Combining Data Quality with Intuitive Operation.

ZEISS EVO Family

Your Modular SEM Platform for Intuitive Operation,
Routine Investigations and Research Applications

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ZEISS

Seeing beyond

Your Modular SEM Platform for Intuitive Operation, Routine Investigations and Research Applications

The instruments of the ZEISS EVO family combine high performance scanning electron microscopy with an intuitive, user-friendly experience that appeals to both trained microscopists and new users. With its comprehensive range of available options, ZEISS EVO can be tailored precisely to your requirements, whether you are in life sciences, material sciences, or routine industrial quality assurance and failure analysis.

Configure a versatile, multi-purpose solution for central microscopy facilities or industrial quality assurance laboratories. Choose from different chamber sizes and stage options that meet all your application requirements—even for large industrial parts and samples that can be a challenge to process with SEM.

Push your SEM investigations with maximum image quality by opting for the lanthanum hexaboride (LaB6) emitter, a proven technology that delivers more beam brightness for superior image resolution and noise reduction.

Experience imaging and analytical excellence on non-conductive samples with variable pressure operation. Benefit from a design that accommodates multiple analytical detectors to support demanding microanalysis applications.

Simpler. More Intelligent. More Integrated.

Class-Leading Usability

EVO caters to all users through implementation of two user interfaces: SmartSEM Touch and SmartSEM. SmartSEM Touch, which can run from a touchscreen, puts interactive workflow control directly at your fingertips. It is quick and easy to learn, dramatically reducing training effort and costs. Within minutes, even new users will begin capturing stunning images. This user interface also supports industrial operators who require automated workflows for repeatable inspection tasks. EVO's expert users will find all the functionality they need for advanced imaging by using the SmartSEM user interface, which runs directly from the instrument PC.

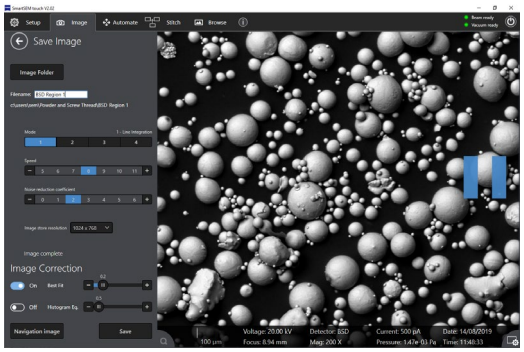
Excellent Image Quality

Image quality scales with how the sample is presented to the SEM. Variable pressure (VP) mode and our unique Variable Pressure and Current Cascade Secondary Electron (SE) detectors work together to deliver the best possible image quality for all non-conductive samples. And Extended Pressure mode, in combination with water vapor and the C2DX detector, will safeguard data quality on hydrated and heavily contaminated samples, by allowing these samples to remain in their native state.

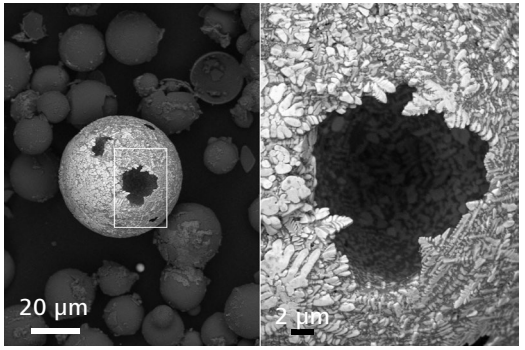
Additionally, the LaB_6 emitter will give that extra boost of resolution, contrast and signal-to-noise that is particularly important when imaging and microanalysis get challenging.

Workflow Automation and Data Integrity

EVO plays well with others. This means EVO can be configured to be part of a semi-automated multi-modal workflow, with tools for seamless relocation of regions of interest and integrity of data collected from multiple modalities. Combine EVO with Smartzoom 5, the ZEISS digital light microscope, or any other compound light microscope, and combine light and electron microscope data for material characterization or parts inspection. Or combine EVO with ZEISS light microscopes for correlative particle analysis.



SmartSEM Touch provides even new users with the most intuitive access to imaging functions and predefined workflows.



Dual magnification, secondary electron images of a ferrocerium particle, acquired in high vacuum.

EVO and the digital light microscope Smartzoom 5 combine to facilitate a correlative workflow.

Easy Operation for Both Experienced and Novice Users

No Sacrifice to SEM Productivity even in Multi-user Environments

Depending on the actual laboratory environment, operation of the SEM can be the exclusive domain of expert electron microscopists. But this situation is challenged by the very common necessity that non-expert users, such as students, trainees, or quality engineers, also require data from the SEM. EVO takes both requirements into account, with user interface options that cater to the operational needs of experienced microscopists as well as non-microscopists.

System administrator

This user is responsible for calibrating the system and preconfiguring parameters, and will have full access to the system controls.

Expert users
Preferred UI: SmartSEM

Expert users have access to custom image directories, advanced imaging parameters, and analysis functions. They can have their own custom profiles that are independent from other user profiles.

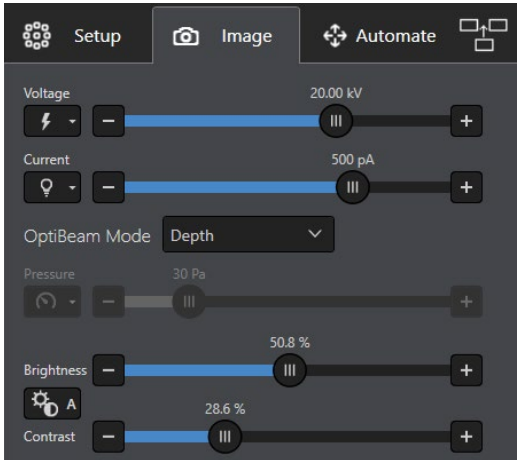
Novice users
Preferred UI: SmartSEM Touch

Novice users have access to custom image directories, predefined workflows and the most frequently used parameters—perfect for a beginner. They can have their own custom profiles that are independent from other user profiles.

EVO perfectly meets the needs of multi-user environments with interface controls and options for users of different experience levels and access privileges.

Intuitive Operation: SmartSEM Touch

SmartSEM is ZEISS' well-established operating system for experienced microscopists that provides user access to advanced microscope settings. And SmartSEM Touch is the highly simplified user interface developed specifically for the occasional operator who has very limited or no knowledge of operating a SEM. In as little as 20 minutes, novice users are up and running, producing their first SEM data. Laboratory managers can preconfigure parameters for recurring imaging routines, samples or parts, ensuring that novice or routine users always use the exact same parameters for repeatable data acquisition. Multiple languages are supported to ensure easy localization and use.



SmartSEM Touch: Intuitive user interface for access to presets, workflows, and imaging parameters

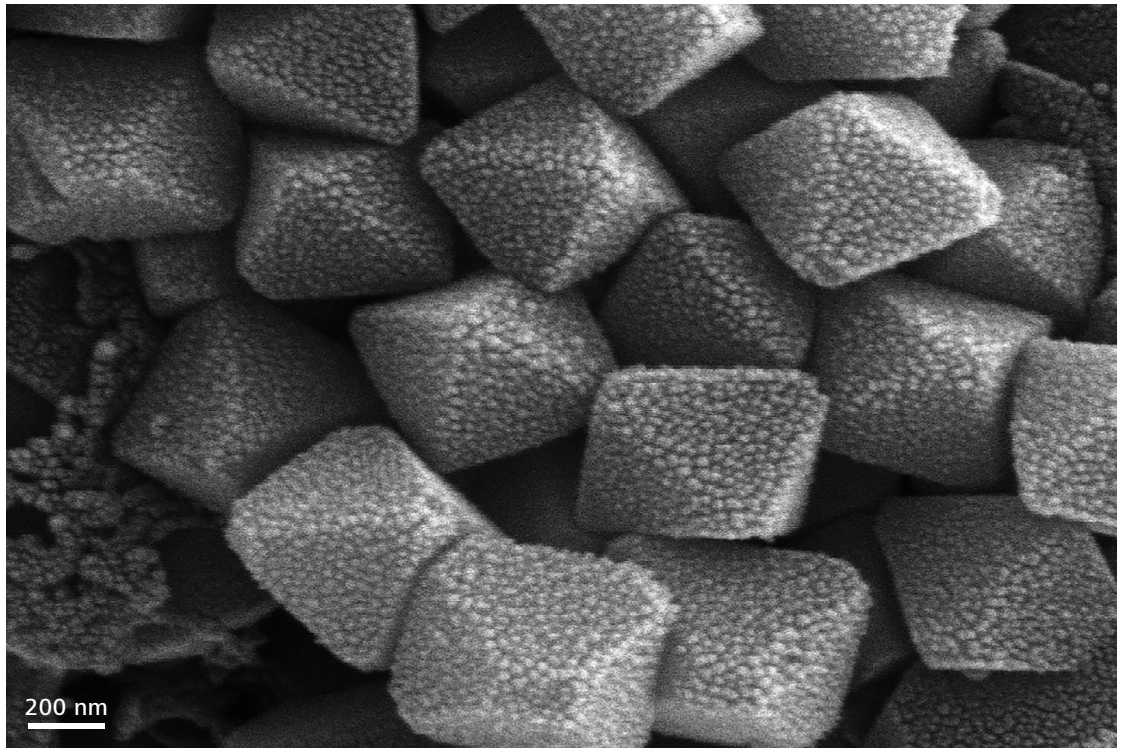
Class-Leading Data Quality

Better Data with a Lanthanum Hexaboride (LaB_6) Electron Emitter

Electron emission from a lanthanum hexaboride cathode, rather than a traditional tungsten hairpin filament, provides the reassurance that every extra component of image quality is there when you need it.

While traditional thermal emission SEMs generate electrons from a superheated tungsten hairpin filament, there are distinct advantages to instead using a LaB_6 thermionic emitter. The pointed LaB_6 crystal emits approximately the same amount of electrons, but does so from a point source that is significantly smaller. The result is up to 10 times higher beam brightness. And that is a benefit you can put into action in two ways:

- At equivalent electron probe sizes (i.e. resolution), there is more probe current to work with, which makes image navigation, analytics and optimization much easier.
- Alternatively, at equivalent probe currents (signal-to-noise), the beam diameter is much smaller, resulting in enhanced image resolution.



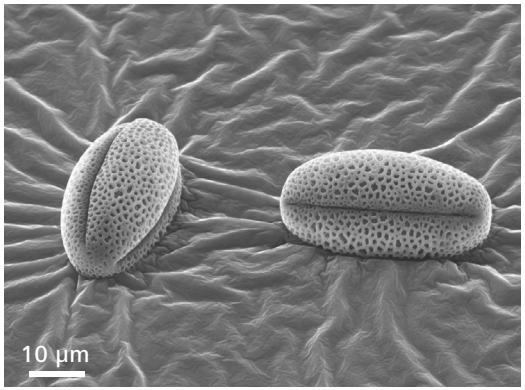
Surface structure of framboidal pyrite. Imaging magnification of 100,000× translates to a horizontal field of view of approximately 3 µm. Image: courtesy of Joseph Dunlop, School of Earth & Environmental Sciences, University of Portsmouth.

Sample Investigations with Challenging Requirements

Wet or dirty samples? No problem!

EVO can be configured for operation at elevated vacuum chamber pressures with custom gases such as water vapor. This enables imaging samples in their natural hydrated state, without sample alteration that would affect data accuracy or even the information value. This extended pressure technology also prevents contamination from oily or uncleaned parts from making its way to the electron column, enabling you to safely examine parts for which a cleaning process would skew your investigative results.

Combine a Peltier cooling stage with the highly sensitive vacuum and humidity control of EVO and you will achieve stunning life science images. It's easy to move between vapor, liquid or ice, using the interactive phase diagram of water to control imaging conditions. You can perform both freezing and heating processes in the SEM vacuum chamber with the dovetail mounted stage that can be thermally controlled within the range of -30° to 50°C.



Freeze-dried pollen imaged at high vacuum conditions; SE detector, 10 kV

Tree pollen imaged with extended pressure and C2DX detector at near to 100% relative humidity.

SEM imaging can be used for plant classification using pollen as systematic classifier. Typically, pollen are prepared with classical critical point-drying and sputter coating procedures. Environmental imaging enables the imaging of near native samples without any of the preparation typically used for topographic investigations. It is clearly visible that under environmental conditions, shrinking artifacts are reduced.

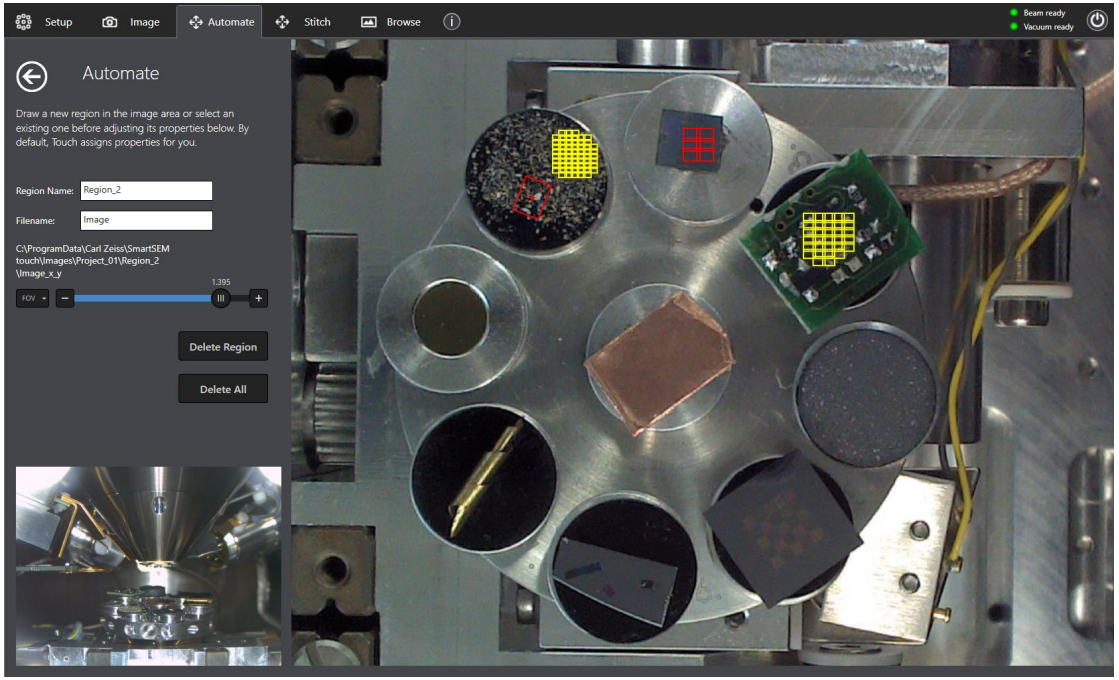
Can't coat? That's fine, too.

While there are times when non-conductive samples or parts move to the SEM after application of a conductive surface layer, there are also imaging and analysis workflows that don't allow for any alteration to the sample or part—including coating. This is particularly true for multi-modal workflows, where parts move from instrument to instrument in the course of an investigation. EVO's VP mode provides a solution to neutralize charge on non-conductive surfaces, but this alone is not always enough to extract the best possible data quality, particularly when imaging for surface morphology (with secondary electrons) and performing microanalysis. EVO's C2D detector and BeamSleeve technology work together with VP mode as key solutions that further ensure high quality SEM data from uncoated, non-conductive samples or parts when preparation of such parts would compromise the results of a multi-modal workflow.

Improved Productivity through Intelligent Navigation and Imaging

ZEISS Navigation Camera

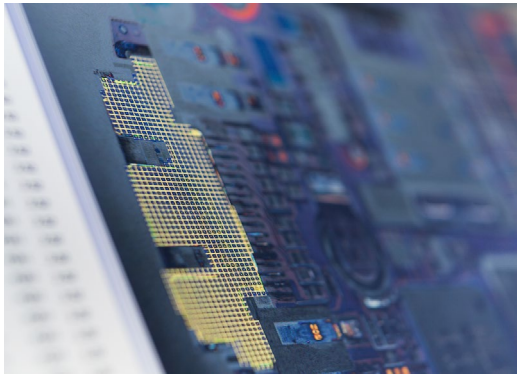
A camera can be mounted either to the chamber to monitor the position of the samples relative to the pole piece (chamberscope); or on the vacuum chamber door (navigation camera) to enable a helicopter view of the arrangement of samples or parts on the sample holder. This view can then be used to set up predefined locations of interest identified from a light microscope image, and for easy navigation during the entire sample investigation process.



Navigation camera overview image with regions of interest marked for investigation

Automated Intelligent Imaging

EVO enables automated, unattended acquisition of images across sample batches. Available in SmartSEM, ZEISS Automated Intelligent Imaging is perfectly suited to routine inspection. It enables the user to define a boundary region, automatically generate regions of interest determined by the required field of view or magnification, and begin automated acquisition. Automated Intelligent Imaging will improve your sample throughput, boosting productivity and performance.



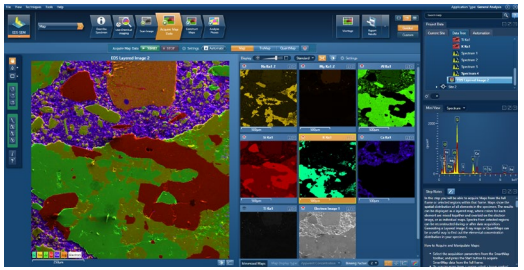
Automated Intelligent Imaging allows users to draw freeform areas of interest. EVO then automatically acquires the dataset.

Integrated Energy Dispersive Spectroscopy Solutions

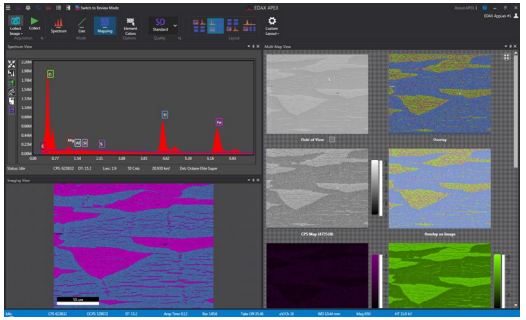
Simplify Operation and Streamline the Service of Your SEM and EDS System

When you need to investigate the chemical composition of your specimens, configure your EVO with an integrated EDS system.

As the user of the microscope, enjoy a streamlined operation of SEM and EDS and benefit from increased efficiency. Now, you can control both EDS and SEM in parallel using one single PC. This integration improves not only usability but also lets you enjoy dedicated user interfaces for your microscope and your EDS system. Moreover, you can reduce your EDS acquisition time by leveraging the optimized detector integration that boosts the EDS signal inputs by at least 17%. The single PC solution offers you various EDS configurations: the Xplore 15, 30 and the Ultim Max 40 detectors from Oxford Instruments can be ordered. ZEISS SmartEDX is available either as the best price-performance EDS detector in a fixed configuration, or as the flexible and still convenient slider version. As the instrument owner you will work more efficiently by being offered just one point of contact. Through the close cooperation between Oxford Instruments and ZEISS you are just one call or click away from any requirement you may have with your SEM or EDS system. This reduces not only your cost of ownership, but service is made easy, too.

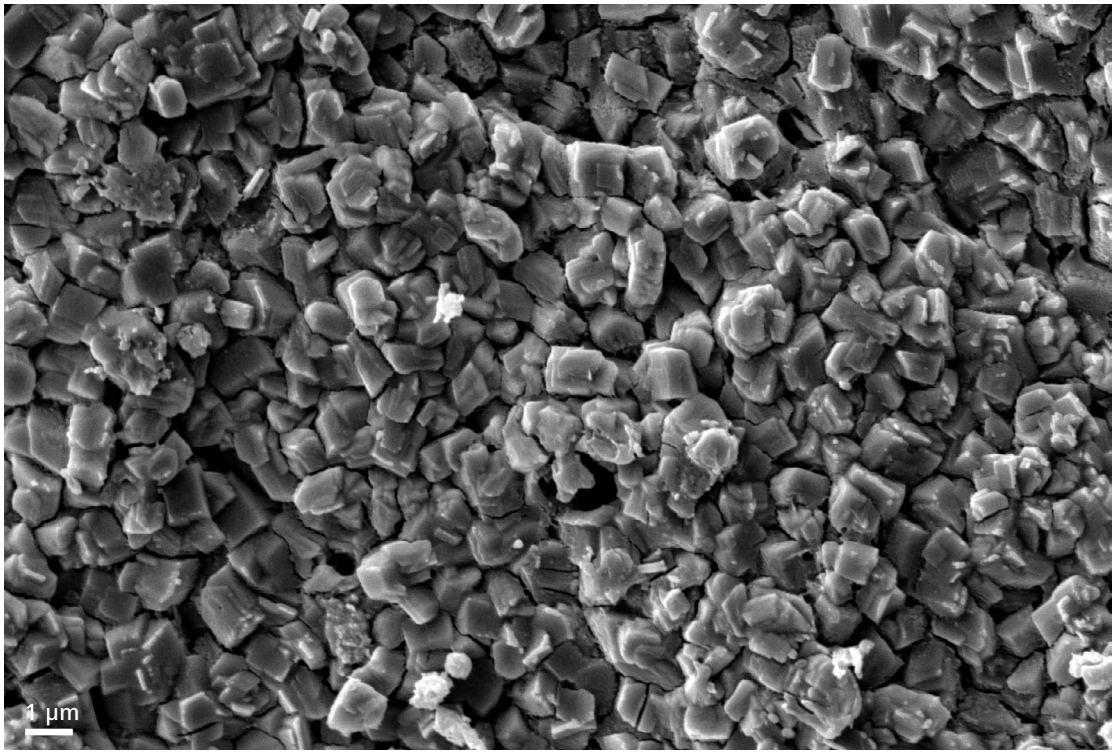


The integration improves usability by requiring only one PC to control both the EDS and the SEM. Xplore detector (left) and graphical user interface of AZtec Software from Oxford Instruments (right) are recommended for demanding applications.



ZEISS SmartEDX is recommended for routine tasks: detector (left) and software GUI (right).

ZEISS EVO at Work: Industry Applications



Zinc-phosphate E-coating, imaged with SE detector in high vacuum. Horizontal field width approximately 20 µm.

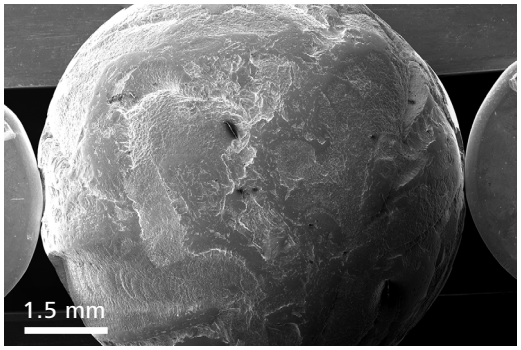
Typical Tasks and Applications

- Quality analysis / quality control
- Failure analysis / metallography
- Cleanliness inspection
- Morphological and chemical analysis of particles to meet ISP 16232 and VDA 19 part 1 & 2 standards
- Analysis of non-metallic inclusions

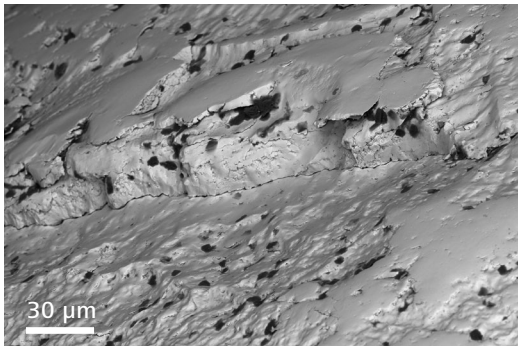
How You Benefit from ZEISS EVO

- Sample flexibility with three chamber size options; samples weighing up to 5 kg; samples up to height of 210 mm and width of 300 mm.
- Intelligent imaging and automated workflows for efficient user interaction
- Optimized settings for each sample type
- Variable pressure (VP) technology for imaging of non-conductive composite materials, fibers, polymers and textiles
- Enhanced data quality from VP imaging with the C2D secondary electron detector
- Fully integrated particle analysis and identification solution for advanced morphology and chemical analysis (SmartPI)

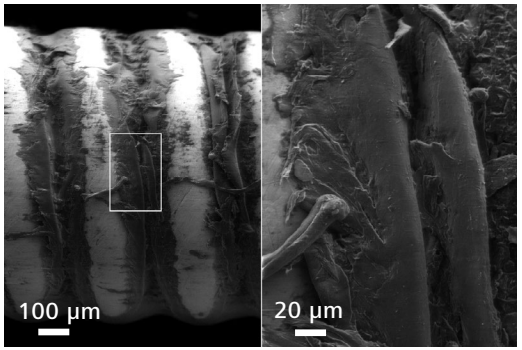
ZEISS EVO at Work: Industry Applications



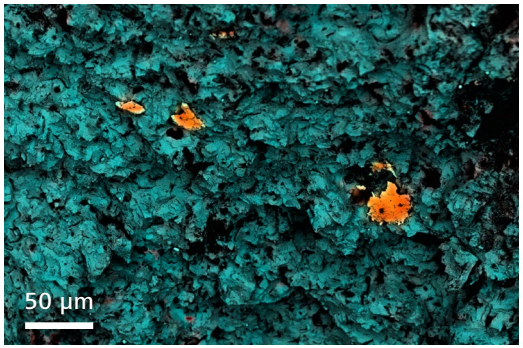
A stitched image shows high resolution and wide field of view of a ball bearing exhibiting characteristic wear patterns. Imaged at 20 kV with the SE detector.



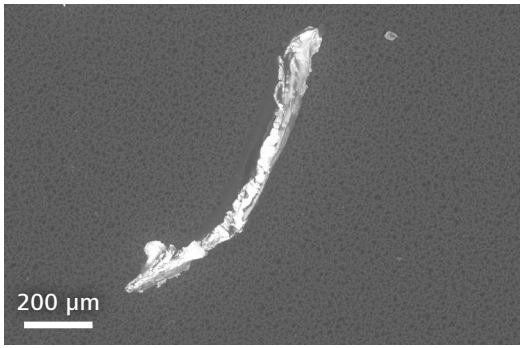
Surface of the ball bearing imaged with the BSE (backscattered electrons) detector reveals cracking and flaking of the surface structure.



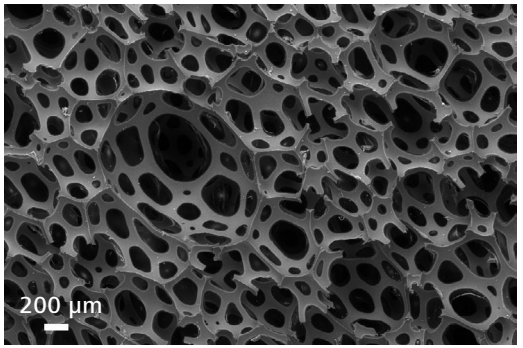
Guitar string showing the copper coil wound around a metal string, and coated with a polymer coating. Imaged in Variable Pressure mode with the C2D detector at 7 kV.



EDS map of fractured sample showing fragments of tin (orange) against the iron (blue) background. Sample: courtesy of J. Scott, West Mill Innovation, UK.

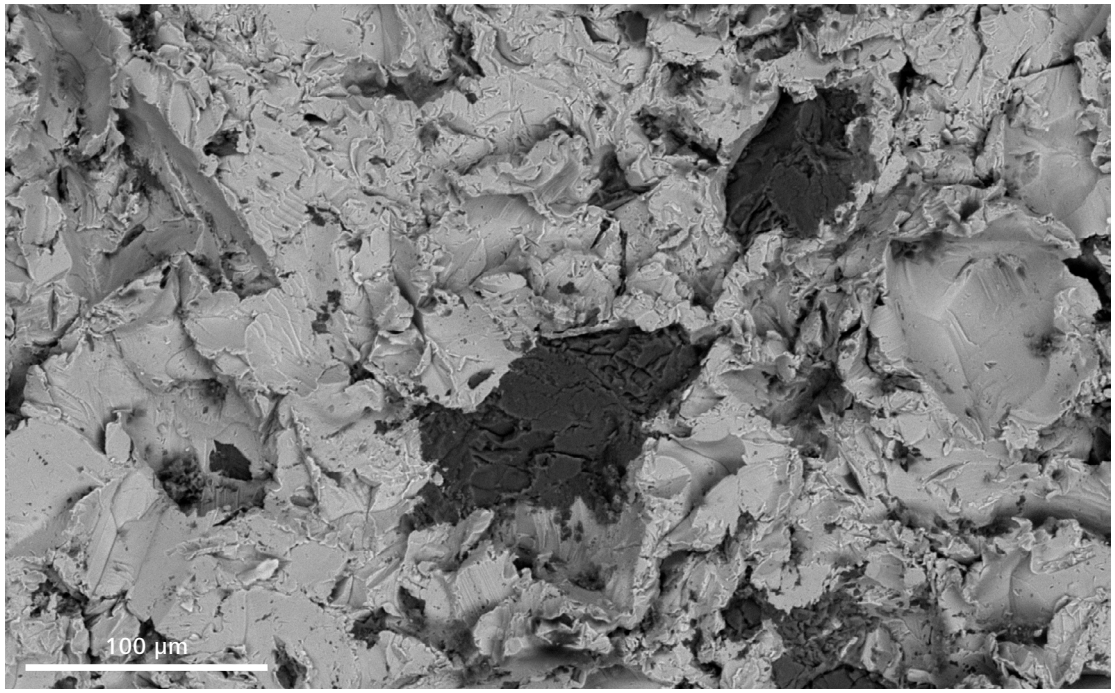


Particle from a particle filter imaged with the BSE detector during a quality control task to analyze the cleanliness of an industrial process.



Car seat cushion foam, imaged uncoated in Variable Pressure mode with the BSE detector.

ZEISS EVO at Work: Steel and Other Metals



Surface of S355 steel after grit blasting with F80 grit alumina. Imaged with the BSE detector on EVO 15. Sample: courtesy of TWI Ltd, UK

Typical Tasks and Applications

- Imaging and analysis of the structure, chemistry and crystallography of metallic samples and inclusions
- Phase, particle, weld and failure analysis

How You Benefit from ZEISS EVO

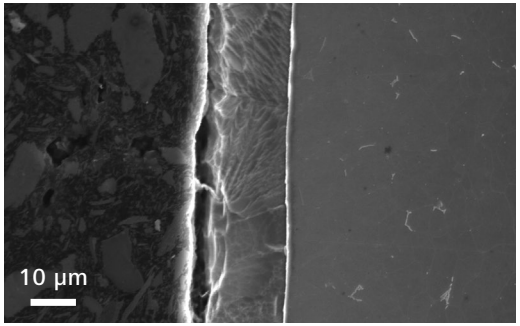
Obtain crisp, clear compositional and crystallographic information from ferritic, austenitic, martensitic or duplex steels and advanced alloys with EVO's best in class Backscattered Electron (BSE) detector.

Take advantage of EVO's easy access chamber door and robust stage to add tensile testers, nanoindenters and heating modules for advanced characterization of metallic samples.

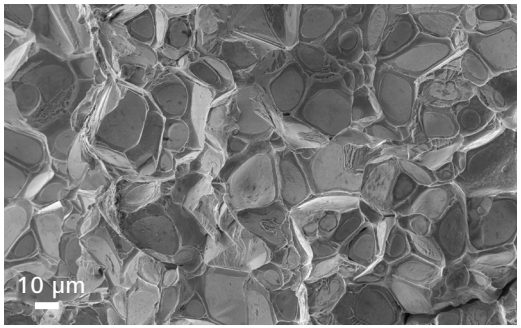
EVO's class leading EDS geometry provides for high throughput, high accuracy X-ray analysis. In addition, its flexible port configurations provide for coplanar EBSD for microstructural characterization of grain boundaries, phase identification, strain and slip system activity.

Unparalleled beam stability allows stable operation for long EDS and EBSD collection runs on large area samples, to consistently deliver reliable and repeatable results.

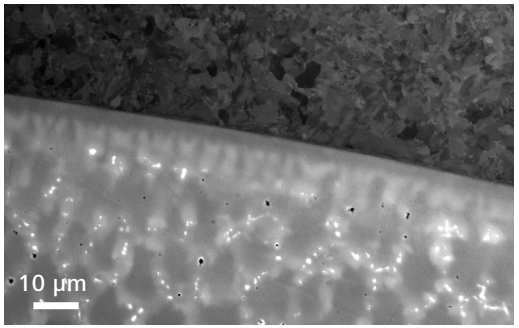
ZEISS EVO at Work: Steel and Other Metals



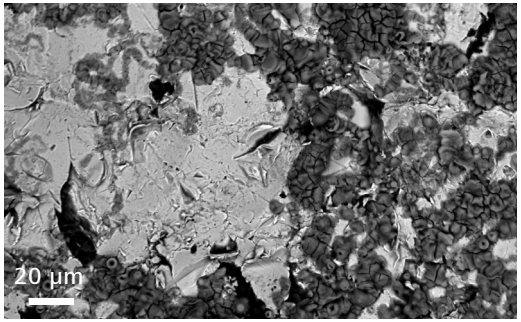
Cross section of galvanised mild steel, imaged using the SE detector on EVO 15. Left: mounting resin; middle: zinc layer; right: mild steel.



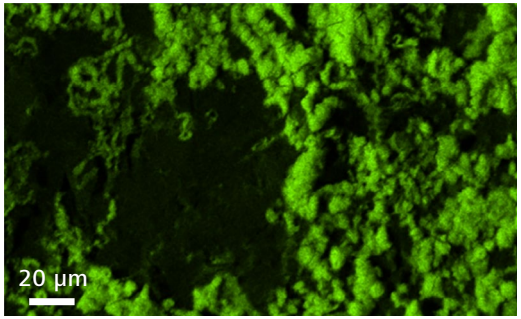
Advanced alloy material shows tungsten core material surrounded by a steel matrix. Imaged at 7 kV with the C2D detector.



Alloy 625 weld overlay on 8630 steel viewed using BSD detector on a EVO 15. Sample provided by TWI Ltd.



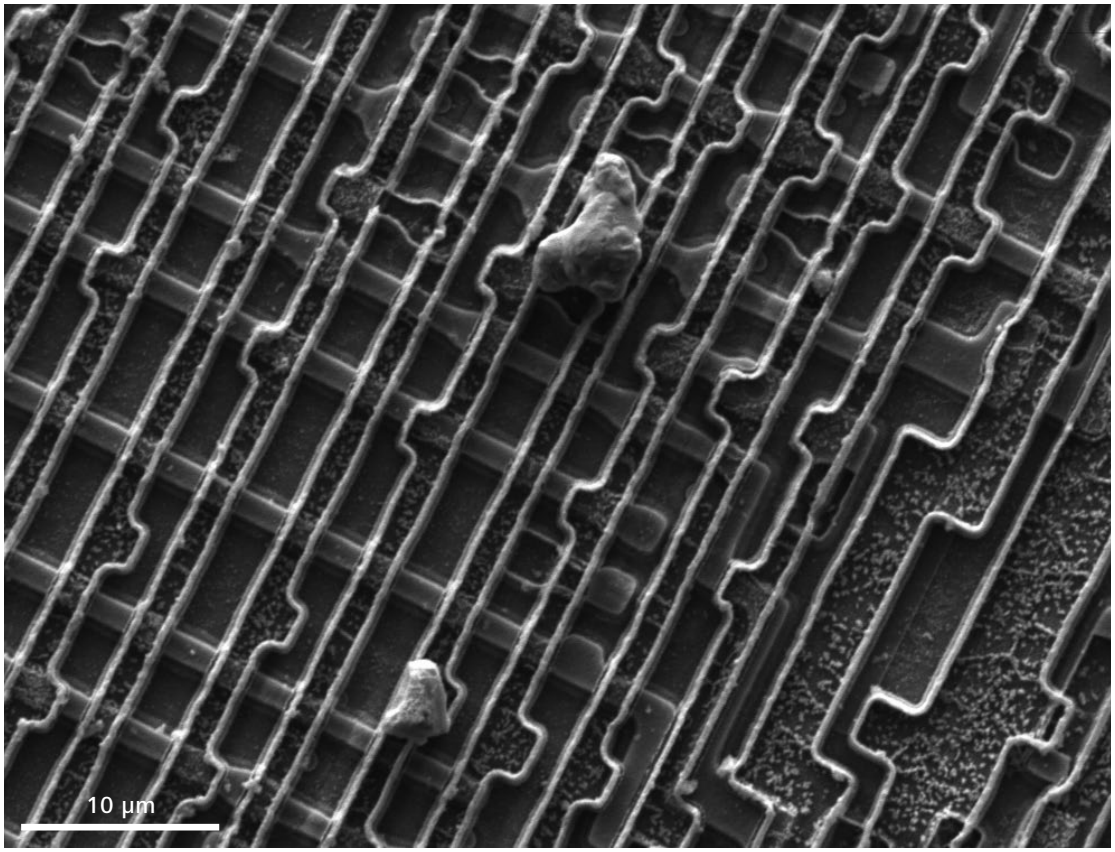
Corroded region of mild steel, imaged with BSE detector in a EVO 15.



Corroded mild steel oxygen map. Region of interest corresponds to backscattered electron image to left.

Surface of titanium alloy (Ti-6Al-4V) additively manufactured using selective laser melting, showing fully melted regions alongside unmelted Ti-6Al-4V particles and other material. Imaged with BSE detector on EVO 15. Sample provided by TWI Ltd.

ZEISS EVO at Work: Semiconductors & Electronics



Debris and contamination is evident on the surface of an integrated circuit. Imaged with the SE detector in high vacuum at 10 kV.

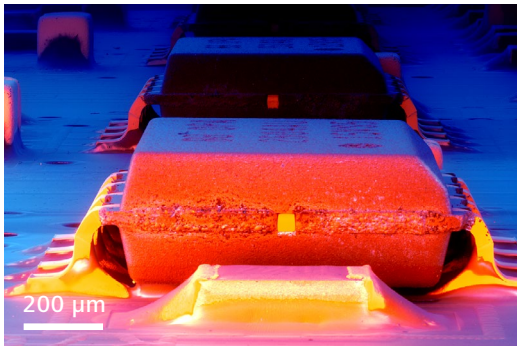
Typical Tasks and Applications

- Visual inspection of electronic components, integrated circuits, MEMS devices and solar cells
- Copper wire surface and crystal structure investigation
- Metal corrosion investigations
- Cross-sectional failure analysis
- Bonding foot inspections
- Capacitor surface imaging

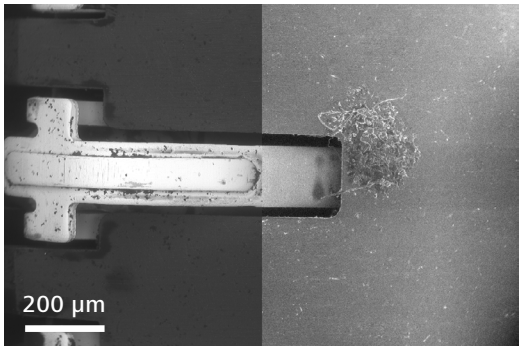
How You Benefit from ZEISS EVO

The range of detectors, including BSE and C2D, provide superb high contrast topographic and compositional imaging in VP mode for semiconductor materials without charging artifacts.
The optional Beam Deceleration system provides highest resolution at lowest accelerating voltages, allowing you to visualize true surface details of solar cells and integrated circuits.
The flexibility of EVO allows many third-party testing and analysis modules to be utilized, including EBIC and nanoprobes for characterizing p-n junctions and IC failure analysis.

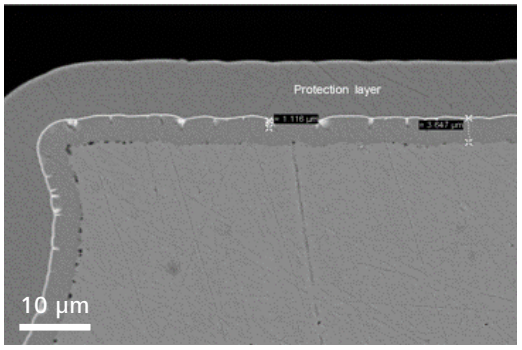
ZEISS EVO at Work: Semiconductors & Electronics



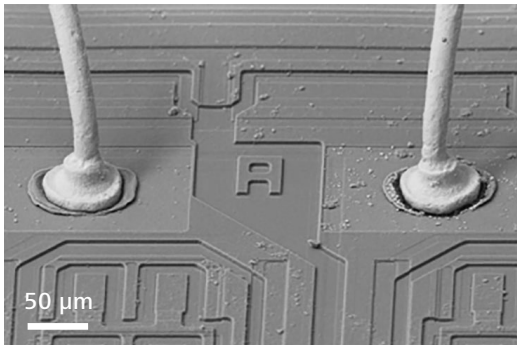
False-colored image of components mounted on a PCB aids visualization during routine inspection.



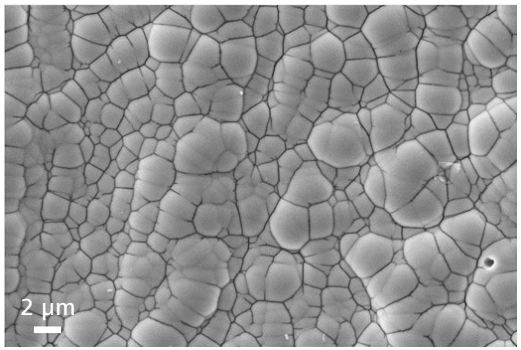
BSE image (left) and SE image (right) of the gold on nickel plated SIM card contact and the UL94V high temperature liquid crystal polymer (LCP) housing.



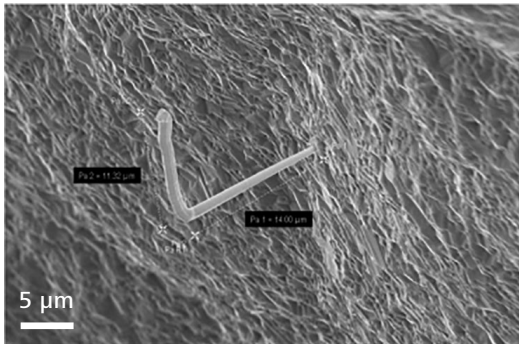
BSE image of a cross section, revealing the different compositional layers.



Wire bond inspection using secondary electron imaging in high vacuum or variable pressure mode.

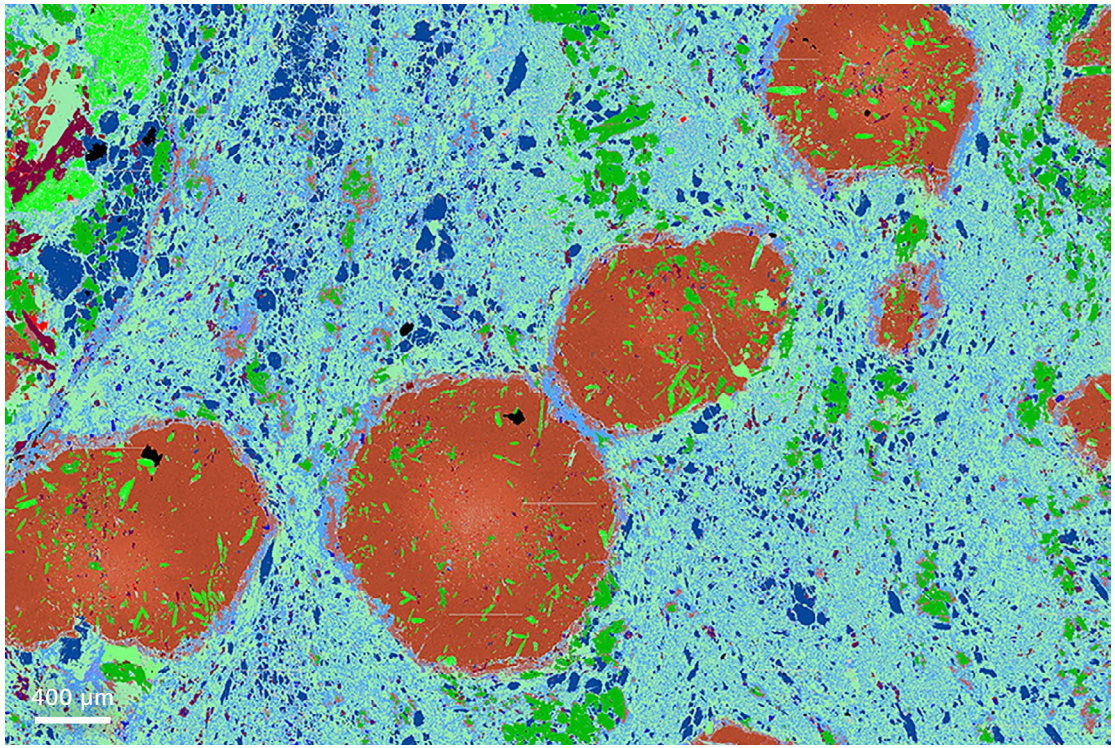


Corroded Nickel layer imaged with secondary electrons.



SE image revealing whisker growth on an electronic device.

ZEISS EVO at Work: Raw Materials



Mineralogic mineral map of blueschist. Sample: courtesy of S. Owen

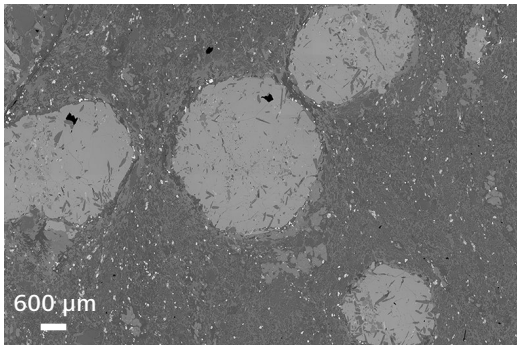
Typical Tasks and Applications

- Morphology, mineralogy and compositional analysis of geological samples
- Imaging and analysis of the structure metals, fractures, and nonmetallic inclusions
- Morphological and compositional analysis of raw chemicals and active ingredients during micronization and granulation processes

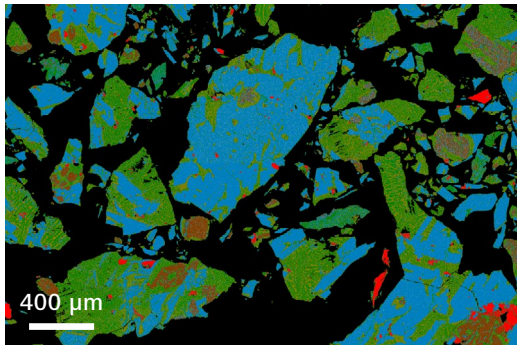
How You Benefit from ZEISS EVO

The high stability analytical design, three chamber sizes, flexible port configuration options and compatible, integrated mineral analysis software make EVO—without question—the best instrument for natural resource characterization.
Image core samples in VP mode with both the C2D and BSE detector to obtain maximum structural and compositional information.
Obtain clear compositional and crystallographic information from duplex steels and advanced alloys with EVO's best in class BSE detector.
Boost the performance of EVO with the ZEISS cathodoluminescence (CL) detector for clear, streak-free imaging of carbonates.

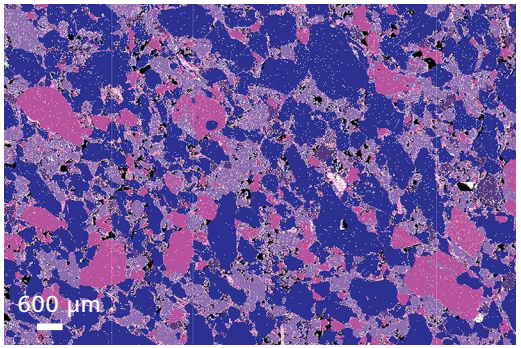
ZEISS EVO at Work: Raw Materials



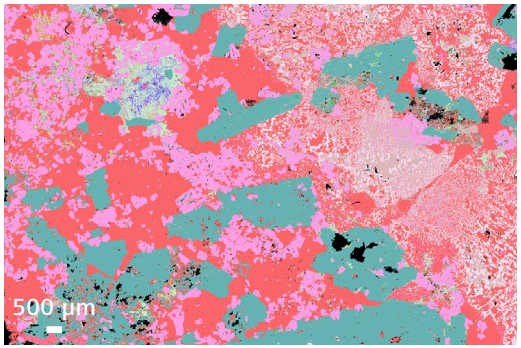
Blueschist imaged with the BSE detector.



Residual copper slag particle from large Zambian copper smelter. Courtesy of Petrolab, UK

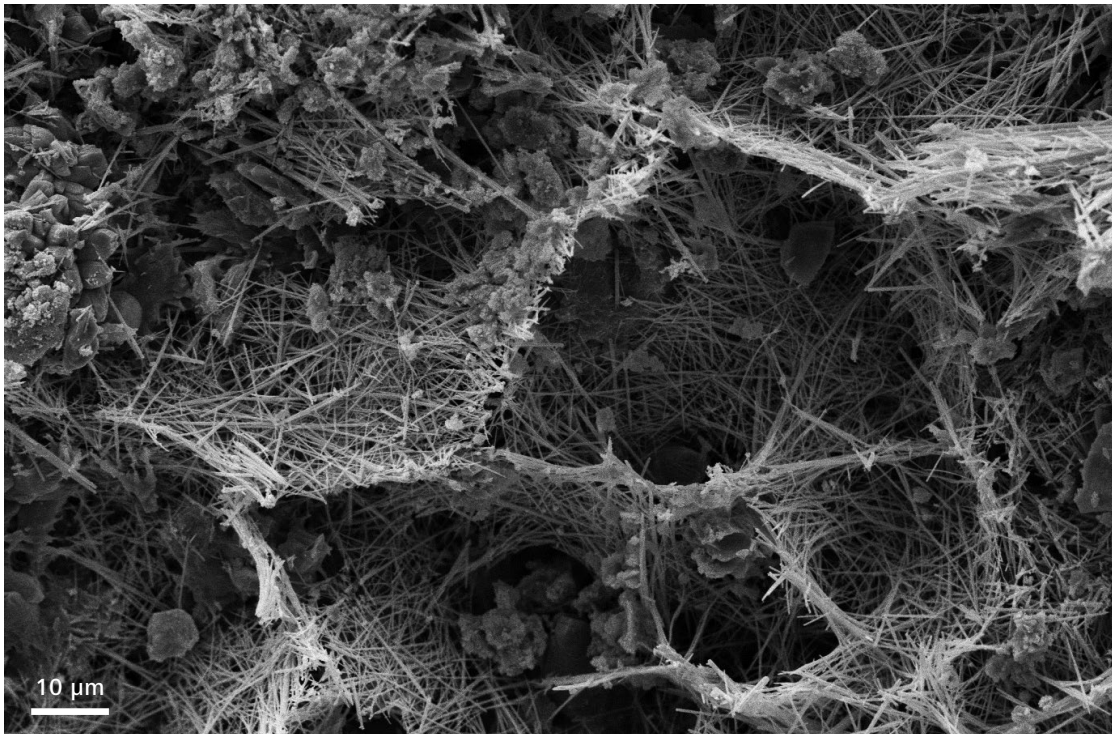


ZEISS Mineralogic mineral map of sandstone reservoir rock



Peralkaline Granite, Northern Quebec, Canada, containing rare earth elements, including a fluorite vein that crosscuts the sample and zoned zircons.

ZEISS EVO at Work: Materials Science Research



Self-healing concrete, 12kV, HV mode. The SE detector reveals the mineral expansion and crack-bridging network of self-healing concrete. Image: courtesy of Tanvir Qureshi, University of Cambridge, UK.

Typical Tasks and Applications

- Characterization of both conductive and non-conductive material samples for research purposes

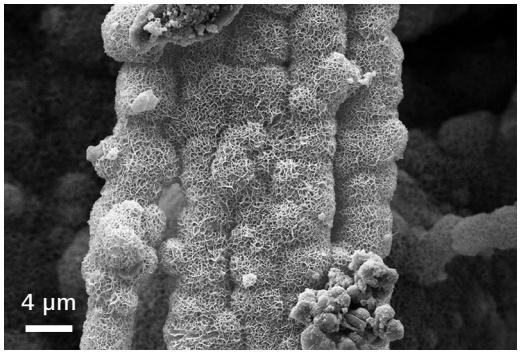
How You Benefit from ZEISS EVO

EVO has been designed to accept a wide range of imaging detectors. Equipped with SE and BSE detectors, Beam Deceleration and coplanar EDS and EBSD geometry, EVO is a flexible research tool for materials analysis.

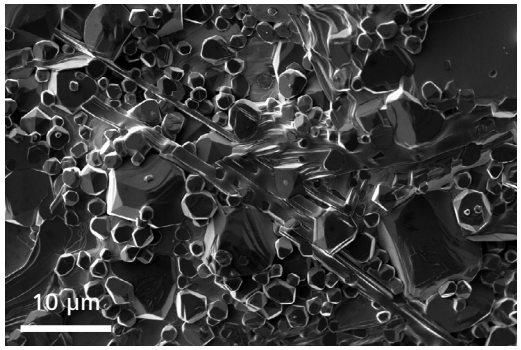
Switching between high vacuum and variable pressure modes of operation is quick and easy, allowing investigations of both conductive and non-conductive samples.

The latest ZEISS detector technology, including Cascade Current Detector (C2D) and Extended Range Cascade Current Detector (C2DX), provides outstanding imaging of polymers, plastics, fibers and composites when operating in extended pressure mode and a water vapor environment.

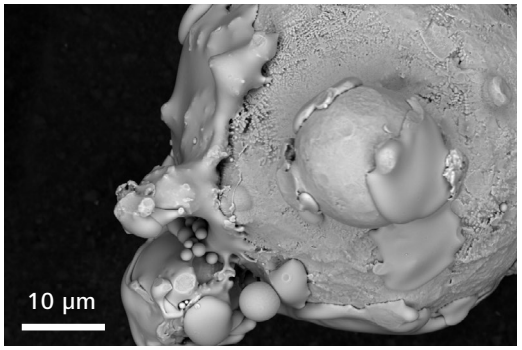
ZEISS EVO at Work: Materials Science Research



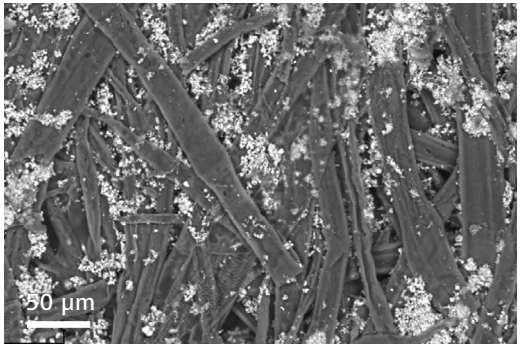
Expansion and crack bridging network of self-healing minerals, imaged using SE detector at 12 kV shows flower-like hydro-magnesite structures is formed.



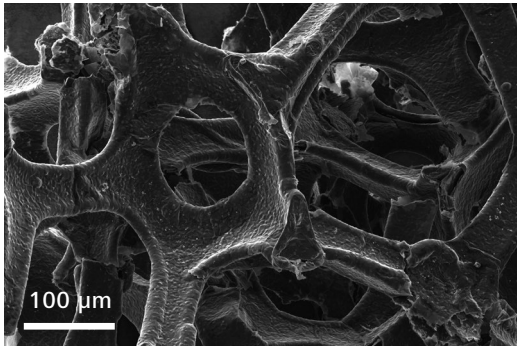
Aerospace composite material imaged with the C2D detector at 10 kV in VP mode.



SE image of stellite particles, a non-magnetic and corrosion resistant cobalt alloy, used in hardfacing and acid-resistant machine parts. Imaged at 15 kV with the BSE detector.

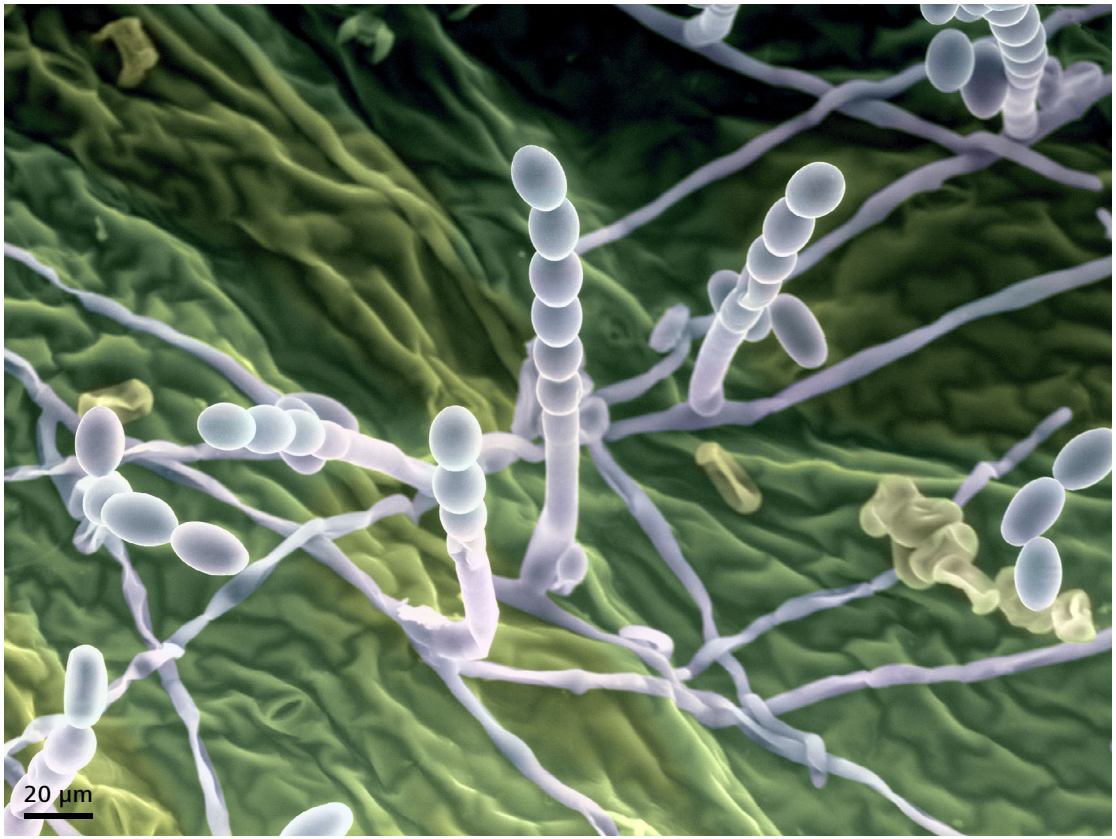


Printer paper imaged at 20 kV and 40 Pa air with the BSE detector.



Graphene foam structure from a battery assembly, imaged in high vacuum with SE detector.

ZEISS EVO at Work: Life Sciences



False-colored image of mildew on the surface of a leaf. Imaged with C2DX detector at 570 Pa water vapor at 1°C, 20 kV.

Typical Tasks and Applications

- Research into plants, animals and micro-organisms

How You Benefit from ZEISS EVO

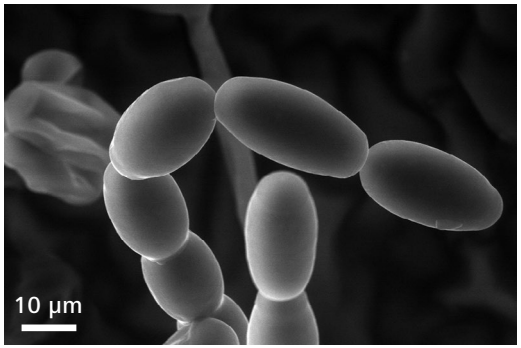
EVO is a true environmental SEM, allowing specimens to be examined in their natural state under a range of water and air conditions. EVO supports cryo and STEM imaging.

The suite of variable pressure and extended pressure detectors including BSE, VPSE-G4, C2D and C2DX, offer unparalleled imaging of biological specimens.

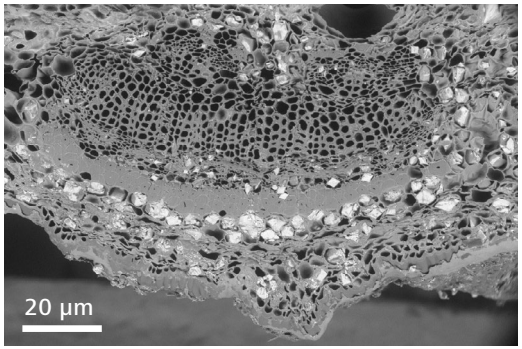
Image delicate hydrated biological specimens with the C2DX detector, which delivers excellent images at high pressures in water vapor.

Obtain highly detailed images of tissue samples without the need for active cooling by imaging samples in dynamic equilibrium in water vapor with the BSE detector and EVO.

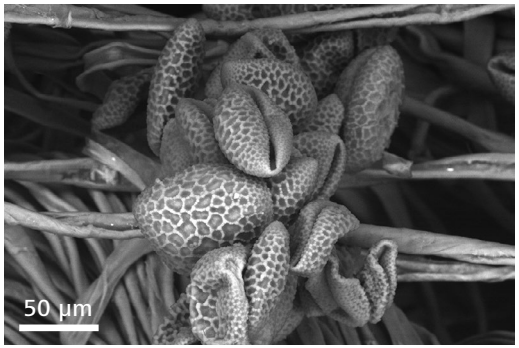
ZEISS EVO at Work: Life Sciences



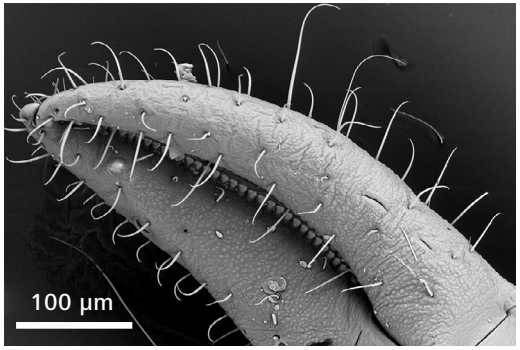
Mildew on the surface of a leaf. The mildew was not critical point-dried or coated. Imaged with C2DX detector at 570 Pa water vapor at 1°C, 20 kV.



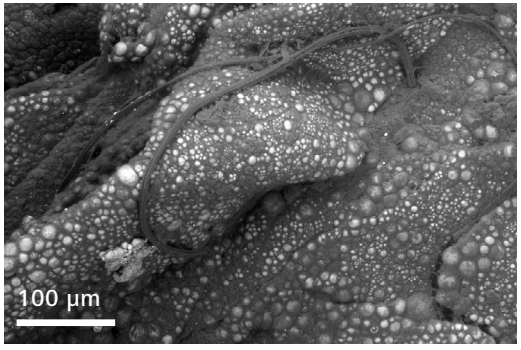
Cellular structure of cross-section of orange, imaged with the BSE detector at 5 kV and 110 Pa variable pressure mode.



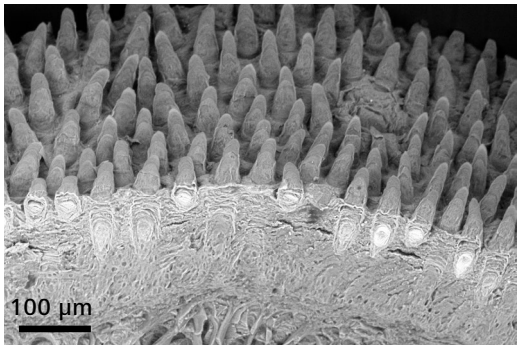
Pollen imaged at extended pressure does not require time-consuming sample preparation workflows. Imaged with BSE detector at 5 kV, 30 Pa air.



Detail of a pseudoscorpion, imaged with BSE detector under high vacuum at 20 kV.

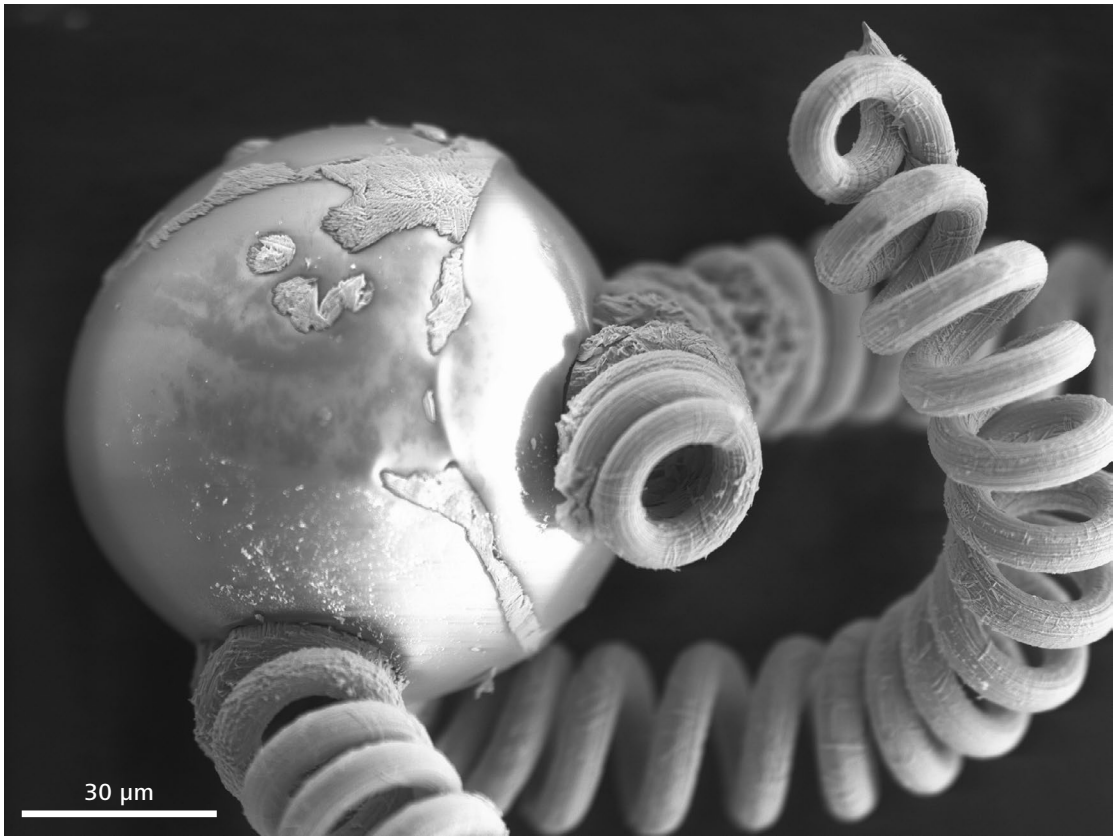


Brown adipose tissue (BAT) from a kidney tissue sample, imaged without cooling in dynamic equilibrium in water vapor. Imaged with the BSE detector at 285 Pa variable pressure mode. Sample: courtesy of R. Reimer, Heinrich Pette Institute, Germany.



A cross-section of mouse tongue, imaged with the BSE detector at 266 Pa variable pressure mode. Sample: courtesy of R. Reimer, Heinrich Pette Institute, Germany.

ZEISS EVO at Work: Forensics



Molten glass solidified on a tungsten fragment indicate the bulb was active at the time of the incident. Imaged with the C2D detector at 20 kV, 30 Pa.

Typical Tasks and Applications

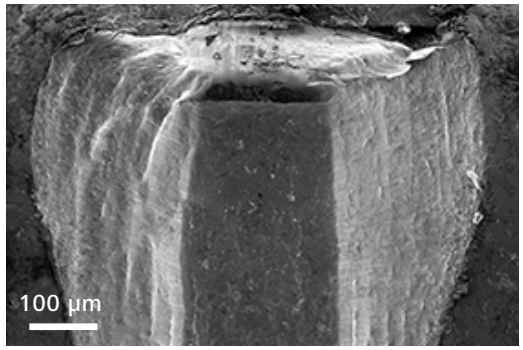
- Gunshot residue (GSR)
- Paint and glass analysis
- Bank note and coin forgery
- Hair and fiber comparisons
- Forensic toxicology

How You Benefit from ZEISS EVO

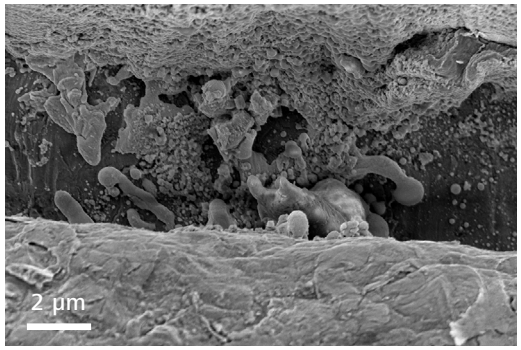
With its range of variable pressure and extended pressure detectors, EVO delivers consistent crisp imaging of samples with minimal sample preparation.

EVO's class leading EDS geometry provides for high throughput GSR analysis. EVO is compatible with third-party specialized GSR analysis software. EVO offers the added benefit of environmental electron microscopy so that samples can be imaged in their original condition.

ZEISS EVO at Work: Forensics

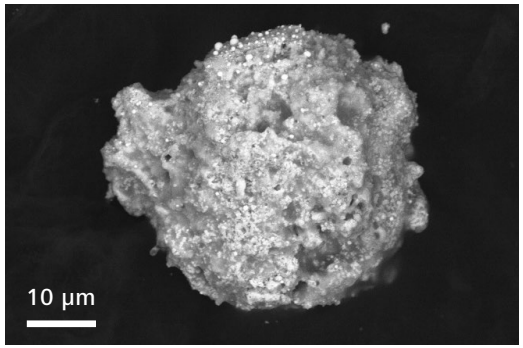


The mark from a firing pin on a gun casing can be used to help identify the weapon used. Imaged with the SE detector at 10 kV.



Solidified molten fragments from a catastrophic explosive event can be used to determine its source.

The C2D produces excellent images of uncoated samples in variable pressure mode, perfectly suited to forensic fiber comparisons.



BSD image of gunshot residue (GSR) particle at 20 kV. Sample: courtesy of I. Tough, Robert Gordon University, Aberdeen, UK.

Expand Your Possibilities: The EVO Family

Flexible Chamber and Stage Design

A choice of three chamber sizes and two stages lets you arrive at a tailor-made solution to your SEM imaging and microanalysis requirements. How much space do you need? Choose the design to not only accommodate the largest samples or parts you may experience in your work environment, but also with the space around the exterior of the vacuum chamber to fit cameras or detectors.

Standard stage

Large Z stage

The EVO stages offer large weight bearing capabilities independent of the chamber type. The flexible stage design allows you to add or remove spacers, and even remove the Z tilt and rotate module, to offer full x, y movement of the complete base platform.

	ZEISS EVO 10	ZEISS EVO 15	ZEISS EVO 25
	Choose EVO 10 with its optional backscatter detector and Element EDS system to be your entry point to scanning electron microscopy, at a remarkable affordable price. Your investment in EVO now assures that you are ready for applications that require more space and ports than you anticipate today.	EVO 15 excels in analytical applications. Opt for the larger vacuum chamber of EVO 15 and benefit from a versatile, multi-purpose solution for central microscopy facilities or industrial quality assurance laboratories.	EVO 25 is your solution for large samples. Expand its capabilities further adding an optional 80 mm Z travel stage that can handle weights up to 2 kg even with tilt. Additionally, the large chamber will accommodate multiple analytical detectors for the most demanding microanalysis applications.
Maximum specimen heights (mm)	100	145	210
Maximum specimen diameter (mm)	230	250	300
Motorized stage travel XYZ (mm)	80 × 100 × 35	125 × 125 × 50	130 × 130 × 50 (or 80)

Expand Your Possibilities: Choose Your Vacuum System

Any electron microscope requires vacuum for the electron beam to not only travel through the optical column, but also within the vacuum chamber to reach the sample or part located on the specimen stage. However, EVO has been designed to allow up to 3000 Pa in the vacuum chamber. This extends the application of the EVO to imaging and microanalysis of non-conductive samples using variable pressure mode, which is important for samples or parts that cannot be coated with a thin, conductive carbon or metal film. And it allows EVO to easily accommodate hydrated and heavily contaminated samples (e.g. oily) when equipped with optional through-the-lens (TTL) differential pumping to enable extended pressure mode.

High Vacuum only

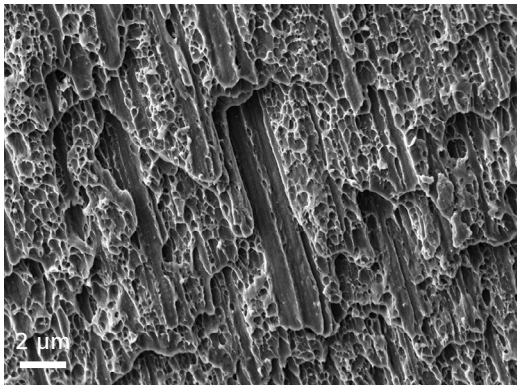
High vacuum in the order of 10-5 mbar typically means samples or parts are presented to the SEM with a conductive surface – native in the case of metals, or applied as a thin carbon or metal film on the surface of non-conductive samples. High vacuum delivers the best quality image and analysis data as the electron beam remains coherent when traveling in high vacuum through the column to the vacuum chamber.

Variable Pressure (VP mode)

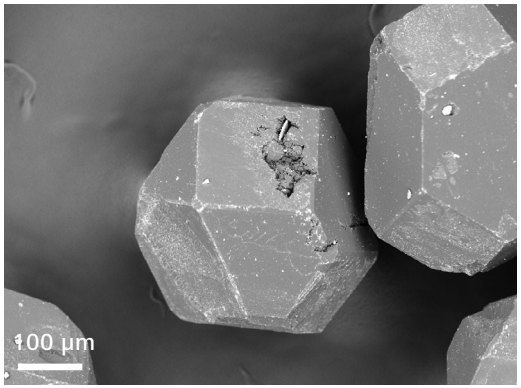
When high quality imaging and analysis are needed on uncoated, non-conductive samples or parts, such as those being imaged in a multi-modal workflow, choose EVO with VP mode. VP mode uses a gas in the vacuum chamber to trigger a process of gas ionization that will neutralize charge build-up on the surfaces of non-conductive materials.

Extended Pressure (environmental mode)

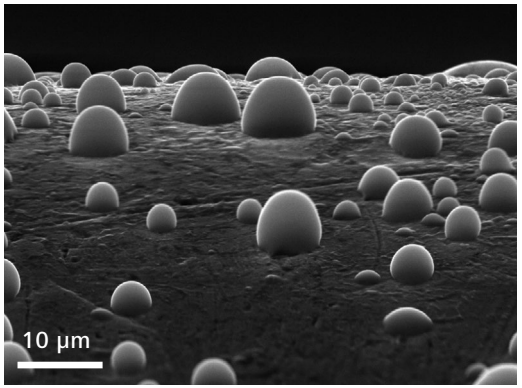
Variable pressure also can be taken to the extreme, by choosing through-the-lens (TTL) pumping and water vapor in the specimen chamber, to work at even higher gas pressures. This allows imaging at relative humidity up to 100% of hydrated samples in their natural state. This vacuum configuration is also recommended for heavily contaminated parts, where through-the-lens pumping will prevent contamination from reaching the optical column.



Stainless steel fracture surface, imaged with secondary electrons in high vacuum; horizontal field of view 20 µm.



Synthetic diamond revealing a defect and inclusion, imaged with the BSE detector in Variable Pressure mode.



Water droplets imaged on a Teflon® sample using EVO with C2DX detector. Beam voltage: 20 kV; chamber pressure: 630 Pa; water vapor at 0.9°C

Expand Your Possibilities: Choose Your Detectors

SE Signals – Optimized Detection for Every Vacuum Mode

Standard on every EVO is the traditional scintillator-type Everhart-Thornley secondary electron detector with a biased grid, for use in high vacuum.

For secondary electron detection from non-conductive samples or parts in VP mode, add the C2D or VPSE detector.

For secondary electron detection at extended pressures in a gaseous (water vapor) environment, choose the C2DX detector.

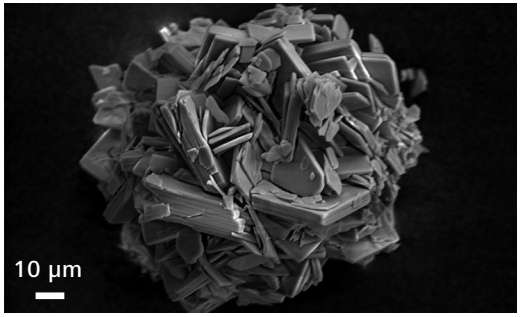
BSE Detection – Accentuate Morphology or Go for Speed

Opt for the 5-segment HDBSD detector for both high vacuum and variable pressure. The segments can be selected individually, mixed or subtracted to accentuate surface morphology from the angular nature of backscattered emission.

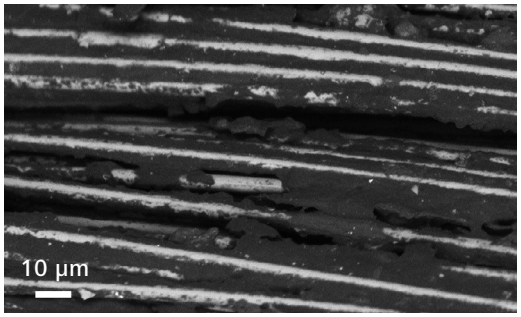
A scintillator backscattered electron detector (YAG BSE) for high vacuum operation provides you with fast scan rate response times.

Use BSE Detectors to Gain Information in 3D

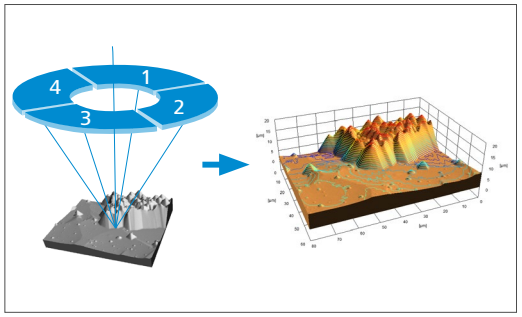
Configure the 5-segments BSD1 detector for extra speed and get quick quantitative information about your sample's surface topography with a module for 3D surface modelling and reconstruction.



C2D imaging with drastically reduced charging effect (Sample: Lanthanum carbonate, a phosphate binder used as a oral therapeutic agent for dialysis patients.).



Backscattered electron image of filler material (dark) in a woven fiber tissue (bright).



Working principle of the 3DSM method. Initially, separate images are acquired by each of the four segments of the diode. Different gradients of gray levels in each image can then be used to calculate the local height profile of the sample line by line.

Expand Your Possibilities: Beam Deceleration Imaging

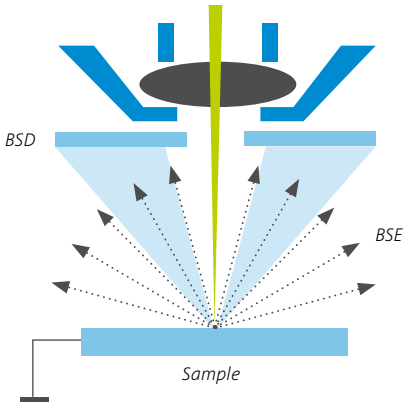
When investigating delicate specimens, extend your EVO with beam deceleration imaging. Gain improved image quality and minimize sample damage. Image non-conducting specimens with higher resolution, more surface sensitivity, and more contrast. How it works: A bias voltage is applied to your sample. This reduces the effective landing energy on your sample while the primary energy is kept high – and lets you benefit from the advantages:

High primary beam energy results in:

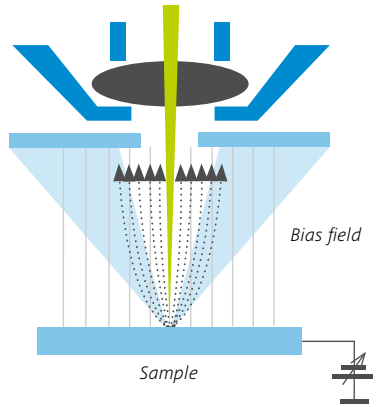
- improved resolution allowing you to use higher magnifications and see more details of your sample
- less image errors thanks to less aberrations and thus better image quality
- better detection efficiency in your detectors eventually optimizing image contrast, again letting you collect more information from your sample.

Low effective landing energy on your specimen permits:

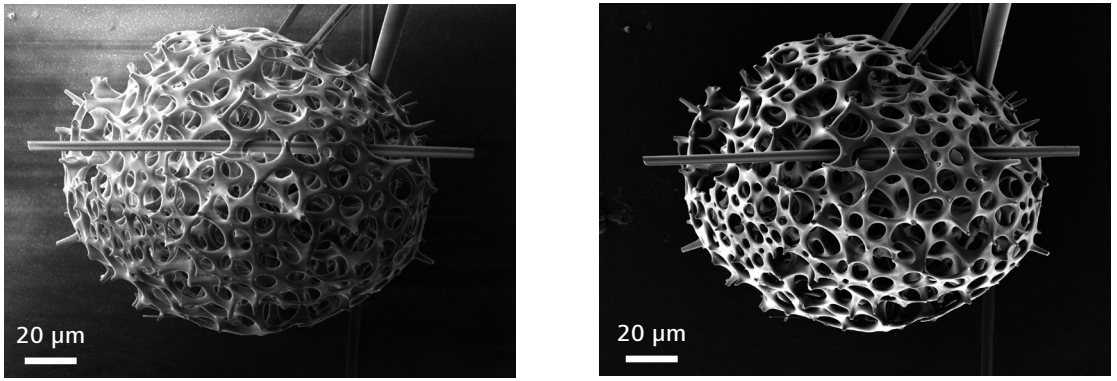
- a reduced interaction volume leading to more surface sensitive image rich in detail and high in resolution
- to minimize charging artifacts and beam damage.



Low kV application without beam deceleartion: No bias voltage is applied on the sample. The signal electrons have roughly straight trajectories and have an energy below 1 kV. The BSD detection efficiency is very low.



Low kV application with beam deceleration: The sample is negatively biased (up to 5 kV). Due to the electric field, the electrons with lower initial energies are accelerated to the BSD detector and the efficiency of the BSD diode is improved dramatically while the interaction volume within the samples stays small.



An uncoated Radiolaria was imaged at 1 keV landing energy. The image obtained using 1 kV acceleration voltage without beam deceleration shows considerable charging artifacts (left). After applying 4 kV beam deceleration and using 5 kV acceleration voltage, surface details and contrast are improved significantly and charging artifacts are essentially reduced (right).

Expand Your Possibilities: ZEISS ZEN core for Connected Microscopy

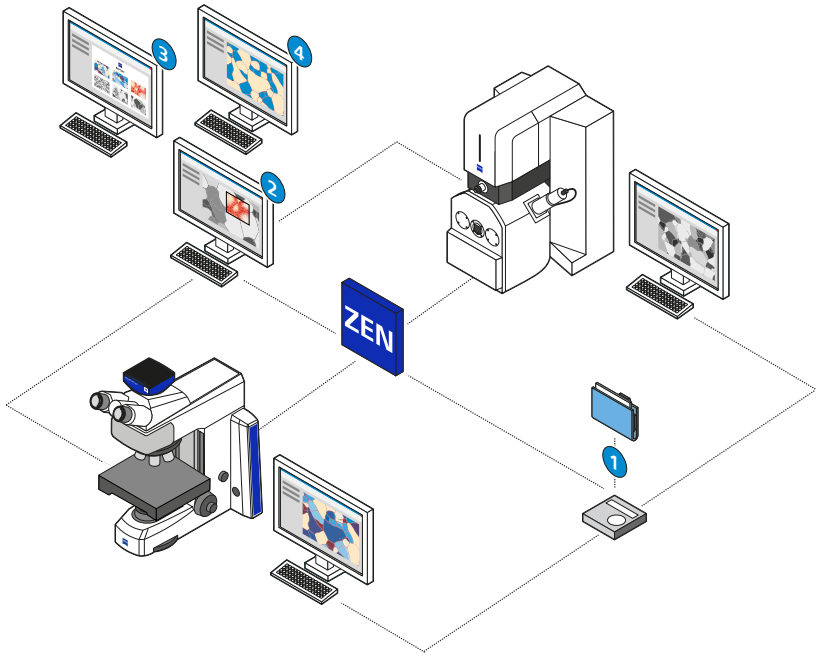
ZEISS ZEN core: Your Software Suite for Connected Microscopy and Image Analysis

ZEN core handles more than just microscopy imaging - it is the most comprehensive suite of imaging, segmentation, analysis, and data connectivity tools. ZEN core is your hub for connected microscopy. Customize its functions to your specific applications and define workflows that consider the experience level of the microscopists in your multi-user environment.

Handle routine tasks on a range of ZEISS microscopes and cameras, extract the highest technical performance from your system, and get access to every function you might wish to optimize through an intuitive and configurable graphical user interface.

Create task-specific workbenches that show only the required microscope controls on the screen. Combine these to assist your operators through a defined flow of consecutive tasks and ensure data repeatability.

Correlate data from different microscopes: Thanks to the connectivity features for contextual data representation, you keep your valuable data together across instruments in your lab.



1 **Correlative Microscopy**
Sample and data exchange between light, digital, and electron microscopes

2 **Contextual Data Representation**
Data visualization and organization across scales and imaging modalities

3 **Metallographic Applications incl. Microsoft Word-based Reporting**
Integrated reporting across connected images and datasets

4 **Automated Image Analysis-based on Deep Learning**
Image segmentation based on machine learning algorithms

Enjoy its Highlights:

- Easy to configure – easy to use. Benefit from an adaptive user interface.
- Advanced imaging and automated analysis. Use built-in analysis routines and take advantage of the consistency of repeatable workflows.
- Infrastructure solution for correlative microscopy. Keep your data together across instruments, laboratories and locations.
- Automated image analysis based on deep learning. Get some help on segmentation, classification and processing within your analysis routine.

Expand Your Possibilities: GxP Compliance for Regulated Industries

Concern over digital data integrity is everywhere, with microscopy being no exception. The GxP module in ZEN core meets the requirements of regulated industries, such as pharmaceutical or food, and helps you assure your systems are compliant with FDA CFR 21 Part 11 requirements. It is anticipated that other industries, like aerospace, also will require more stringent data regulation. So, when you select the EVO, you select the microscope that is already prepared for a more regulated future.

GxP Module

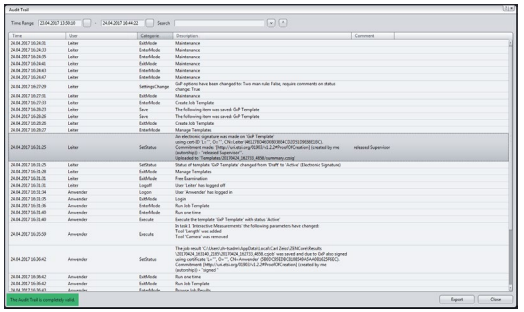
The GxP module meets the requirements of regulated industries, such as pharmaceutical or food, and helps you assure your systems are compliant with FDA CFR 21 Part 11 requirements. This module lets you audit every single step in your workflow. You have the advantage of using many different tools and functionalities in combination with the required qualification and validation activities to maintain CFR compliance for your images, tables and reports.

ZEN core Provides the Following GxP Functionality:

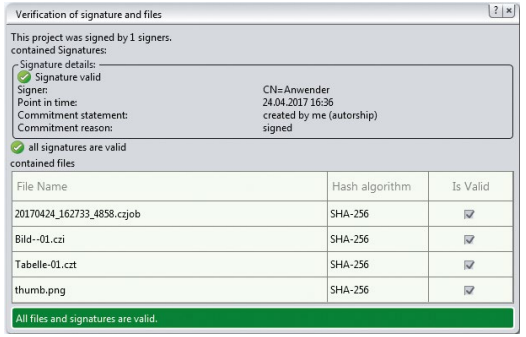
- Digital signature
- Audit trail
- Check sum
- User management
- Disaster recovery
- Release procedures of workflows

Attention for IQ/OQ

Regulation compliance requires more than GxP software functionality. GxP compliance also includes a meticulous process of qualifying the installation and operation of the analytical systems subjected to qualification (IQ/OQ). Contact your ZEISS representative to learn more about GxP compliance solutions, and the OQ and IQ services ZEISS can either provide or orchestrate.



The GxP Module offers all functionalities that are needed for CFR compliance, such as an audit trail of all user activities.

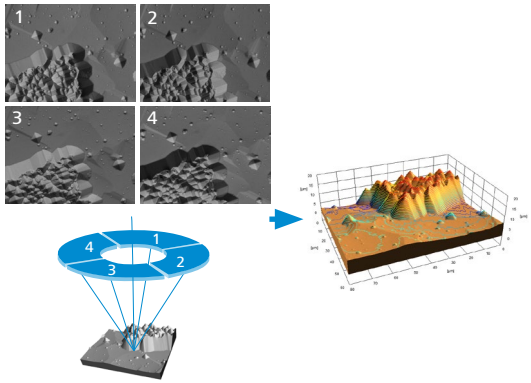


Verification of signature and files

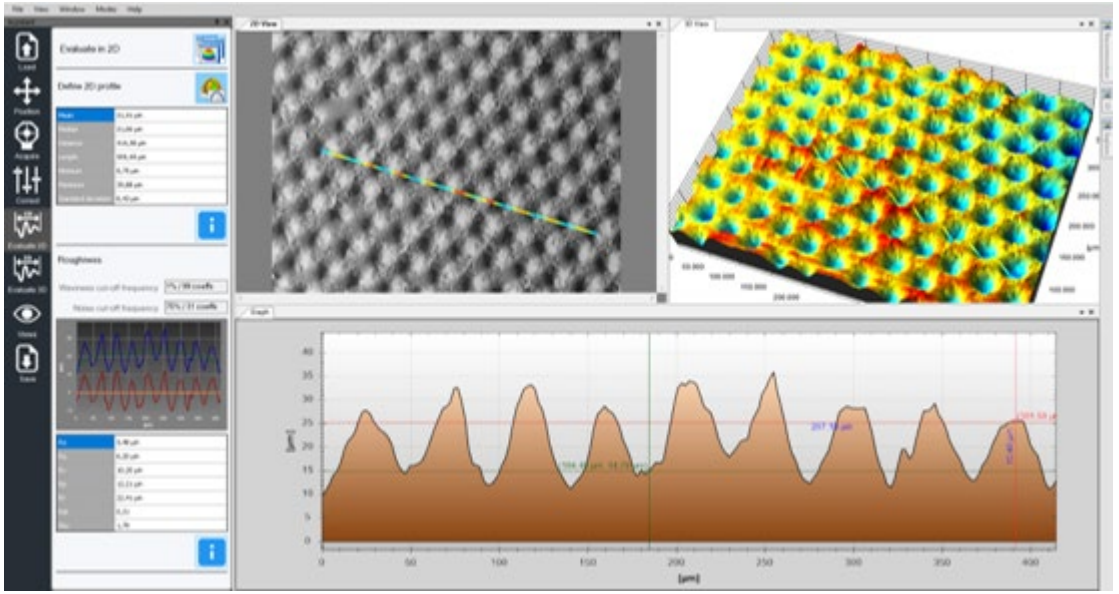
Expand Your Possibilities: 3D Surface Modelling and Reconstruction

Get Quick Quantitative Information About Your Sample Surface Topography with 3DSM

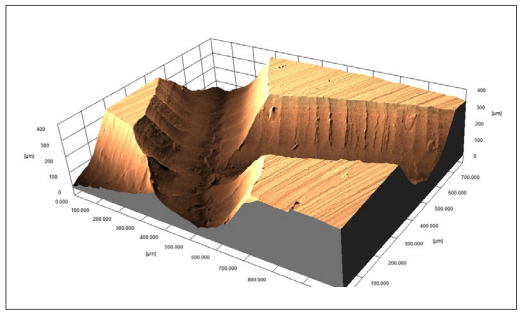
Put user-friendly 3DSM software together with the BSD1 detector to acquire a quantitative 3D model of your surface with a single click. The underlying “shape-from-shading” algorithm handles the reconstruction, using individual images taken by each of the four segments of the outer ring of the BSD1. The resulting 3D model will be visualized so you can perform basic measurements such as profile dimensions, and 2D- and 3D roughness evaluations directly—with just a few mouse clicks. For more sophisticated analysis methods, simply hand over the as-generated 3D model to the optional Mountains® software.



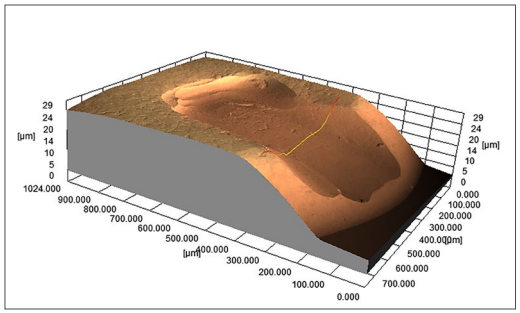
Working principle of the 3DSM method. Initially, separate images are acquired by each of the four segments of the diode, respectively. Different gradients of gray levels in each image can then be used to calculate the local height profile of the sample line by line.



3D reconstruction of a "water-repelling" polyurethane film by roll-to-roll imprinting. 3D model of the surface, profile evaluation, and 2D- and 3D roughness determinations for quantitative assessment. Sample: courtesy of G. Umlauf, Fraunhofer IGB, Stuttgart, DE.



3D model of a machined and engraved steel surface.



3D model of an imprint of the firing-pin left on a bullet.

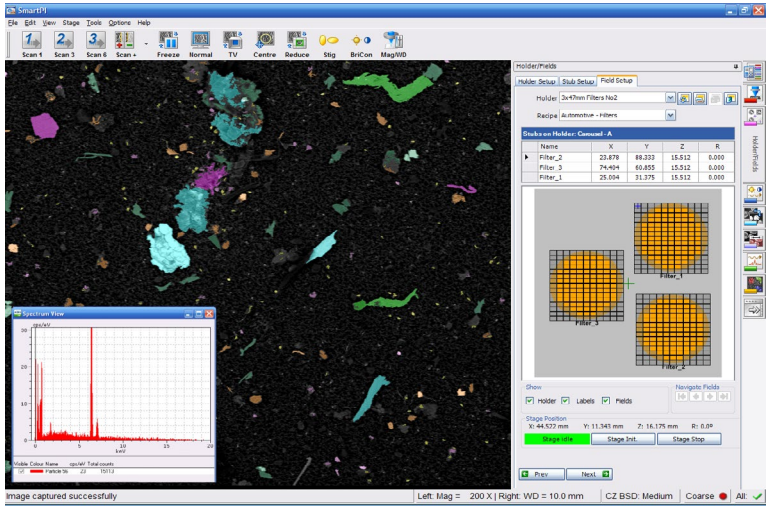
Expand Your Possibilities: Automated Particle Analysis

ZEISS SmartPI

Whether your work is in manufacturing cleanliness, engine wear prediction, steel production or environmental management, count on ZEISS turnkey particle analysis solutions to deliver thorough, actionable data.

SmartPI (Smart Particle Investigator) is a powerful, automated particle analysis tool for EVO. It automatically detects, analyzes, and then characterizes designated particles in your sample. Gain additional productivity from your EVO through automated analysis, for example, by running it fully unattended overnight and on weekends. Generate standard reports automatically, or manually review your data. Advanced particle analysis allows you to optimize industrial processes by quantifying samples rapidly and objectively. Application specific plug-ins provide pre-built recipes and report templates tailored specifically to the industry in which you work. SmartPI is fully compatible with the solutions for correlative particle analysis for advanced industrial cleanliness applications from ZEISS.

SmartPI is ISO 16232 and VDA 19 part 1 & 2 compliant.



SmartPI with EDS: Rapid particle identification and classification.

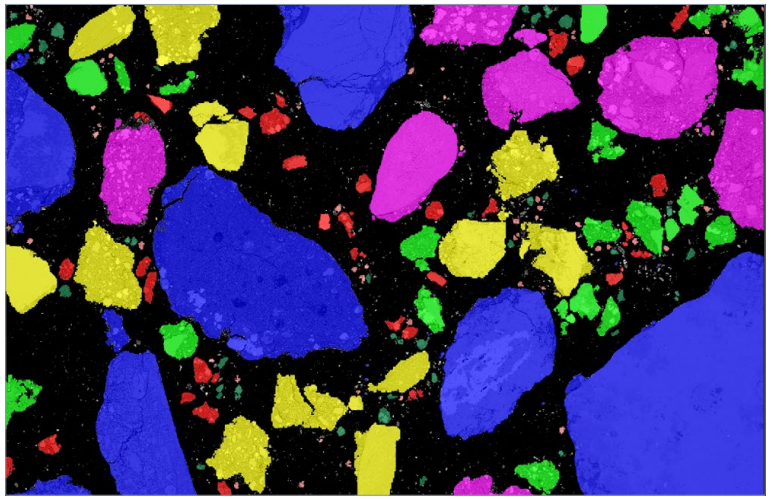


Image from ZEISS SmartPI, displaying particles of different size ranges, with particles of a defined size range identified by a unique color.

Use SmartPI to automatically locate and characterize particles, and then identify them using image analysis and EDS.

Catalog particles in a database along with a full suite of supplemental multi-modal data – ready for review and reporting.

Expand Your Possibilities: Automated Mineralogy

Automated Mineralogy

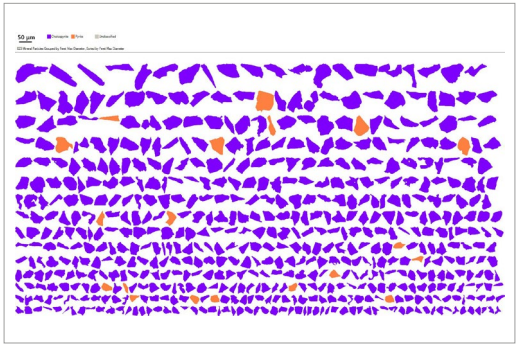
ZEISS Mineralogic combines an advanced mineral analysis engine with a range of application-specific outputs to your EVO, enabling you to characterize and quantify even the most challenging geological samples with submicron precision.

Oil & Gas

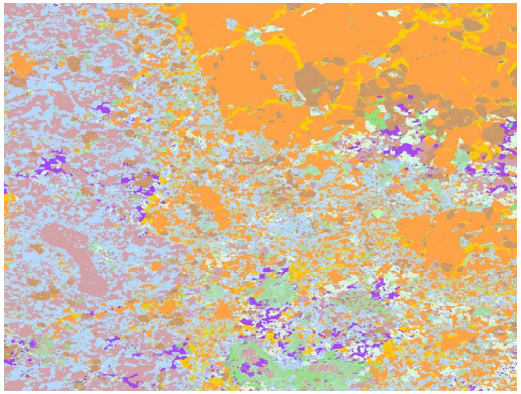
Use Mineralogic Reservoir as a part of your digital rock petrophysics workflow suite to gain a deeper understanding of your reservoir. This lets you automatically map and characterize minerals, porosity and organics. Tailor your system to analyze any type of rock, from conventional sandstone reservoirs to highly heterogeneous shale and mudrocks. Your automated petrological system provides unique insights into reservoir rocks, playing a vital role in characterizing samples from the centimeter to the nanometer scale.

Mining

Mineralogic Mining provides quantitative mineralogy for geometallurgy, optimization of mineral processing plant and ore characterization. Generate valuable understanding to support process modelling and decision-making, thereby reducing risks and costs. Target process improvements with quantitative mineralogy, elemental deportment, grain size distribution, and liberation and locking characteristics. Your automated mineralogy system is an essential part of the modern mining operation.



Mineral particles images of heavy mineral sand feed, sorted by Feret max diameter.



High resolution mineral map. Ni-Cu ore, Fraser Mine, Sudbury. Courtesy: University of Leicester, UK

Steps to a Greener World

Energy Saving Recommendations

At ZEISS, we are committed to achieving sustainable economic success and strengthening resilience through the continual reduction of energy and resource consumption in all processes. We invite users to reduce unnecessary energy consumption by ZEISS products in their laboratories and research sites and support the development of a sustainable energy saving plan.

CO_2 Emission Calculations.

To estimate the carbon footprint and greenhouse gas (GHG) emissions for ZEISS systems, the table offers typical values of energy consumed during operation. The exact power consumed by each system will vary depending on the application, the accessories used, and the age of the system.

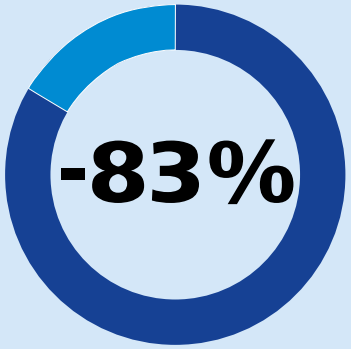
Calculating the GHG and carbon dioxide equivalent.

A simple method to calculate GHG is to add the usage power and the standby power per year. The total kWh is then multiplied by the emissions factor of the local electricity supplier.
This factor can range from 1.2 to 0.05 $kgCO_2e/kWh$ depending on the fossil fuel or renewable sources used to generate the energy by your local provider in that year.

Equation

$$\frac{\textit{Hours per day system is used (hrs)} \times \textit{days per year used (days)} \times \textit{the power used (watt)}}{1000} + \frac{\textit{Hours per day system is in standby (hrs)} \times \textit{days per year used (days)} \times \textit{the power used (watt)}}{1000} = \textit{TOTAL kWh}$$

ZEISS EVO (with ECO Quiet mode)



Standby mode

Electron Microscope Systems	Max Power	Typical Operating Power	Standby Power	Saving	% Saving	Description of Standby Mode
EVO	3.0 kVA	870 W	455 W	415 W	47%	Standby mode
EVO with ECO Quiet mode	3.0 kVA	570 W	93 W	477 W	83%	Standby mode with the ECO Quiet mode active

ECO Quiet mode saving is dependent on number of sample changes per day while saving most energy in standby mode. In VP mode, the pre vacuum pump will constantly run, drawing approximately 300 W depending on the application vacuum level.

General Systems and 3rd Party Items	Max Power	Typical Operating Power	Standby Power	Saving	% Saving	Description of Standby Mode
32" Monitor	50 VA	45 W	1 W	44 W	97%	
Typical Workstation (PC)	0.5 kVA	200 W	100 W	100 W	50%	
Extra Rotary Pump for EP	1.7 kVA	350 W				This pump is only activated in EP mode
Integrated Energy Dispersive System	0.1 kVA	75 W				For integrated EDS using the SEM workstation
Stand alone EDS	0.7 kVA	300 W	80 W	220 W	73%	Highly dependent on the workstation and monitors used

Technical Specifications

		ZEISS EVO 10	ZEISS EVO 15	ZEISS EVO 25
Resolution: High Vaccum Mode	2 nm, 3 nm @ 30 kV SE with LaB_6, W			
	6 nm, 8 nm @ 3 kV SE with LaB_6, W			
	9 nm, 15 nm @ 1 kV SE with LaB_6, W			
	3.8 nm, 4 nm @ 30kV BSE with LaB_6, W			
Resolution: VP Mode	3 nm, 3.4 nm @ 30 kV SE VP mode with LaB_6, W			
Acceleration Voltage	0.2 to 30 kV			
Probe Current	0.5 pA to 5 µA			
Magnification		< 7 – 1,000,000×	< 5 – 1,000,000×	< 5 – 1,000,000×
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, Depth, Analysis, Field, Fisheye[2]			
Pressure Range	10 – 133 Pa (EasyVP) 10 - 400 Pa (Variable Pressure)			
	10 – 3000 Pa (Extended Pressure)			
Available Detectors	SE – Everhart-Thornley Secondary Electron Detector (supplied as standard)		CCD – Charge Coupled Device for Raman spectroscopy	
	HDBSD / BSD1 – Solid State Backscattered Electron, 5 quadrants YAG-BSD – YAG Crystal Backscattered Electron Detector			
	VPSE-G4 – Variable Pressure Secondary Electron Detector C2D – Cascade Current Detector Detector C2DX – Extended Range Cascade Current Detector			
	SCD – Specimen Current Detector			
	STEM – Scanning Transmission Electron Microscopy Detector			
	CL – Cathodoluminescence Detector			
	ZEISS SmartEDX – Energy Dispersive Spectrometer (EDS)			
	WDS – Wavelength Dispersive Spectrometer			
	EBSD – Electron Backscatter Diffraction Detector			

Technical Specifications

		ZEISS EVO 10	ZEISS EVO 15	ZEISS EVO 25
Chamber Dimensions		310 mm (Ø) × 220 mm (h)	365 mm (Ø) × 275 mm (h)	420 mm (Ø) × 330 mm (h)
5-Axes Motorized Specimen Stage	Stage control by mouse or optional joystick and control panel	X = 80 mm, Y = 100 mm, Z = 35 mm, T = -10° to 90°, R = 360° (continuous)	X = 125 mm, Y = 125 mm, Z = 50 mm T = -10° to 90°, R = 360° (continuous)	X = 130 mm, Y = 130 mm, Z = 50 mm or 80 mm T = -10° to 90°, R = 360° (continuous)
Maximum Specimen Height		100 mm	145 mm	210 mm
Future Assured Upgraded Paths[2]	BeamSleeve, Extended Pressure, Water vapor VP and EP			
Image Framestore	32,000 × 24,000 pixels, signal acquisition by integration and averaging (scan speed 2 or above)			
System Control	SmartSEM[3] GUI operated by mouse and keyboard			
	SmartSEM Touch[2] GUI operated by 23" touchscreen, mouse and optional hardware control panel			
	Hardware control panel with rotary controls for improved manual feedback and more intuitive control during imaging			
	Ease of use features – auto saturation, auto align, sample selection & automated imaging			
	Windows® 10 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] Optional upgrade
[3] SmartSEM – Sixth generation SEM control Graphical User Interface

ZEISS Service – Your Partner at All Times

Your microscope system from ZEISS is one of your most important tools. For over 175 years, the ZEISS brand and our experience have stood for reliable equipment with a long life in the field of microscopy. You can count on superior service and support - before and after installation. Our skilled ZEISS service team makes sure that your microscope is always ready for use.

Procurement

- Lab Planning & Construction Site Management
- Site Inspection & Environmental Analysis
- GMP-Qualification IQ/OQ
- Installation & Handover
- IT Integration Support
- Startup Training

Operation

- Predictive Service Remote Monitoring
- Inspection & Preventive Maintenance
- Software Maintenance Agreements
- Operation & Application Training
- Expert Phone & Remote Support
- Protect Service Agreements
- Metrological Calibration
- Instrument Relocation
- Consumables
- Repairs

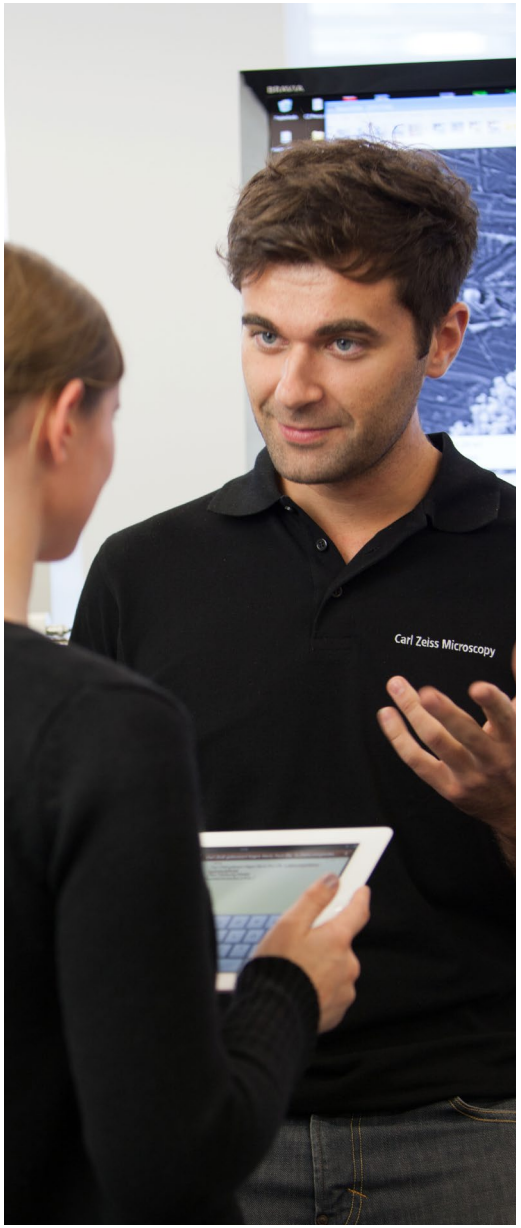
New Investment

- Decommissioning
- Trade In

Retrofit

- Customized Engineering
- Upgrades & Modernization
- Customized Workflows via ZEISS arivis Cloud

Please note: Availability of services depends on product line and location



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