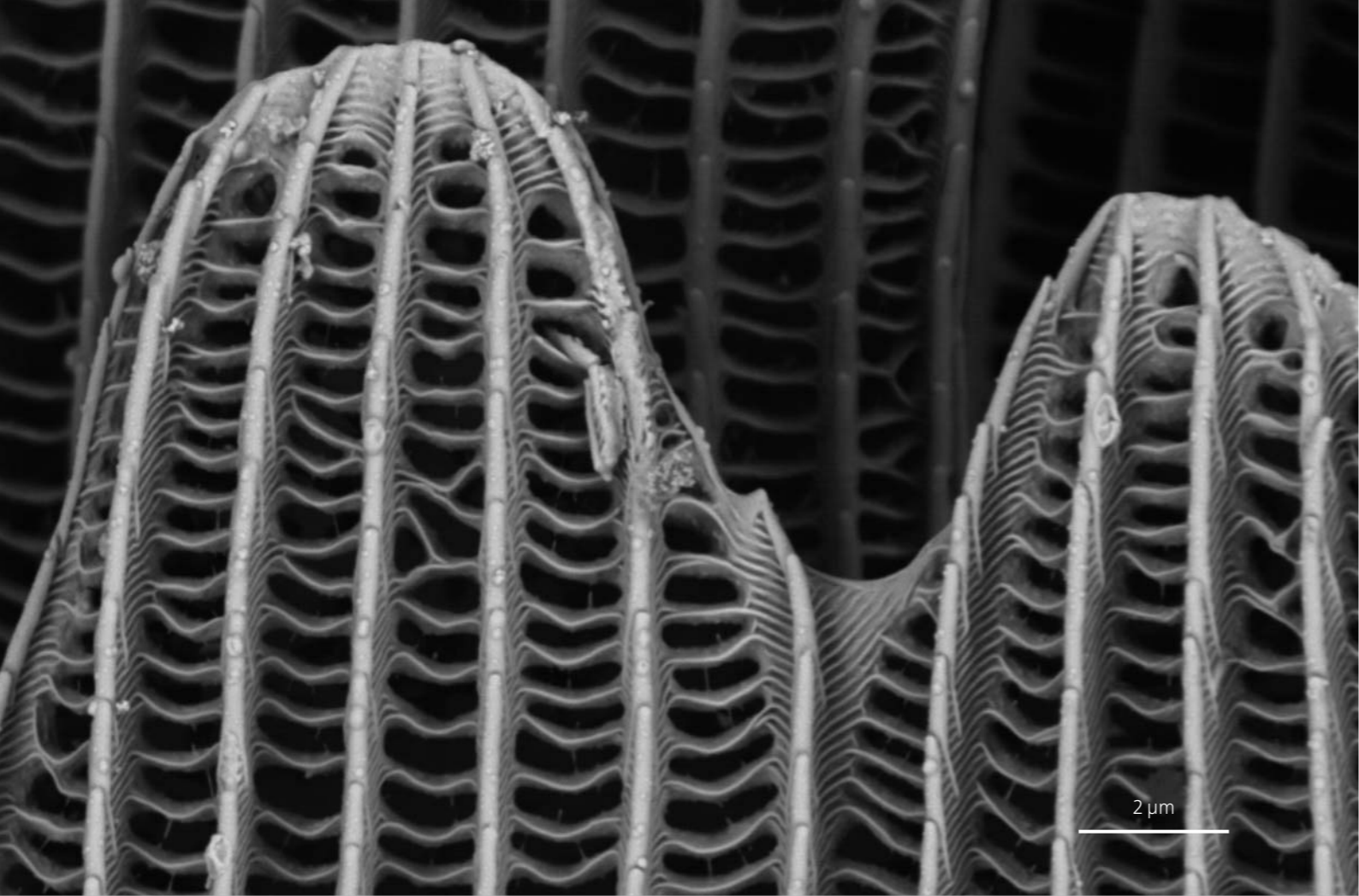
In-situ lift-out of semiconductor sample (using CrossBeam®).

Quantification and Analysis

Particle beam systems are irreplaceable tools for global research, the development of innovative products, and the production or quality-relevant process control. The latter is especially supported by a wide range of methods for detection, analysis and quantification of ultra-fine particles in industrial production.



Fe distribution of a malaria germ in a red blood cell. (using LIBRA®120 PLUS).



EVO® HD

High Performance, Total Flexibility

The EVO® HD is the latest innovation in scanning electron microscopy from Carl Zeiss. Delivering a groundbreaking increase in resolution over conventional scanning electron microscopes (SEM), the EVO® HD introduces High Definition to electron microscopy.

The EVO® HD features a new electron source technology facilitating unmatched low-kV resolution. This makes the EVO® HD the premier choice for challenging specimens, the imaging of surface detail or for beam-sensitive materials. The resolution improvements at higher probe currents provide enhanced analytical accuracy. This technology demonstrates unchallenged performance in the conventional SEM (C-SEM) arena and as a result, the EVO® HD dramatically improves on the imaging resolution currently achievable in C-SEM.

With this step-change in resolution, the EVO® HD now advances knowledge in those applications that were previously limited in conventional SEMs.



Images left page, top: A butterfly wing scale imaged at 5kV with the low-kV BSE detector. Image below: Stellite imaged at 1 kV with the SE detector in the EVO® HD.

EVO® MA & LS Series

High Performance, Total Flexibility

Evolution to new MA and LS series.

The **EVO®** microscopes have evolved into two series that are optimum for the distinct materials analysis and life science environments.

The **MA** and **LS** series are thoroughbred scanning electron microscopes from the **EVO®** line. Built on the success of its acclaimed predecessors, the new **EVO®** microscopes deliver focussed solutions for Materials and Life Science optimised for image quality, versatility, throughput, ease-of-use and visual appeal.

- Superior low-kV BSE imaging
- Class leading X-ray and analytical geometry
- Fully comprehensive SE detectors for VP and environmental modes
- Optional high performance LaB₆ source
- BeamSleeve® to provide enhanced analytical accuracy
- Future Assured upgrade paths

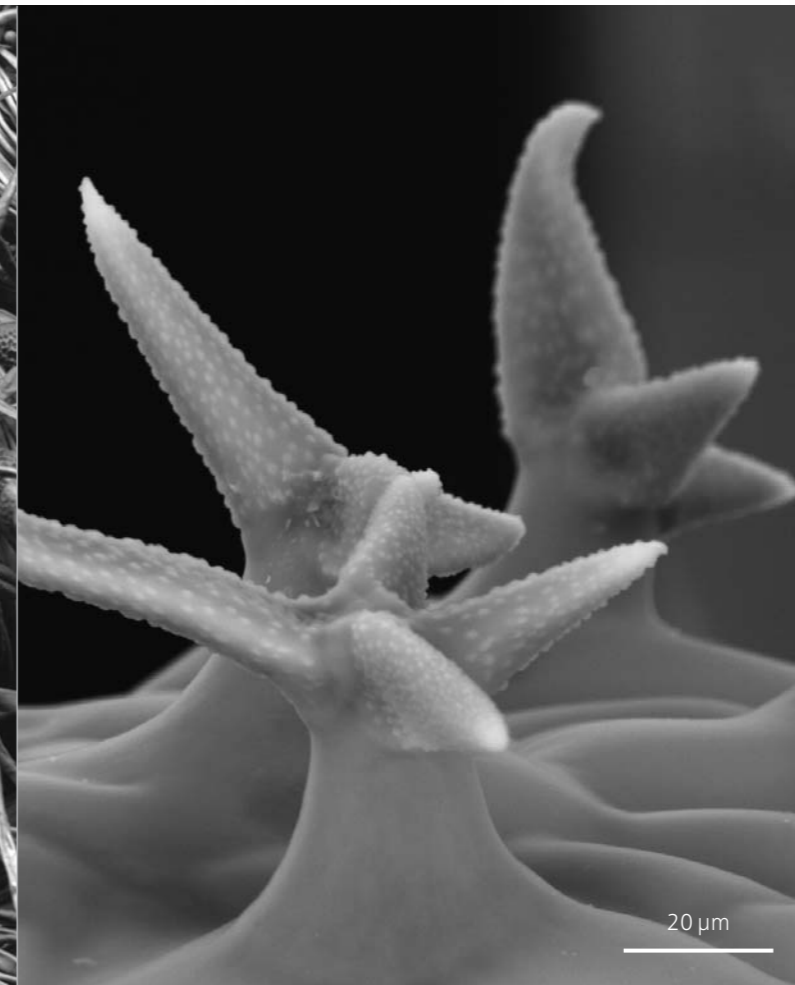
The **EVO® MA** series of scanning electron microscopes is an indispensable tool for every application area in materials analysis. From aggregates to zeolites, an **MA SEM** will provide an imaging solution to drive your enterprise forward.

Three microscopes with differing chambers accept the widest range of specimen sizes whilst imaging to perfection.

The **MA 15** introduces a port as standard for the addition of a wavelength dispersive spectrometer. With the super large **MA 25**, even the tallest and heaviest engineering part can be analysed.



Pollen on fabric imaged in water vapour at 20 kV using the BSE detector.



A rosemary leaf imaged at 20 kV using the VPSE detector in environmental mode.

The **LS** series delivers a new imaging experience for the life scientist. For fauna, flora, and fungi the **LS** series unravels the nanoscale designs of life on earth. The **LS** series provides a high magnification imaging solution for surface morphology to complement the optical microscope.

The **LS** series can maintain a locally high humidity to prevent water loss through cell membranes. In this way de-hydration artefacts are avoided and the true structures are made visible.



EVO® MA series for Materials Analysis



EVO® LS series for Life Sciences

ParticleSCAN VP

A New Dimension in Process Control

Benefits

■ Dedicated Particle Analysis Solution

Turnkey platform for repetitive analysis in process monitoring, quality control and routine analysis applications

■ Rugged and Mobile

Rapid installation and re-location of equipment, designed for industrial environments.

■ Variable Pressure SEM

Charge compensation using variable pressure for measuring non-conducting particles or filtered samples

■ SmartPI™

Smart Particle Investigator – Integrated Particle Analysis software for automatic and routine analysis with easy to use operator interface

■ Integrated EDS

Particle identification by chemical classification combined with morphology measurements from a single application and user interface

■ High Performance SEM Platform

Option to use as a conventional SEM with Carl Zeiss SmartSEM® software

Application Fields

- Manufacturing Cleanliness
- Mining & Geological Research
- Oil & Gas Exploration
- Engine Health Monitoring
- Steel Inclusions
- Environmental
- Pharmaceutical
- Forensic Analysis

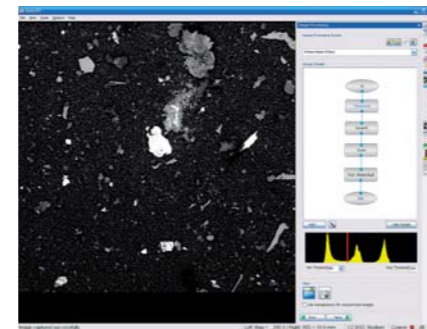


SmartPI™

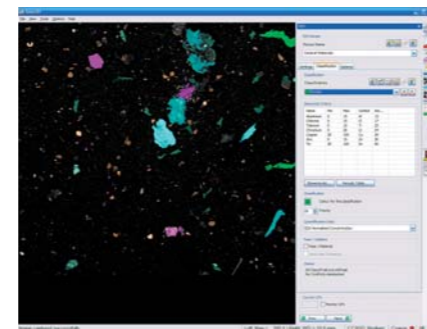
The Complete Automated Particle Analysis Solution

Smart Particle Investigator (SmartPI™) is a powerful particle analysis package for use with all conventional and field emission Scanning Electron Microscopes (SEM) from Carl Zeiss, enabling the automatic detection, investigation and characterisation of particles of interest.

SmartPI™ incorporates all aspects of the SEM control, image processing and Energy Dispersive Spectroscopy (EDS) analysis for particle detection and characterisation within a single application. SmartPI™ automates repetitive sample analysis to provide non-subjective results with minimal user involvement and enables continuous unattended operation of the instrument.



Automated detection of particles for advanced image processing.



Particle categorisation by elemental composition and morphological classification.

Ease of Use

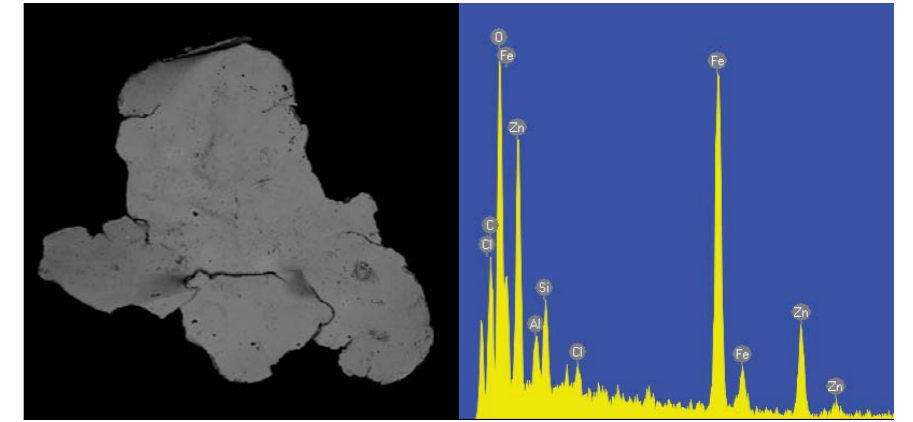
The automated nature of SmartPI™ dramatically simplifies daily operation such that an operator is only required to load the sample holder and initiate the predefined analysis routines (recipes).

Auto-calibration Procedures

Self-diagnostic and auto-calibration routines are performed before each auto-run and periodically during multi-sample runs, to ensure system stability and results accuracy.

Morphological & Chemical Classification

SmartPI™ employs advanced image processing and analysis techniques to measure a variety of morphological characteristics of each particle detected, for example feret max diameter and surface area. In addition, the chemical composition of each particle can be determined using EDS analysis. Each particle can be analysed rapidly using Spot Mode or in more detail using the advanced ZEISS Feature Scan Mode, which scans the complete particle shape to provide an accurate classification.



Example spectrum image for an identified particle of interest.

Border Particle Stitching

SmartPI™ incorporates a sophisticated border particle stitching algorithm which determines the full characteristics and measurements of an individual particle which crosses multiple fields. Images of stitched particles can easily be saved and reviewed.

Advanced Stop Criteria

A range of advanced stop criteria allow the auto-run to end the analysis when a predefined threshold has been reached. Stop criteria can include analysis time, particle size, number of particles or fields counted, a specific classification, etc. This feature can be applied to single or multiple samples thereby significantly reducing the overall run-time. A live results window also allows the operator to monitor the progress and decide whether any intervention is required.

SmartPI™ Reporter

A standalone application with a number of built-in tools allowing the operator to construct dedicated reports using drag-and-drop controls, modify one of the supplied report templates or select an ISO standard report.

Once a report has been defined, it can be saved as a template for future use. SmartPI™ Reporter can also be used for off-line results generation and analysis.

SmartPI™ Explorer

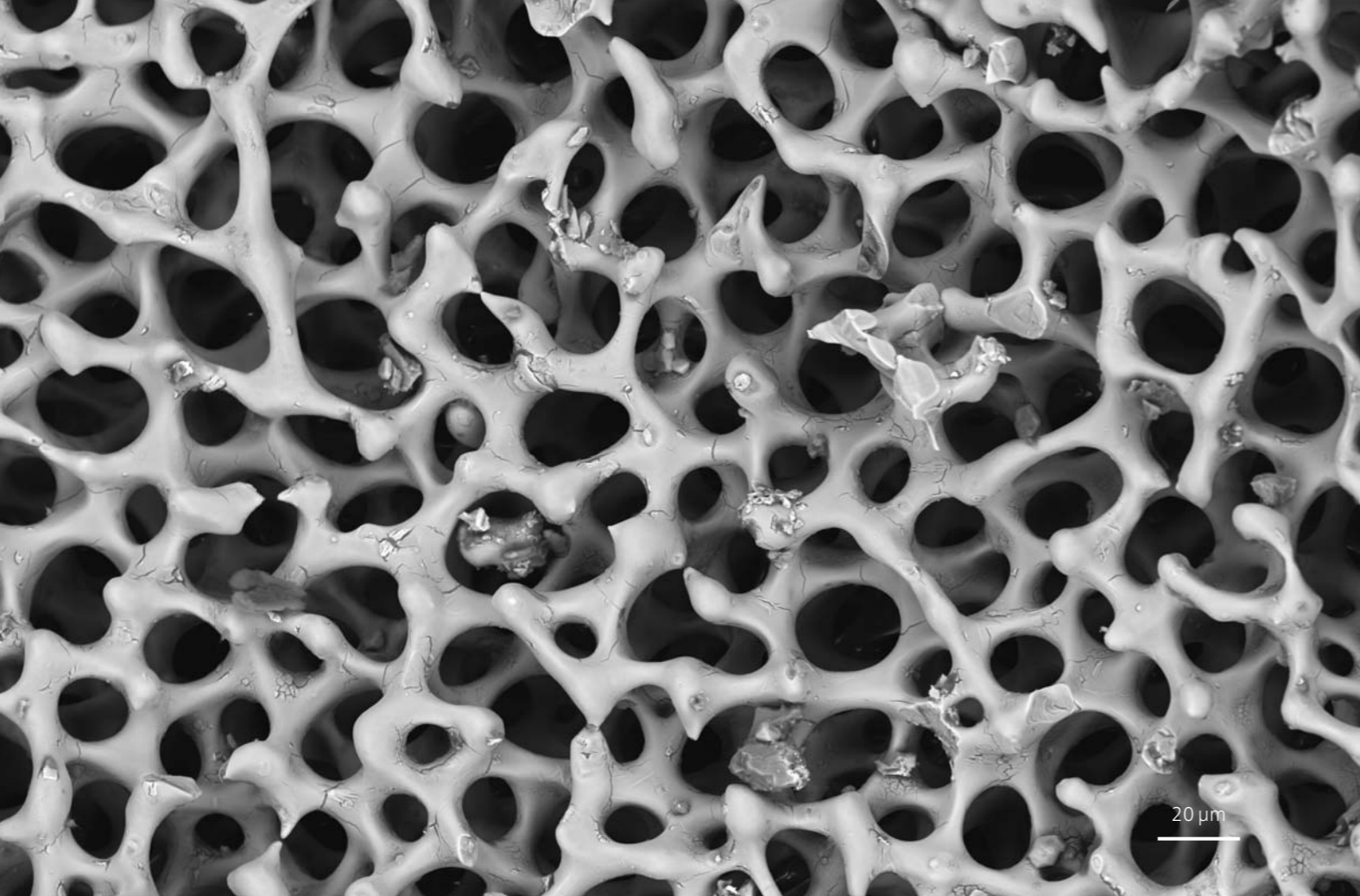
This standalone application provides an intuitive user interface allowing the operator to browse or search the results for individual spectra, particle images, field images, border particles etc. In addition, SmartPI™ Explorer includes housekeeping and archiving options and an image montage feature for creating a stitched image from the fields analysed. Explorer may also be used off-line, freeing machine time for analysis.

Review & Retrospective Analysis

Review Output Mode allows a detailed examination of the results in order to refine and improve the classification recipes.

Retrospective Analysis allows the re-evaluation of existing results using new classification criteria without the need to re-analyse the sample.





ΣIGMA™

Advanced Analytical Microscopy

The ΣIGMA™ featuring GEMINI® technology, provides outstanding imaging and analytical results from a field emission scanning electron microscope with the capability to handle all material types.

GEMINI® is established as the market leading field emission column design offering unrivaled ease of use, superb low voltage imaging and ultra stable probe currents for analytical applications.

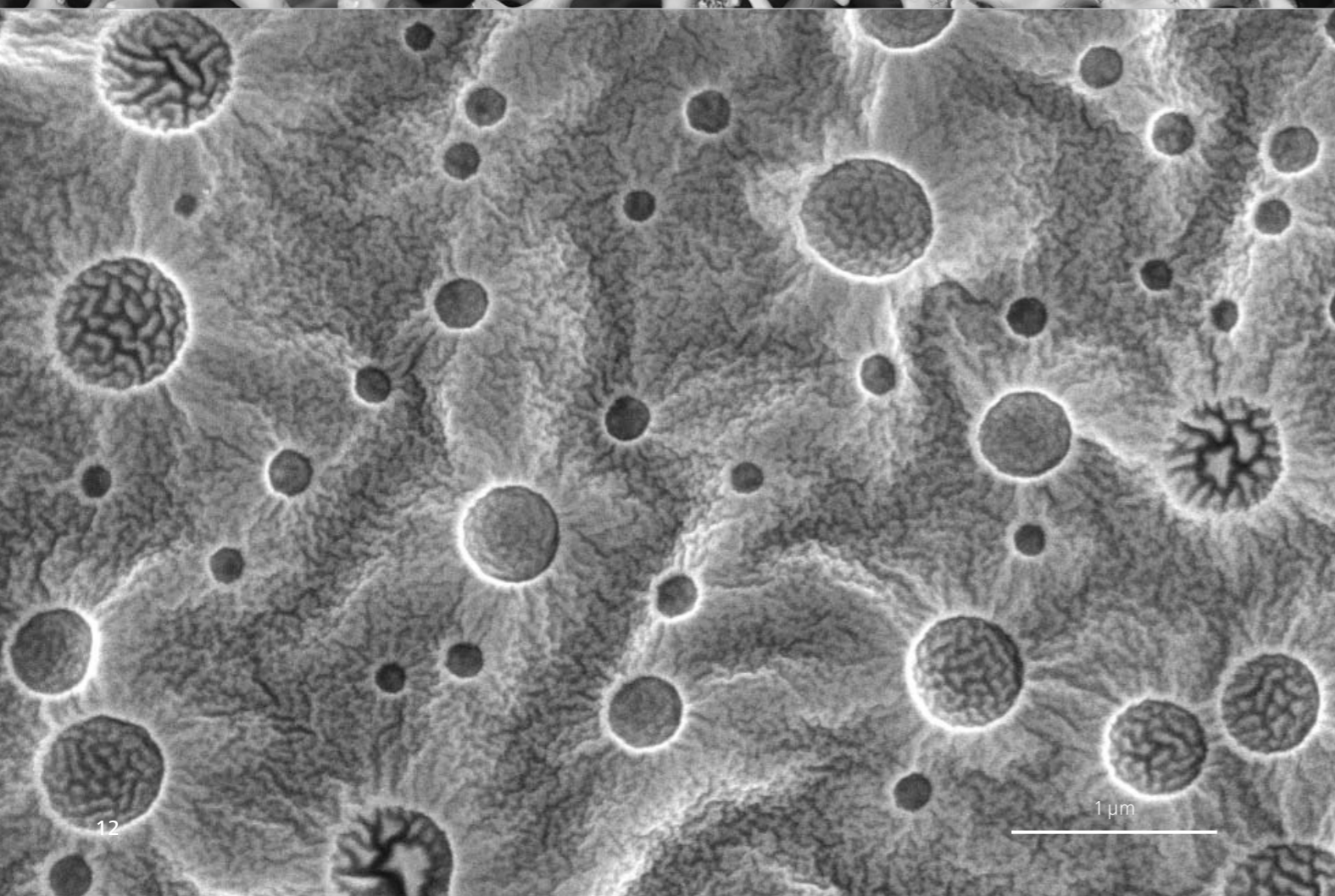
The ΣIGMA™ is available with variable pressure (VP) technology for exceptional imaging and analysis of non-conductive specimen. It is compatible with a wealth of accessories including the class leading BSD and VPSE G3 detectors for superior materials contrast and SE imaging in VP.

The ΣIGMA™ can handle specimen of up to 250 mm diameter and 145 mm tall. Furthermore, the coplanar chamber design provides the ideal geometry for simultaneous EDS and electron backscattered diffraction (EBSD). Materials analysis at high resolution is provided by the class leading X-ray geometry for both energy (EDS) and wavelength dispersive spectroscopy (WDS).

The ΣIGMA™ provides comprehensive imaging solutions for demanding applications in semiconductor, materials analysis, pharmaceutical and life science applications.

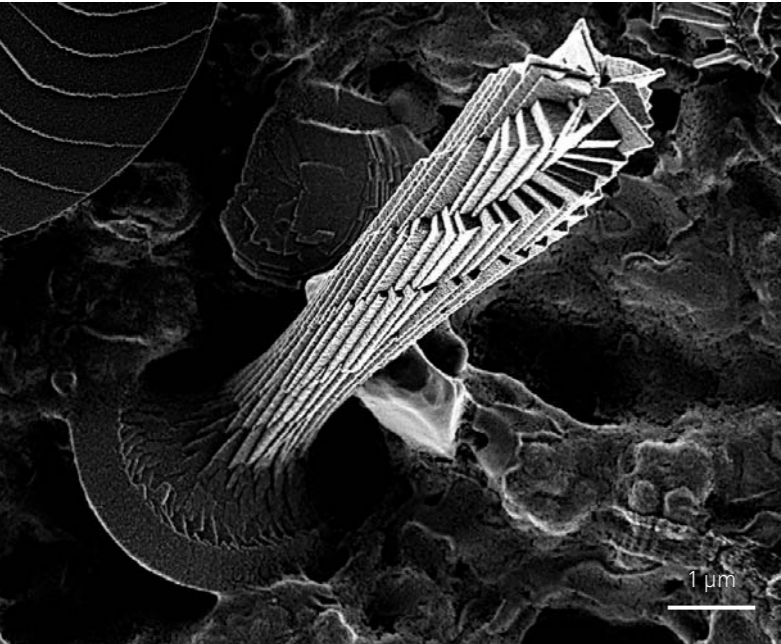
- Analytical platform to suit every application
- Best-in-class imaging with GEMINI® Technology
- Unparalleled ease of use
- FE-SEM providing unrivaled versatility

*Images left page, top:
Backscattered electron image of a sea urchin taken at 15 kV.
Image below:
In-lens SE image of a chromium coated polymer film taken at 5 kV.
Courtesy of Imaging Analysis Unit,
University of Brighton.*

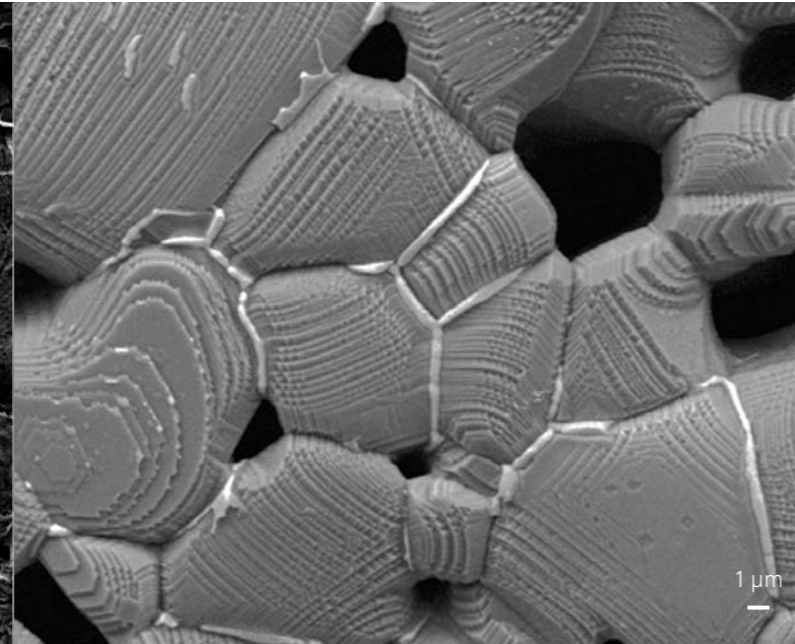


SUPRA® Series

Ultra High Resolution FE-SEM for Versatile Analytics



Deep sea Coccoolith.



BSE image of uncoated magnetic chromite specimen at the analytical WD 8.5 mm (8kV).

The SUPRA® is a general purpose ultra high resolution FE-SEM based on the unique GEMINI® Technology. Excellent imaging properties combined with analytical capabilities makes this high end FE-SEM suitable for a wide range of applications in materials science, life science and semiconductor technology.

The large specimen chamber for the integration of optional detectors and accessories enables the user to configure the SUPRA® for specific applications without sacrificing productivity or efficiency. The unique variable pressure (VP) capability of SUPRA® enables examination of non-conducting specimens without time consuming preparation.



SUPRA® 40/40VP

The workhorse in the SUPRA® range with large stage and VP mode, especially suited for failure analysis, process control and cryo applications.



SUPRA® 55/55VP

The most versatile instrument in the SUPRA® range combines ultra high resolution with fully analytical applications.

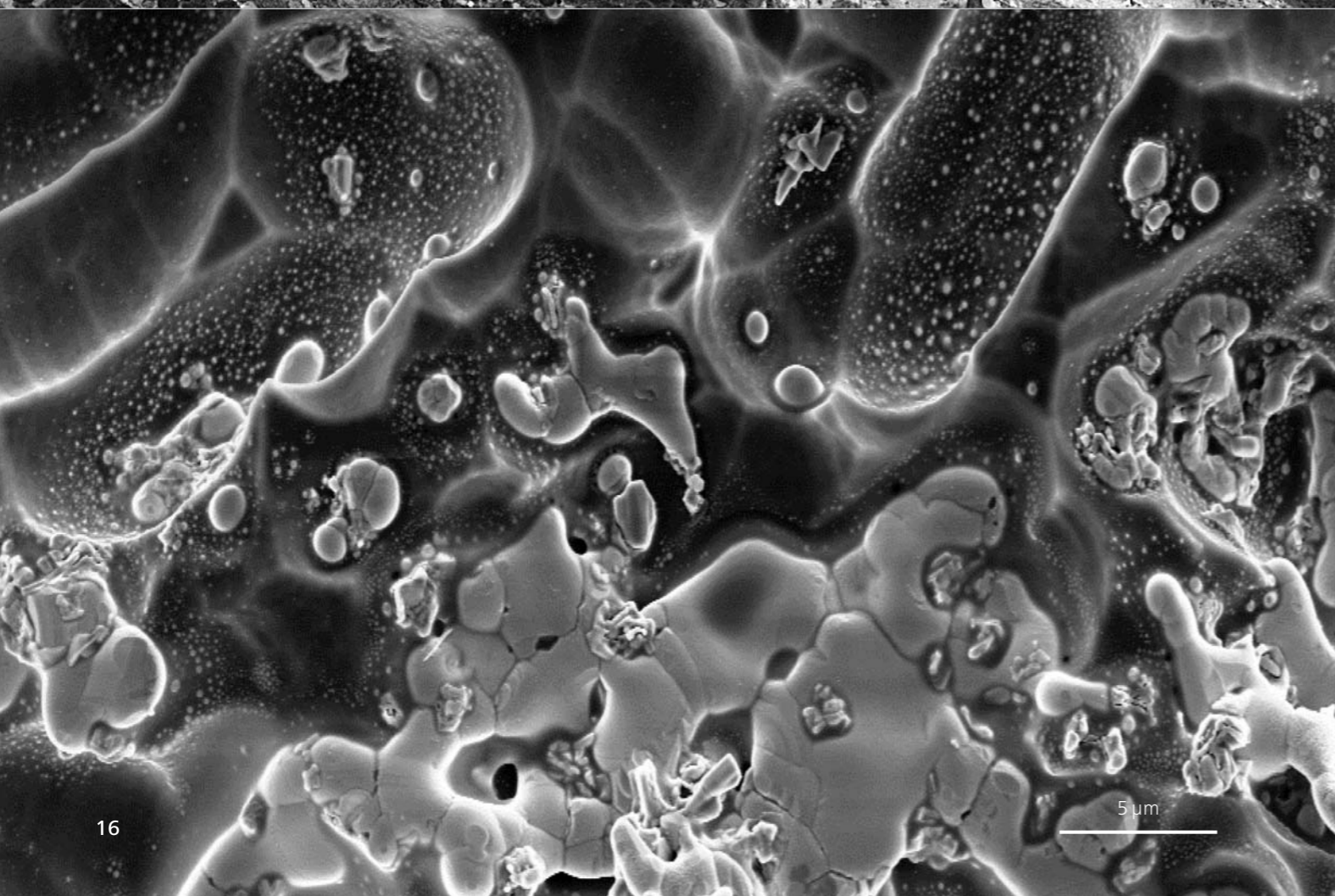


SUPRA® 60/60VP

The large chamber with the 6" super eucentric stage and the 8" airlock is the perfect solution for full wafer analysis and for users who need to examine large specimens.

The key advantages of the SUPRA® FE-SEM are as follows:

- GEMINI® Technology with high efficiency in-lens detector and no magnetic field at specimen level
- Superb resolution and image quality at high and low operating voltages
- Extremely wide operating voltage range from 0.02 - 30 kV
- Designed-in ease of use with minimal adjustments required when changing operating conditions
- Short analytical working distance of 8.5 mm for simultaneous high resolution imaging and X-ray analysis
- High probe current (up to 100 nA) with high stability (better than 0.2 %/h) for precise analytical results
- Variable Pressure (VP) mode up to 133 Pa for superb imaging of non-conductive samples
- Multi-User friendly with Windows® XP based SmartSEM® control software



ULTRA Series

Ultra High Resolution FE-SEM for Nano-scale Compositional Analysis

The ULTRA FE-SEM is the ultimate lab tool to meet the most demanding requirements from material science, life science and semiconductor applications. The ULTRA FE-SEM integrates the GEMINI® technology utilising a newly developed Energy selective Backscattered detector (EsB®). The ULTRA features the GEMINI® in-lens SE detector for clear topographic imaging and the EsB® detector for compositional contrast imaging enabling simultaneous real time imaging and mixing of both signals. The EsB® detector incorporates filtering technology which enables high resolution energy selective BSE imaging at low voltages revealing previously unseen image details.

Combined with the optional AsB® (Angle selective Backscattered electron) detector for compositional and crystal orientation imaging, the ULTRA FE-SEM delivers high resolution nanostructural information along with surface topography, composition, crystal orientation and magnetic domains.



Imaging and metrology workstation



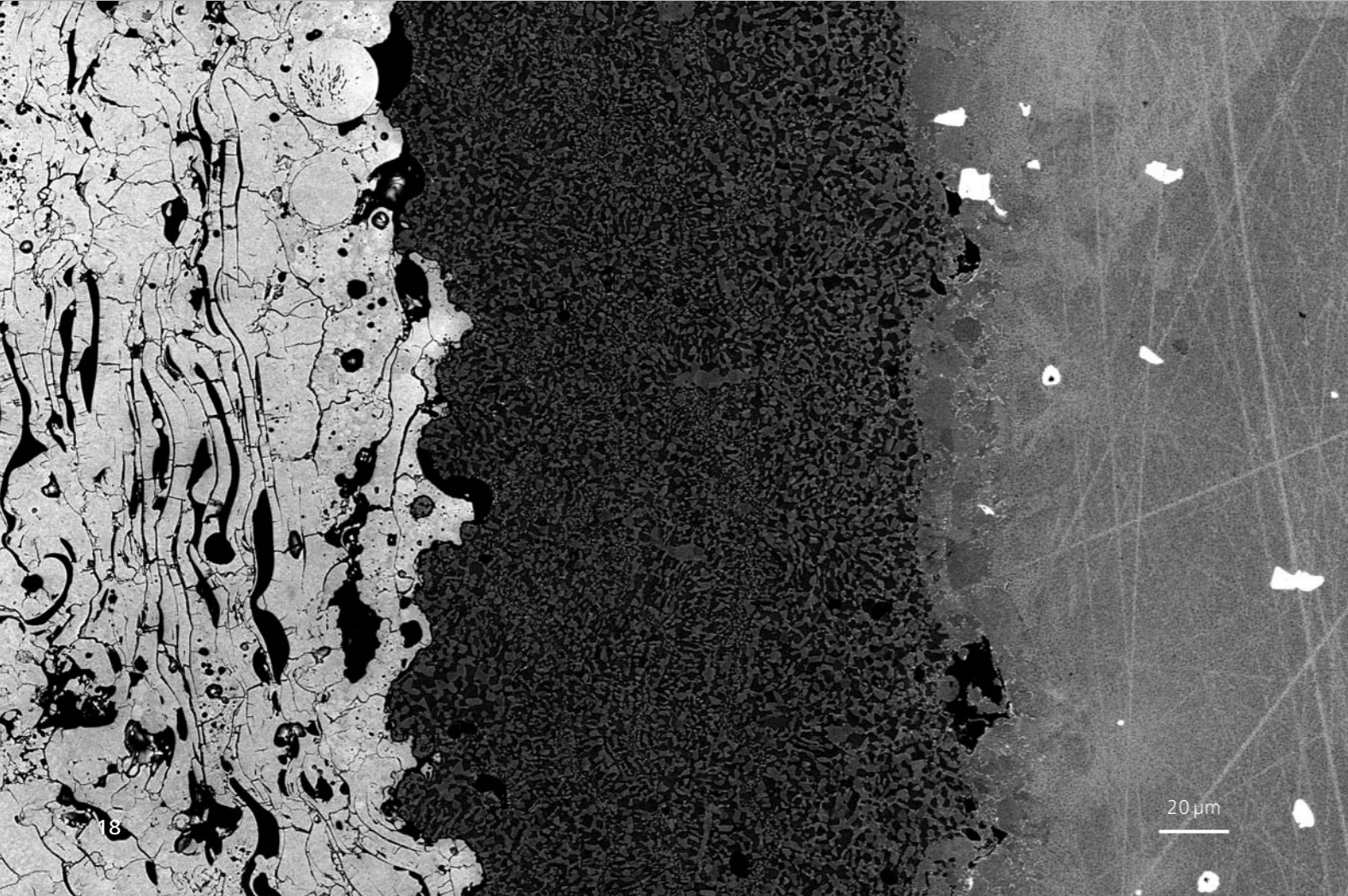
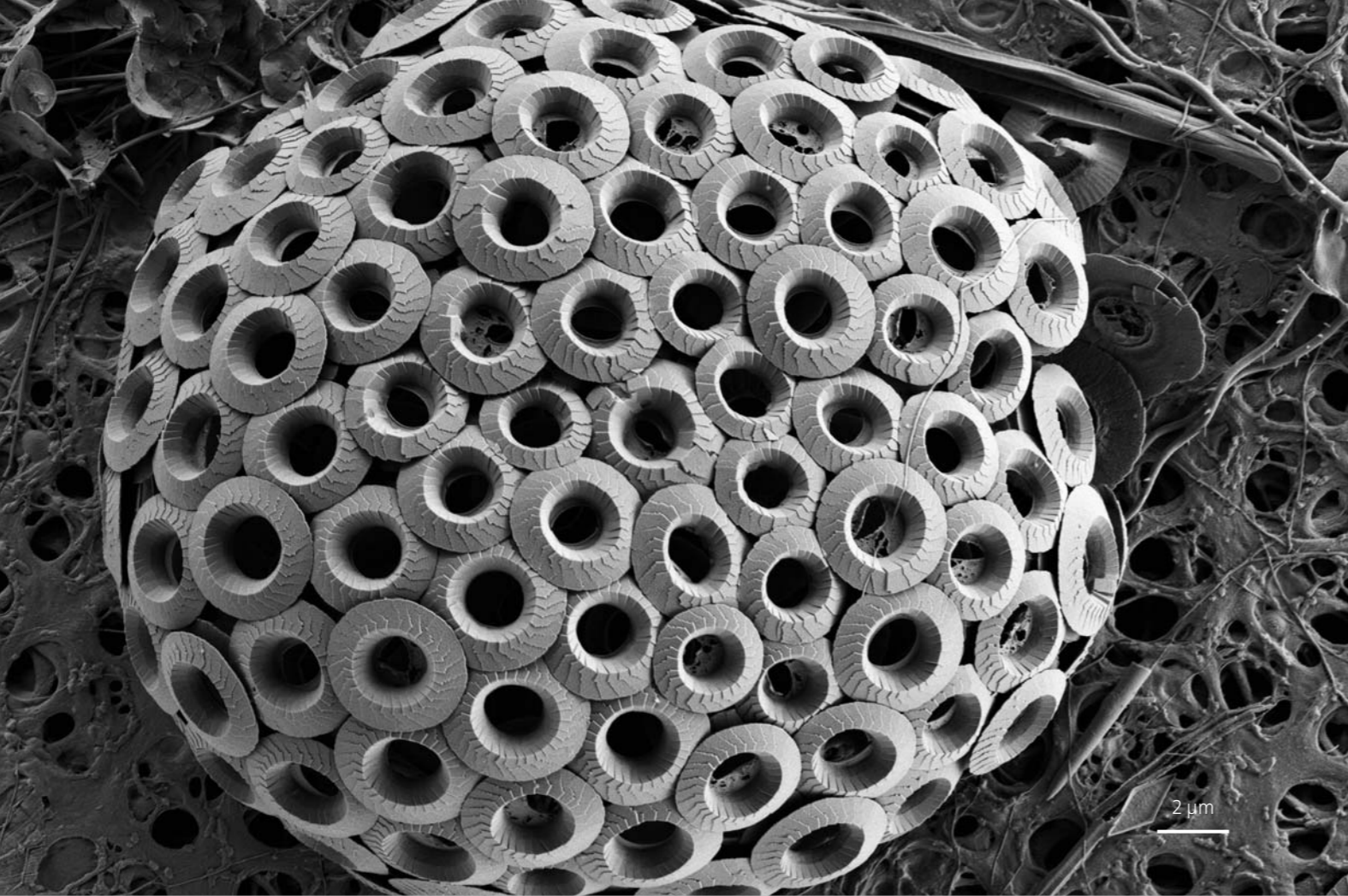
The key advantages of the ULTRA FE-SEM are as follows:

- Designed-in ease of use for high reliability in Multi-User laboratories
- EsB® detector for compositional information fully integrated
- Low kV BSE imaging at short working distance: WD = 1 mm
- Ultra stable high beam current for analytical applications up to 100 nA @ 0.2 %/h
- GEMINI® technology with high efficiency in-lens detector for high contrast topographic imaging
- No magnetic field at the specimen level
- Superb resolution and image quality at high and low operating voltages
- Extremely wide operating voltage range from 0.02 - 30 kV
- Sub nm resolution at 15 kV
- Local Charge Compensator in ULTRA PLUS for imaging of non-conductive sample

Images left page, top: Unstained Bright-field (BF) image from biopsy of kidney. Image below: Secondary electron image of the surface of a solar cell. Taken with the in-lens detector at 4 kV primary energy.

ULTRA PLUS

Nanoanalytical tool for high resolution imaging and material analysis



MERLIN®

Analytical Power for the Sub-nanometer World

As the flagship of the FE-SEM portfolio, the MERLIN® is a two-in-one system: it both meets even the highest demands on a high resolution imaging microscope and is also an optimized system for performing ultrafast analytical investigations with maximum beam current capabilities. On this basis, the MERLIN® is an optimized, combined tool for both the imaging and analytical markets, featuring the following benefits:

Nano Analytics

- High resolution & high current: The GEMINI® II column enables high resolution even at high probe current
- Optimized for fastest EDX, WDX, EBSD & CL signal acquisition
- Best-in-class material contrast with unique EsB® detector

Total Information

- Parallel information acquisition of compositional contrast, topographical & crystalline information through complete detection system (CDS)
- High resolution imaging of non-conductive materials through charge compensation
- Optimized image quality as a result of in-situ sample cleaning during imaging
- In-situ 3 dimensional surface modelling

Ease of Use

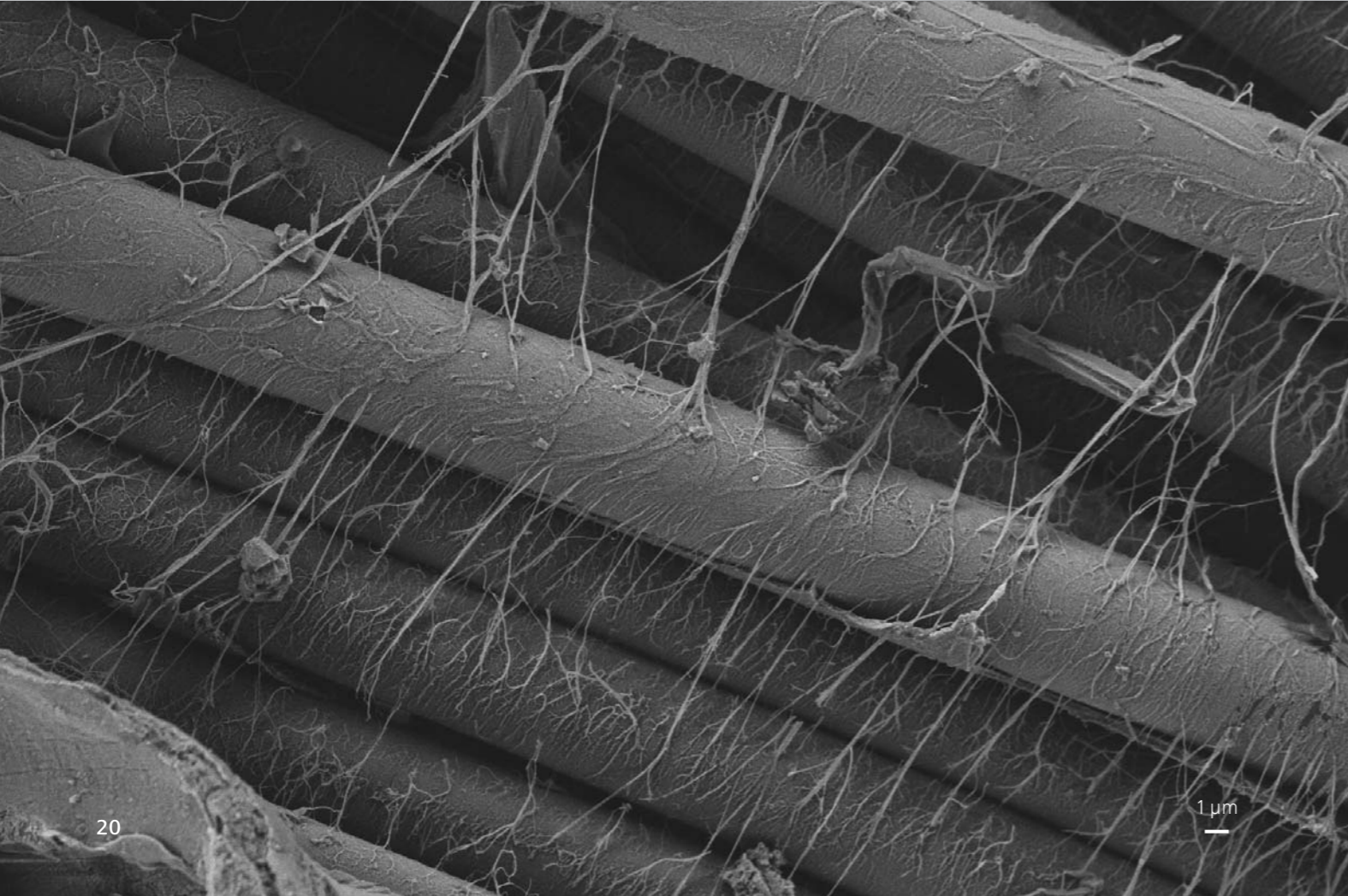
- Fastest Sub nm image acquisition including sample transfer in less than 60 seconds
- Professional results by novice user due to fully automated instrument adjustment
- No time consuming sample preparation of non-conductive samples due to unique charge compensation

Future Assured

- Upgradeable building blocks for decades of first class system performance
- Fastest, forward-design SEM electronics ready for future technology integration
- Upgradeable detection possibilities by plug & play solutions for years of leading edge technology integration



Images left page, top: Radiolaria, imaged at 3 kV with lower Everhart Thornley detector.
Image below: Material analysis of an airplane turbine. In-lens SE image showing different material components.
Courtesy of Dr. Penkalla, Research Center Juelich, Germany.



AURIGA® Information Beyond Resolution

CrossBeam® workstations – the ultimate combination of FIB and GEMINI® column

The AURIGA® is a highly flexible CrossBeam® workstation for custom tailored applications.

Unique Imaging

- Imaging of non-conductive specimens using all standard detectors with local charge compensation
- Simultaneous detection of topographical and compositional information with a unique detector scheme including EsB®-technology
- Investigation of magnetic samples with GEMINI® objective lens design

Advanced Analytics

- Analysis of non-conducting materials with local charge compensation
- Optimum chamber geometry for the simultaneous integration of EDS, EBSD, STEM, WDS, SIMS etc.

Precise Processing

- Innovative FIB technology with best-in-class resolution (< 2.5 nm)
- High resolution live FE-SEM monitoring of the entire preparation process
- Advanced gas processing technology for ion and e-beam assisted etching and deposition



AURIGA®

Custom-Tailored and Future Assured

- Based on a fully modular concept, the AURIGA® CrossBeam® workstation can be tailored to the individual customer's applications – today and in the future
- Starting with a high-performance FE-SEM platform, the system can be upgraded with a wide variety of hardware and software options, such as FIB, GIS, local charge compensation system and different detectors

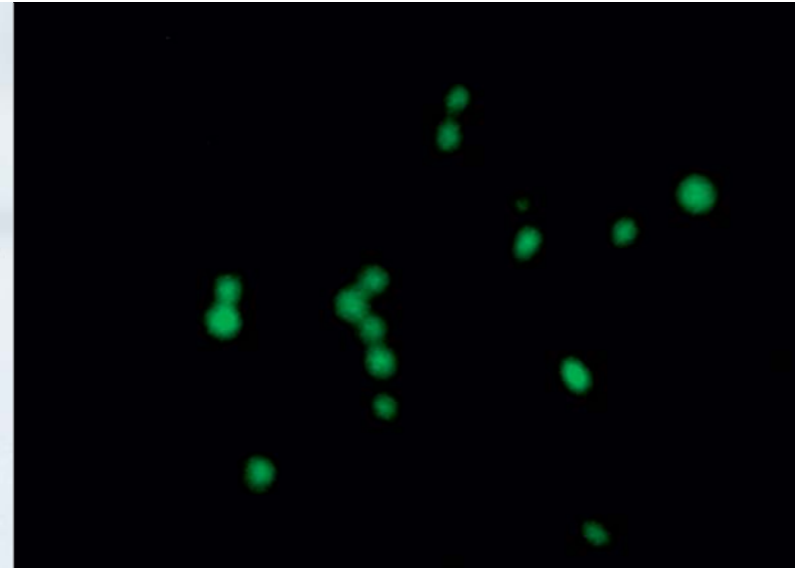
Images left page, top:
Large volume 3D
reconstruction
(170 x 120 x 40 µm)
of a transverse section of
a zebrafish embryo.
Courtesy of London
Vascular Biological
Laboratory and Electron
Microscopy Unit, London
Research Institute, Cancer
Research, UK.
Image below:
Chamber SE image of an
uncoated fibre adhesive
taken at 5 kV with local
charge compensation.



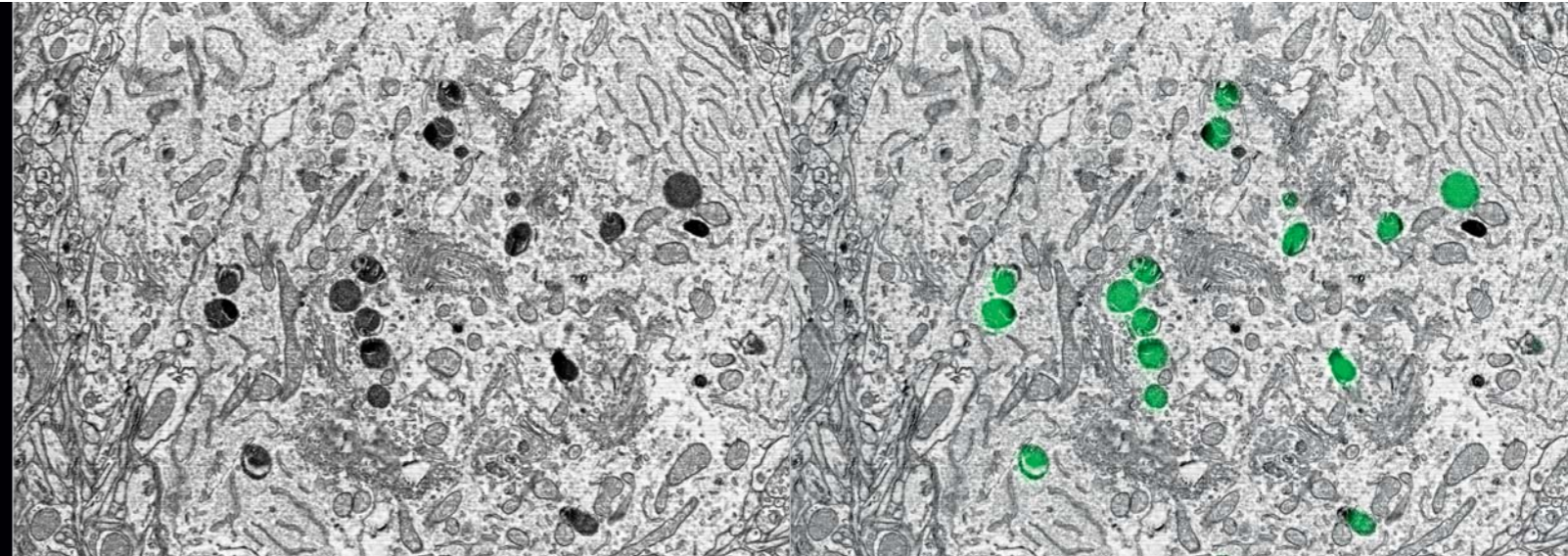
AURIGA® 60

Shuttle & Find

Enabling Productivity in Correlative Microscopy



a: Overview image from the fluorescence microscope.



b: SEM image from Fig. a.

c: Overlay of fluorescence and scanning electron microscope images.

An interface solution for ZEISS light and scanning electron microscopes

The new "Shuttle & Find" solution from Carl Zeiss is an interface for correlative light- and electron-microscopy (CLEM) which opens up new dimensions of information in numerous materials analysis and life science applications. It consists of specially designed sample holders, adapters and AxioVision based correlative software modules.

The chosen point or region of interest (ROI) in the light microscope (LM) can easily be relocated and examined at much higher resolution in the electron microscope (EM) by means of automated calibration and work routines. LM images can then be precisely extended by their morphological or structural background and/or material distribution, e.g. with energy dispersive X-ray spectroscopy (EDS). Overlaying the images of LM and EM merges all the information into one image.

However "Shuttle & Find" is a two-way system. If the investigation begins using the capabilities of SEM images, the same region of interest can be enhanced with the capabilities of LM. The highly flexible design is compatible with all current ZEISS SEM/CrossBeam® platforms and the Axio Imager, Axio Observer and SteREO Discovery LM platforms equipped with a motorized stage.

Shuttle (hardware solution):

- Fast and easy sample transfer between LM and EM platforms
- No dismounting
- Compatible with all current ZEISS SEM/CrossBeam® and the Axio Imager, Axio Observer and SteREO Discovery LM platforms with motorized stage

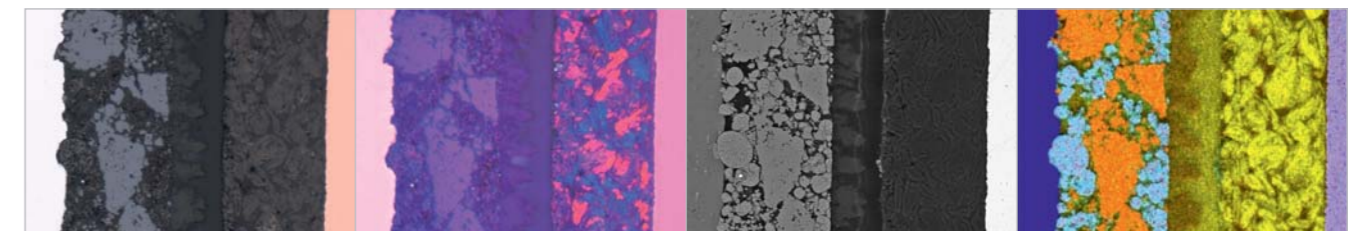
Find (software solution):

- AxioVision user interface for LM and correlative SEM control
- Instant and reliable recall of region of interest (ROI)
- Overlap and match function
- AxioVision functionality for LM and SEM/CrossBeam®
 - Image processing
 - Image analysis
 - Documentation

*Ultra-thin section from the HVC region of a zebra finch brain.
M. Kirschmann, D. Oberti, R. Hahnloser,
Institute of Neuroinformatics, University of Zurich
and ETH Zurich, Switzerland.
Images taken with an Axio Observer fluorescence
microscope and a SUPRA® 40VP scanning electron
microscope.*

Application Example of Materials Analysis

Correlative light and electron microscopy (CLEM) overview within the layer structure of an aged Li-Ion battery with different illuminations in LM as well as BSE-Signal and EDS mapping in SEM. In cooperation with Aalen University, Materials Research Institute, Germany.

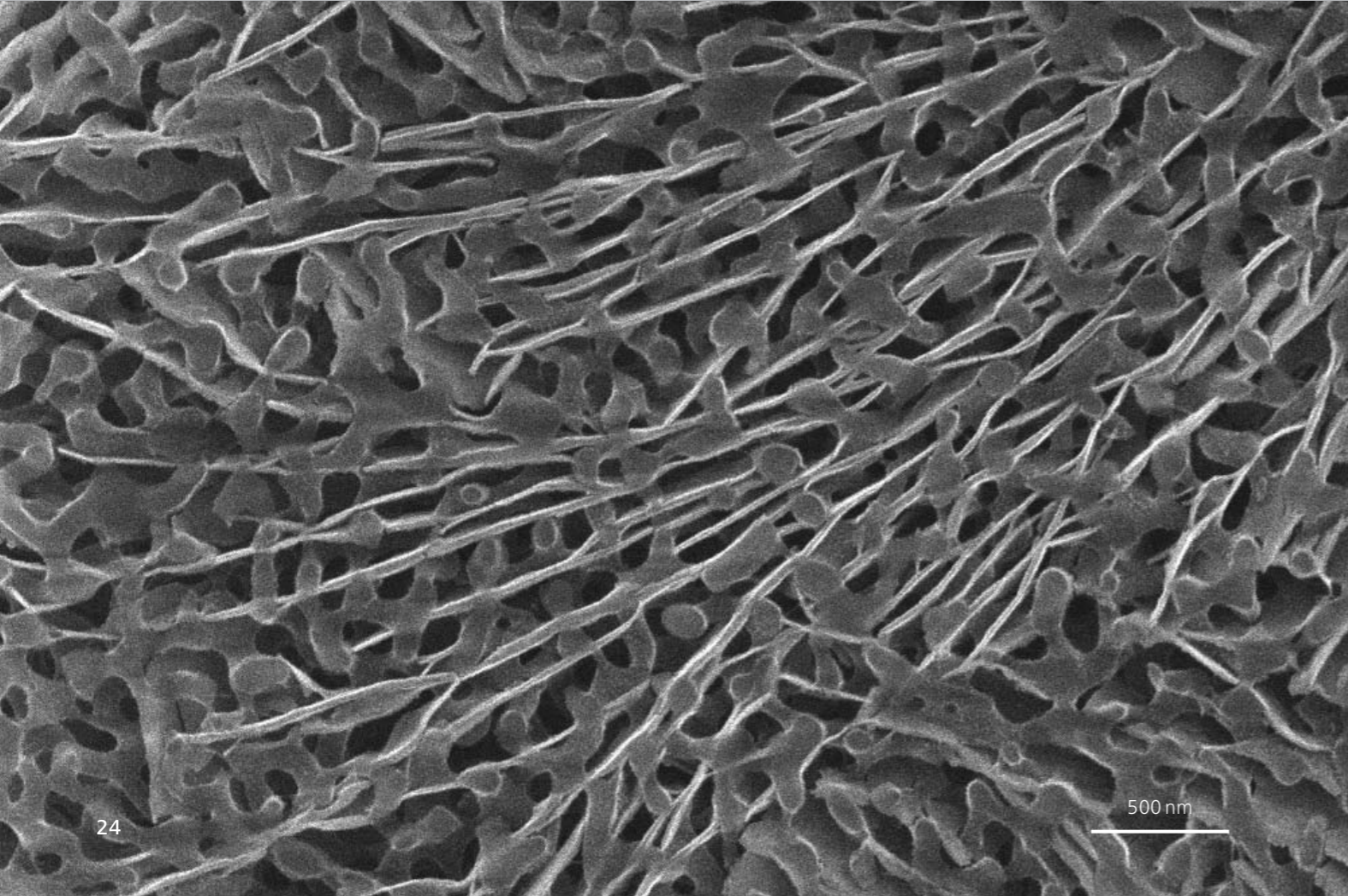
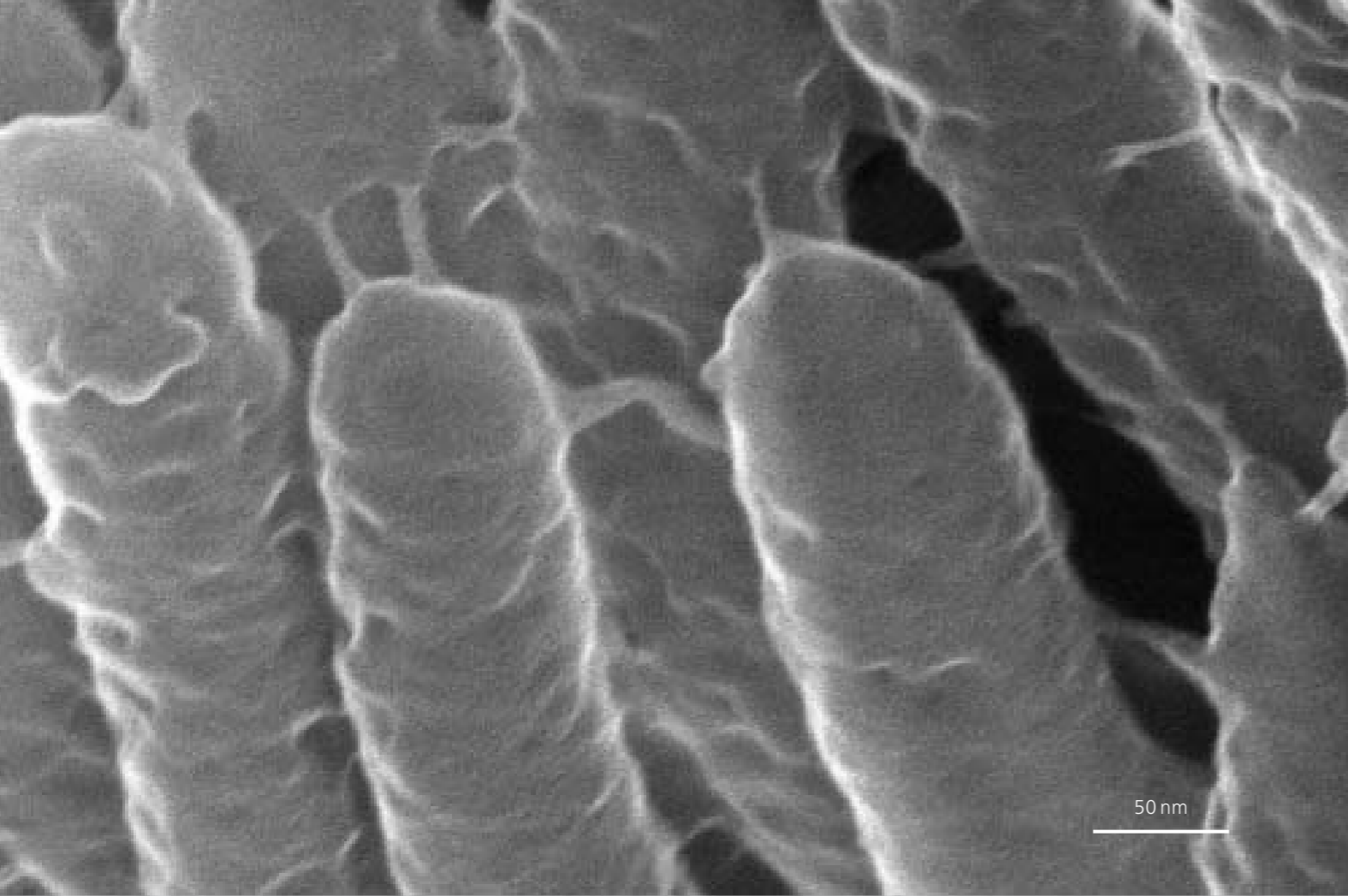


CLEM of the ROI with different contrasts of brightfield in LM.

CLEM of the ROI with polarized light in LM.

BSE signal in SEM.

EDS mapping in SEM.



ORION® PLUS

Helium Ion Microscope

Next Generation Workstation for Nanoscale Research

Helium Ion Microscopy complements existing microscopy techniques in the life sciences, materials sciences, and sets new records in nanomodification applications.

As an **imaging** highlight, its elegant charge neutralization capability yields ideal results from strongly insulating specimens, including uncoated biological specimens. Other applications take full advantage of the <0.35 nm lateral resolution and high degree of surface sensitivity.

For **nanomodification** applications, the ORION® PLUS has boldly demonstrated the ability to create sub-10 nm features with ease. Proximity effects, and optical- and electrical contamination that potentially limit Gallium and electron approaches are a thing of the past. Emerging application areas include graphene nanoribbon research, plasmonics, nanopores, and more.

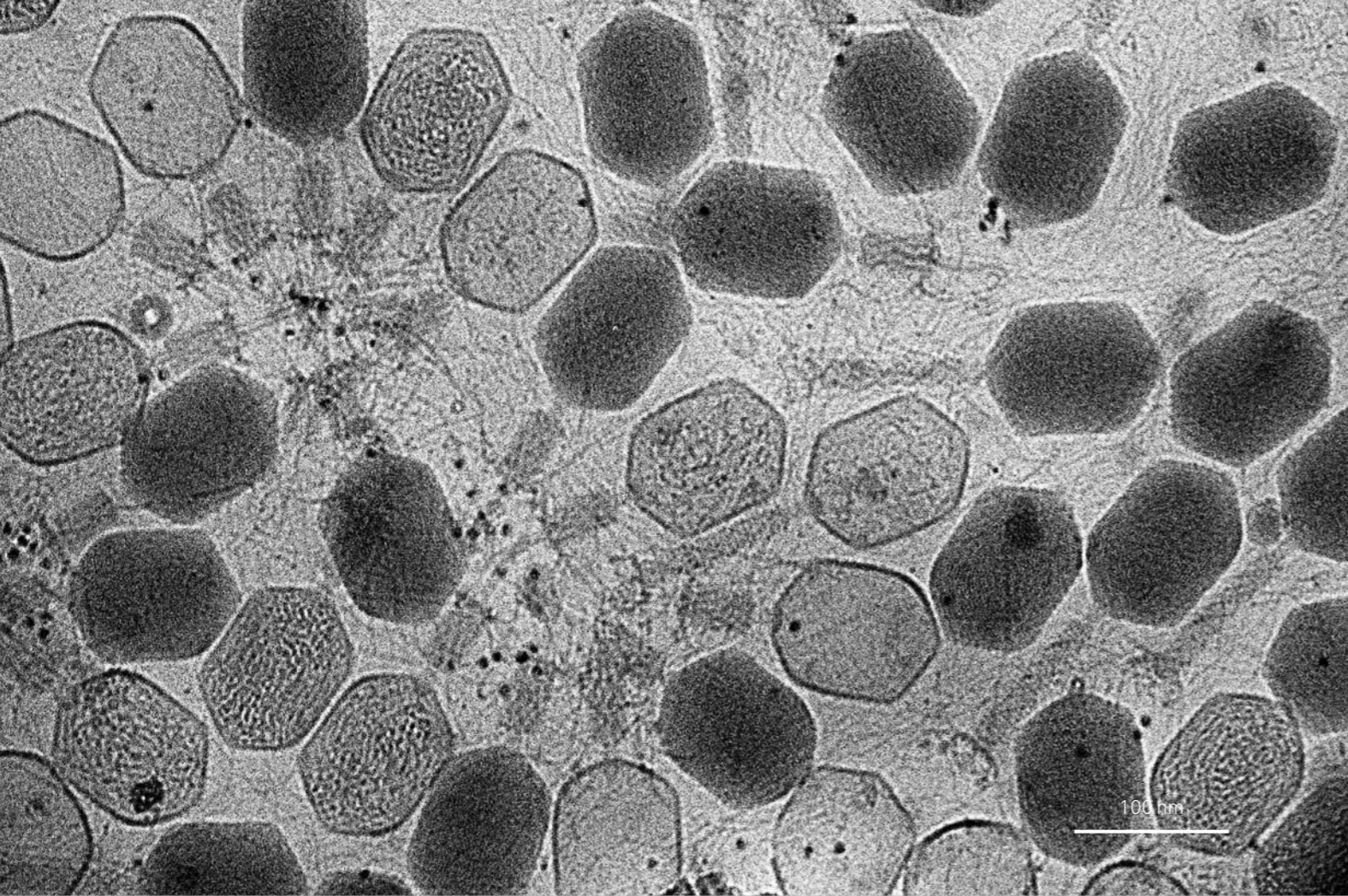
The ORION® PLUS microscope is based on the revolutionary, atomic-sized, ALIS gas field ion source (GFIS). Emanating from a single atom, this remarkably bright and stable beam of helium ions overcomes the limitations of diffraction and energy spread that affect the electron beam used in scanning electron microscopes.

ORION® PLUS

The ORION® PLUS is the second generation helium ion microscope, providing superior surface- and high-resolution **imaging** even on challenging insulating materials and precision **nanomodification** capabilities.



Images left page, top: Uncoated high-resolution image of stereocilia of the inner ear, illustrating <10 nm tip links. Sample courtesy of NIH. Image below: Iron phosphate fingers growing into porous silica, demonstrating ORION® PLUS charge control. Sample courtesy of Pacific Northwest National Laboratory.



LIBRA® Series

EFTEMs with Unique OMEGA Energy Filter

The LIBRA® 120 PLUS is a state-of-the-art 120 kV EFTEM with in-column OMEGA energy filter and Koehler illumination system (both introduced by ZEISS).

The Koehler illumination concept, meanwhile considered as the most versatile illumination in microscopy, guarantees an absolutely parallel beam path and always homogeneous illumination of the sample.

For low-dose applications the illuminated area can be restricted independent of the brightness, thus reducing beam damage to a minimum and allowing precisely quantifiable and reproducible dose rates. Spot illumination with a centred and well focussed spot can be achieved by simple push button operation for all spot sizes.

The built-in Omega Filter transforms the LIBRA® 120 PLUS to a fully analytical TEM that enables ESI and EELS. Improved contrast by zero loss filtering and removal unwanted blur from thick samples caused by inelastically scattered electrons makes this instrument the tool of choice for cryo and tomography applications.

The unique concept of the in-column energy filter, which comes with a lifetime factory alignment, allows the user to get the maximum information out of any sample on every post OMEGA filter detector even on a wide angle camera, the viewing screen or on a sheet film camera. Upgrade possibilities combined with a highly flexible detector concept, including EDS and STEM make this EFTEM an extremely versatile tool for a broad range of applications that demand ease of use and high specimen throughput.

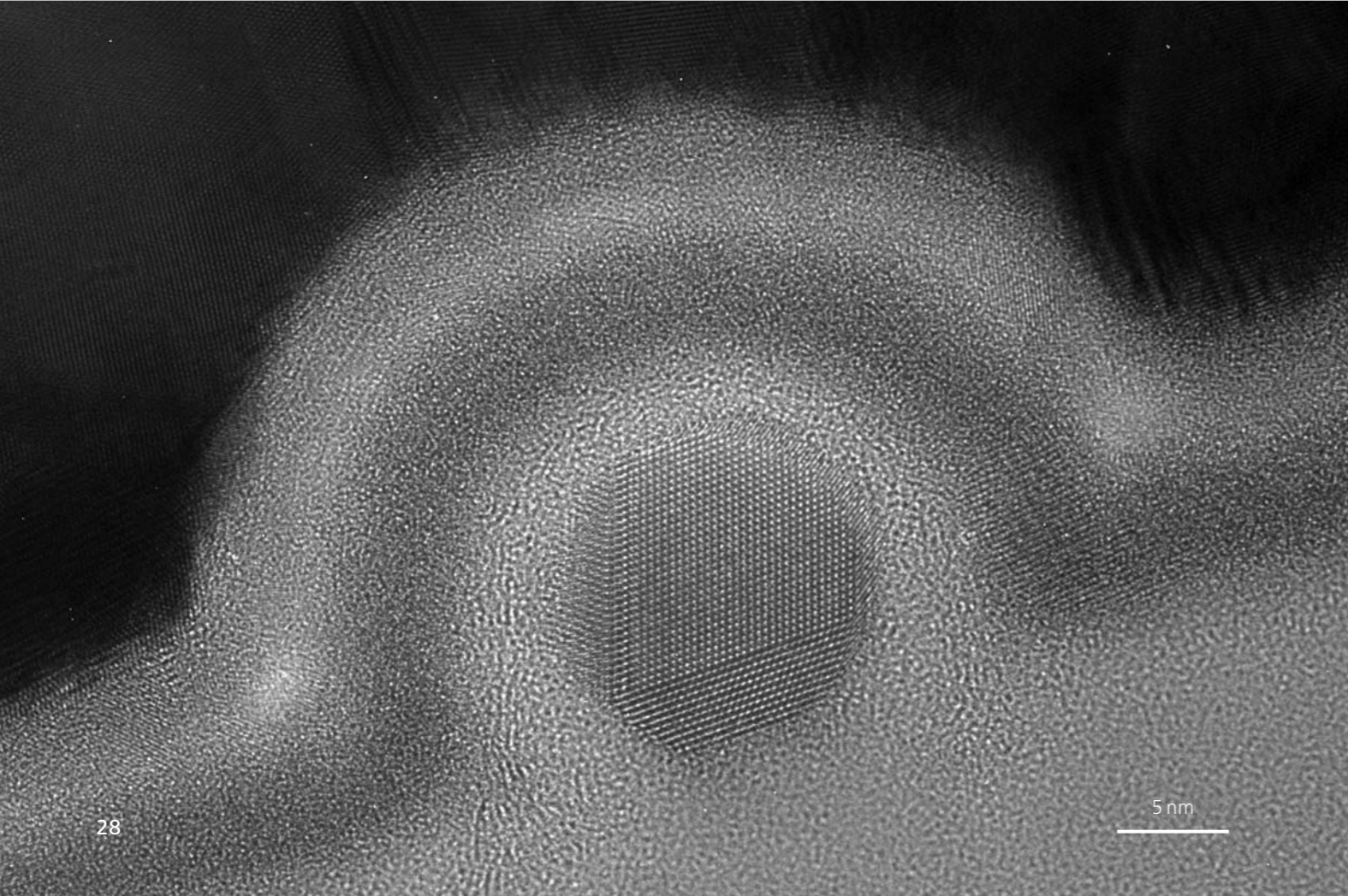
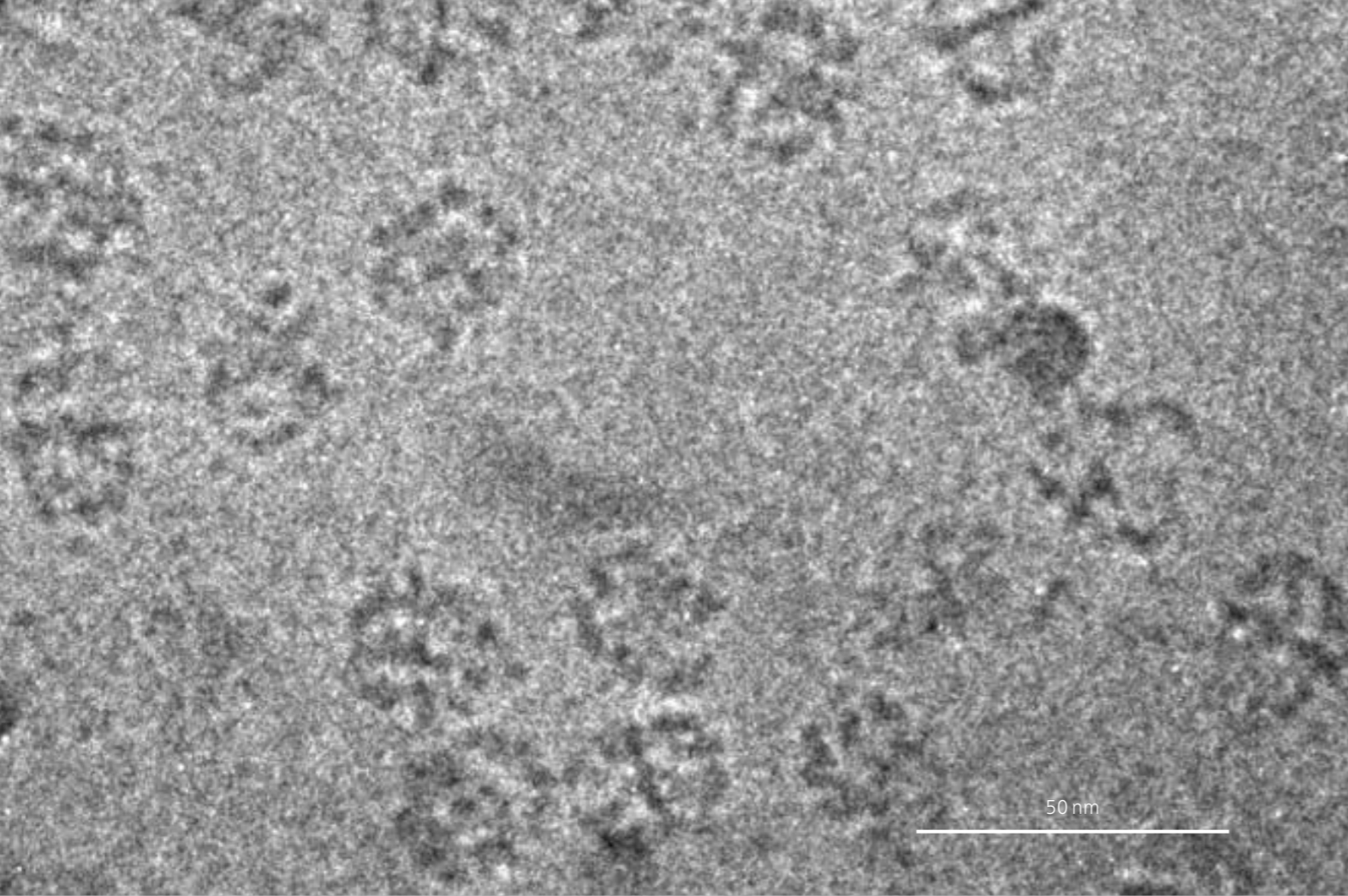
Whatever the information in your sample, the LIBRA® 120 PLUS will make it visible.

- In-column OMEGA energy filter
- Koehler illumination system
- Patented Automatic Illumination System (AIS) for maximum flexibility
- Market-leading, completely dry vacuum system (TMP, IGP and scroll pump based) to ensure optimal performance and the lowest contamination rates in cryo STEM and analytical applications
- Open detector strategy
- Flexible upgrade possibilities for the detectors and vacuum system
- Optimum cryo and tomography performance resulting from unique combination of Koehler illumination and energy filtering

LIBRA® 120 PLUS
Versatile analytical TEM workhorse



*Images left page, top:
T4 Bacteriophage, frozen hydrated. TEM mag 30 k, zero loss filtered.
Specimen courtesy:
Dr. J. Dubochet.
Image below:
Peripheral nerve of rat.*



LIBRA® Series

EFTEMs with Unique OMEGA Energy Filter

The LIBRA® 200 series of transmission electron microscopes stands for the versatility of patented Kohler illumination and the unique in-column 2nd order corrected OMEGA energy filter with a high brightness field emission electron gun. The 2nd order corrected OMEGA energy filter offers unrivalled isochromatic specimen viewing areas, high diffraction acceptance angles and sub-eV energy resolution for high performance EFTEM.

An exclusive Monochromator (MC) technology for the field emission gun gives rise to the LIBRA® 200MC. No longer limited by the energy spread of the source, the corrected OMEGA energy filter combined with the monochromator yields high energy resolution for spectroscopy (EELS) and low-loss EFTEM applications.

Combining the well-established LIBRA® 200 TEM technology with state-of-the-art aberration correctors provides powerful new capabilities for atomic-scale imaging and analytics. Dramatically improved resolution and chemical sensitivity, now give access to developing next-generation applications in material sciences, soft matter analysis, life sciences and nanotechnology.

- In-column 2nd order corrected OMEGA energy filter (for EFTEM, ESI, EELS, filtered diffraction)
- Kohler Illumination System (for parallel illumination, dose control, parallel diffraction)
- Schottky Field Emitter
- Truly symmetrical objective lenses in two variants: High Resolution (HR) and High Tilt (HT)
- Exclusive monochromator (MC) technology (for LIBRA® 200MC)
- Operation at acceleration voltages between 80 and 200 kV
- Spherical aberration Corrector for illumination system (LIBRA® 200 C₅ STEM)
- Spherical imaging corrector for the objective lens (LIBRA® 200 C₅ TEM)
- Optional cryo-objective for ice-contamination-free data acquisition under liquid nitrogen conditions

LIBRA® 200FE & LIBRA® 200MC LIBRA® 200C₅ TEM & LIBRA® 200C₅ STEM

Atomic scale analysis
on wide-ranging applications



*Images left page, top:
Cryo-EM of the protein
complex fatty acid
syntase.*

*Courtesy of
Prof. Kühlbrandt and
Dr. Barton, Max Planck
Institute of Biophysics,
Frankfurt, Germany.*

*Image below:
Pt particle at 200 kV.
Courtesy of David C. Bell,
School of Engineering
and Applied Sciences,
Harvard University,
Boston, USA.*

EVO® HD Technical Data

Essential Specifications	EVO® HD15 and EVO® HD25	
Resolution	1.9 nm @ 30 kV – SE 3 nm @ 30 kV – SE (VP mode) 10 nm @ 30 kV – 1 nA 5 nm @ 3 kV – SE 8 nm @ 1 kV – SE	
Acceleration Voltage	0.2 – 30 kV	
Magnification	< 5 – 1,000,000 x	
Field of View	6 mm at Analytical Working Distance (AWD)	
X-ray Analysis	8.5 mm AWD and 35° take-off angle	
OptiBeam⁽¹⁾ Modes	Resolution ⁽²⁾ , Depth ⁽²⁾ , Analysis ⁽²⁾ , Field, Fisheye	
Pressure Range	10 – 400 Pa ⁽³⁾ (MA configuration) 10 – 3000 Pa (LS configuration)	
Available Detectors	BSD – Multisegment Diode ETSE – Everhart-Thornley Secondary Electron Detector VPSE – Variable Pressure Secondary Electron Detector EPSE – Extended Pressure Secondary Electron Detector SCD – Specimen Current Detector STEM – Transmission Imaging Detector CL – Cathodoluminescence Detector	
Chamber	EVO® HD15 365 mm (Ø) x 275 mm (h)	EVO® HD25 420 mm (Ø) x 330 mm (h)
5-Axes Motorized Specimen Stage	EVO® HD15 X = 125 mm, Y = 125 mm, Z = 50 mm, T = -10° to 90°, R = 360° (continuous) Stage control by mouse or optional joystick and control panel	EVO® HD25 X = 130 mm, Y = 130 mm, Z = 50 mm, T = -10° to 90°, R = 360° (continuous) Stage control by mouse or optional joystick and control panel
Maximum Specimen Height	EVO® HD15 145 mm	EVO® HD25 210 mm
Future Assured Upgraded Paths	BeamSleeve®, Extended Pressure, Water vapour VP gas	
Image Framestore	3072 x 2304 pixel, signal acquisition by integration and averaging	
System Control	SmartSEM ⁽⁴⁾ GUI operated by mouse and keyboard Windows® XP multilingual operating system	
Utility Requirements	100 – 240 V, 50 or 60 Hz single phase, no water cooling requirement	

⁽¹⁾ Optibeam® – active column control for best resolution, best depth of field or best field of view

⁽²⁾ available in HV and VP (up to 133 Pa)

⁽³⁾ with optional TTL upgrade

⁽⁴⁾ SmartSEM® – Fifth generation SEM control Graphical User Interface


EVO® MA and LS Series Technical Data

Essential Specifications	EVO® MA and LS Series	
Resolution	3 nm (2 nm) @ 30 kV SE and W (LaB ₆) 4.5 nm @ 30 kV BSD (VP mode) 15 nm @ 30 kV 1 nA, LaB ₆ 20 nm (15 nm) @ 1 kV SE and W (LaB ₆) 10 nm @ 3 kV SE	
Acceleration Voltage	0.2 – 30 kV	
Magnification	< 7 – 1,000,000 x / < 5 – 1,000,000 x	
X-ray Parameters	8.5 mm WD / 35° TOA	
OptiBeam® Modes	Resolution, Depth, Analysis, Field, Fisheye	
Pressure Range	10 – 400 Pa (MA Series) 10 – 3000 Pa (LS Series)	
Available Detectors	BSD – Multisegment Diode ETSE – Everhart-Thornley Secondary Electron Detector VPSE – Variable Pressure Secondary Electron Detector SCD – Specimen Current Detector EPSE – Extended Pressure Secondary Electron Detector	
Image Processing	7 integration and averaging modes	
System Control	Windows® XP based SmartSEM®	

SUPRA® Technical Data

Essential Specifications	SUPRA®
Resolution (optimal WD) <i>All resolution specifications are dependent on the system configuration.</i>	SUPRA® 40/SUPRA® 40VP 1.0 nm @ 15 kV 1.9 nm @ 1 kV 2.0 nm @ 30 kV (VP mode) SUPRA® 55/SUPRA® 55VP and SUPRA® 60/SUPRA® 60VP 0.8 nm @ 15 kV 1.6 nm @ 1 kV 2.0 nm @ 30 kV (VP mode)
Magnification	12 – 1,000,000 x
Electron Emitter	Thermal field emission type
Acceleration Voltage	0.02 – 30 kV
Probe Current	Configuration 1: 4 pA – 20 nA / Configuration 2: 12 pA – 100 nA
Detectors	High efficiency in-lens detector, Everhart-Thornley Secondary Electron Detector, VPSE detector (VP mode), Cap mounted AsB® detector
Image Processing	Resolution: Up to 3072 x 2304 pixel, Noise reduction: Seven integration and averaging modes
System Control	SmartSEM** with Windows®XP, operated by mouse, keyboard, joystick, control panel


SmartSEM** – Fifth generation SEM control Graphical User Interface

 = upgrades

ULTRA Technical Data

Essential Specifications	ULTRA
Resolution <i>All resolution specifications are dependent on the system configuration.</i>	0.8 nm @ 30 kV (STEM mode) 0.8 nm @ 15 kV 1.6 nm @ 1 kV
Magnification	12 – 1,000,000 x in SE mode, 100 – 1,000,000 x with EsB® detector
Electron Emitter	Thermal field emission type, stability > 0.2 % / h
Acceleration Voltage	0.02 kV – 30 kV
Probe Current	Configuration 1: 4 pA – 20 nA / Configuration 2: 12 pA – 100 nA
Detectors	EsB® detector with filtering grid (0 – 1500 V), High efficiency in-lens SE detector, Chamber mounted Everhart-Thornley detector, Integrated AsB® detector
Image Processing	Resolution: Up to 3072 x 2304 pixel Noise reduction: Seven integration and averaging modes
System Control	SmartSEM** with Windows®XP, operated by mouse, keyboard, joystick, control panel

SmartSEM** – Fifth generation SEM control Graphical User Interface


 = upgrades

SIGMA™ Technical Data

Essential Specifications	SIGMA™
Resolution	1.3 nm @ 20 kV 1.5 nm @ 15 kV 2.8 nm @ 1 kV 2.5 nm @ 30 kV (in VP mode)
Accelerating Voltage	0.1 – 30 kV
Probe Current	4 pA – 20 nA (40 nA optional for SIGMA™ HV)
Magnification	12 x – 1,000,000 x
Electron Emitter	Thermal field emission type
Standard Detectors	In-lens SE detector, ETSE detector, VPSE detector (in VP mode)
Image Processing	7 integration and averaging modes
System Control	Windows® XP based SmartSEM®


MERLIN® Technical Data

Essential Specifications	MERLIN®
Resolution (optimal WD) <i>All resolution specifications are dependent on the system configuration.</i>	0.8 nm @ 15 kV 1.4 nm @ 1 kV 3.0 nm @ 20 kV at 10 nA, WD = 8,5 mm 0.6 nm @ 30 kV (STEM mode)
Acceleration Voltage	0.02 – 30 kV
Probe Current	10 pA up to 300 nA (depending on system configuration)
Magnification	12 – 2,000,000 x in SE mode 100 – 2,000,000 x with EsB® detector
Electron Emitter	Thermal field emission type, stability > 0,2 % / h
Detectors	High efficiency in-lens SE detector Everhart Thornley Secondary Electron detector EsB® detector with filtering grid, filtering voltage 0 – 1500 V Integrated AsB® detector
Specimen Stage	5-Axes Motorised Eucentric Specimen Stage X = 130 mm Y = 130 mm Z = 50 mm T = -3° to 70° R = 360° (continuous) Further additional optional stage systems available
Chamber	330 mm (Ø) x 270 mm (h) 15 accessory ports for various options including STEM, 4QBSD, EBSD, EDS, WDS CCD-Camera with IR-illumination Charge compensation with in-situ cleaning
Image Processing	Resolution: Up to 6144 x 4608 pixel (32 k x 32 k pixel optional available) A large number of integration and averaging modes available
Image Display	Single 19" TFT monitor with SEM image displayed at 1024 x 768 pixel
System Control	SmartSEM® with Windows®XP, operated by mouse, keyboard, joystick, control panel

 = upgrades

AURIGA® Technical Data

Essential Specifications	AURIGA® and AURIGA® 60	
	SEM	FIB
Resolution	GEMINI® column 1.0 nm @ 15 kV 1.9 nm @ 1 kV Values measured at optimum working distance	Cobra column: < 2.5 nm @ 30 kV Canion column: < 7 nm @ 30 kV
Magnification	12 x – 1000 kx	300 x – 500 kx
Probe Current	4 pA – 20 nA (100 nA optional)	1 pA – 50 nA
Acceleration Voltage	0.1 – 30 kV	< 1.0 – 30 kV
Emitter	Thermal field emission type	Ga Liquid metal ion source (LMIS)
Gas Injection System	a) Multi GIS for up to 5 precursors (Pt, C, W, insulator, fluorine, further gases on request) b) Multi GIS for up to 4 precursors with integrated local charge compensation system (use of all standard detectors possible) c) Single GIS system for 1 precursor (Pt, further gases on request) d) Fully automated and pneumatic retractable gas injector for local charge compensation and in-situ sample cleaning (use of all standard high vacuum detectors possible)	
Detectors	In-lens: High efficiency annular type SE detector Chamber: Everhart-Thornley type SE detector In-lens: EsB® detector with filtering grid for BSE detection, filtering voltage 0 – 1500 V Chamber: Combined Secondary Electron Secondary Ion (SESI) detector based on scintillator photomultiplier system Solid state or scintillator type BSD detector GEMINI® multimode BF/DF STEM detector	
Chamber	Multiple accessory ports for various options including STEM, 4QBSD, EBSD, EDS, WDS, SIMS, CL, GIS systems, cryo, local charge compensation and sample manipulation systems 2 x IR CCD-cameras included for sample viewing	

 = upgrades

Correlative Microscopy Technical Data

Essential Specifications	Correlative Microscopy
Samples	<p>Materials Analysis Mount for three metallurgical specimens: - 1 specimen with d = 1 1/2" or 1 x d = 30 mm via adapter - 2 specimens with d = 1" or 1 x d = 1" and, via adapter, 1 x d = 1/2" Alternatively, specimen slides: 2 75 x 25 mm² specimen slides; mount for 2 SEM stubs with 1/2" surface and 1/8" pin</p> <p>Life Sciences Cover slips (22 mm x 22 mm) Up to 4 TEM grids (3 mm)</p>
Relocation Accuracy	≤ 25 μm (coarse); ≤ 10 μm (fine) – depending on stages
Compatibility	Guaranteed with AxioVision 4.8.1 or higher, SmartSEM® V5.04 or higher (requires Remote API 2.4 or higher) Zeiss SteREO Discovery, Axio Imager, Axio Observer families equipped with motorized stages, all current ZEISS SEM / CrossBeam® platforms (correlative workflow between all microscopes)
Calibration	Manual or semi-automatic calibration of holders with automatic software detection of marks 100 ROIs / points for storage and recall per image ROI is automatically adjusted to the magnification level of the EM
Additional Functionalities	Image overlay and match option

ORION® PLUS Technical Data

Essential Specifications	ORION®PLUS
Resolution (Probe Size)	≤ 0.35 nm
Accelerating Voltage	10 kV – 35 kV ± 5 kV
Magnification	100 x – 1,000,000 x
Field of View	1 mm – 100 nm
Probe Current	Range: 1 fA – 100 pA
Ion Source	ALIS Gas Field Ion Source
Process Chamber	Volume 400 mm ³ Base Vacuum 8 x 10 ⁻⁷ Torr Customizable port plate Loadlock: Integrated Plasma Cleaner
Image Detectors	Everhart-Thornley Microchannel Plate
Gas Injection System	Pt, W, TEOS, other chemistries upon request. Integrated into the ORION®PLUS user interface
Analytical Detector	Spectra – Solid-state Backscattered Helium Spectroscopy. Materials analysis and thin film metrology.
Sample Stage	5-axis motorized stage, 50 mm travel in X and Y, 12 mm Z, 360°, 0° to 45° tilt
Vacuum System	300 L/sec Mag-Lev turbomolecular pumps backed with oil and particle free roughing pumps
Video Cameras	Two video monitoring cameras – Source View and Chamber View

LIBRA® 120 PLUS Technical Data

Essential Specifications	LIBRA® 120 PLUS
Line Resolution	< 0.2 nm
Energy Resolution	< 1.5 eV
Acceleration Voltage	up to 120 kV
Magnification	8 – 630,000 x
Electron Emitter	LaB ₆ or W
Illumination System	Koehler (Parallel illumination)
Modes of Operation	EFTEM: Global and elastic BF/DF/Low Dose (elemental and structure sensitive contrast) Analysis: EELS, ESI, Image EELS, EDS Diffraction: Global and elastic SAED, CBED, LACBED, micro-ED STEM: SE, BSE, HAADF, BF, DF, SI, EDS
Vacuum System	Completely oil-free
System Control	WinTEM™ based on Windows®XP

LIBRA® 200 Technical Data

Essential Specifications	LIBRA® 200FE	LIBRA® 200MC	LIBRA® 200C _S TEM	LIBRA® 200C _S TEM MC
Information Limit @ 200 kV*	0.14 nm	0.12 nm	0.10 nm	0.08 nm
Energy Resolution	< 0.7 eV	< 0.2 eV	< 0.7 eV	< 0.15 eV
	for all LIBRA® 200 TEMs:			
Acceleration Voltage	80 – 200 kV FEG			
Illumination System	Koehler (Parallel illumination)			
Cryo Option	available with HT and Cryo Objective			
System Control	WinTEM™ based on Windows®XP			

* for high resolution objective



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