SUPRA® Series

Ultra High Resolution FE-SEM for Versatile Analytics

We make it visible.

Carl Zeiss SMT – Nano Technology Systems Division

Maximum Information – Maximum Insight

More than 160 years of experience in optics has laid the foundation for pioneering 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.

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Our mission at all times: Maximum Information – Maximum Insight.

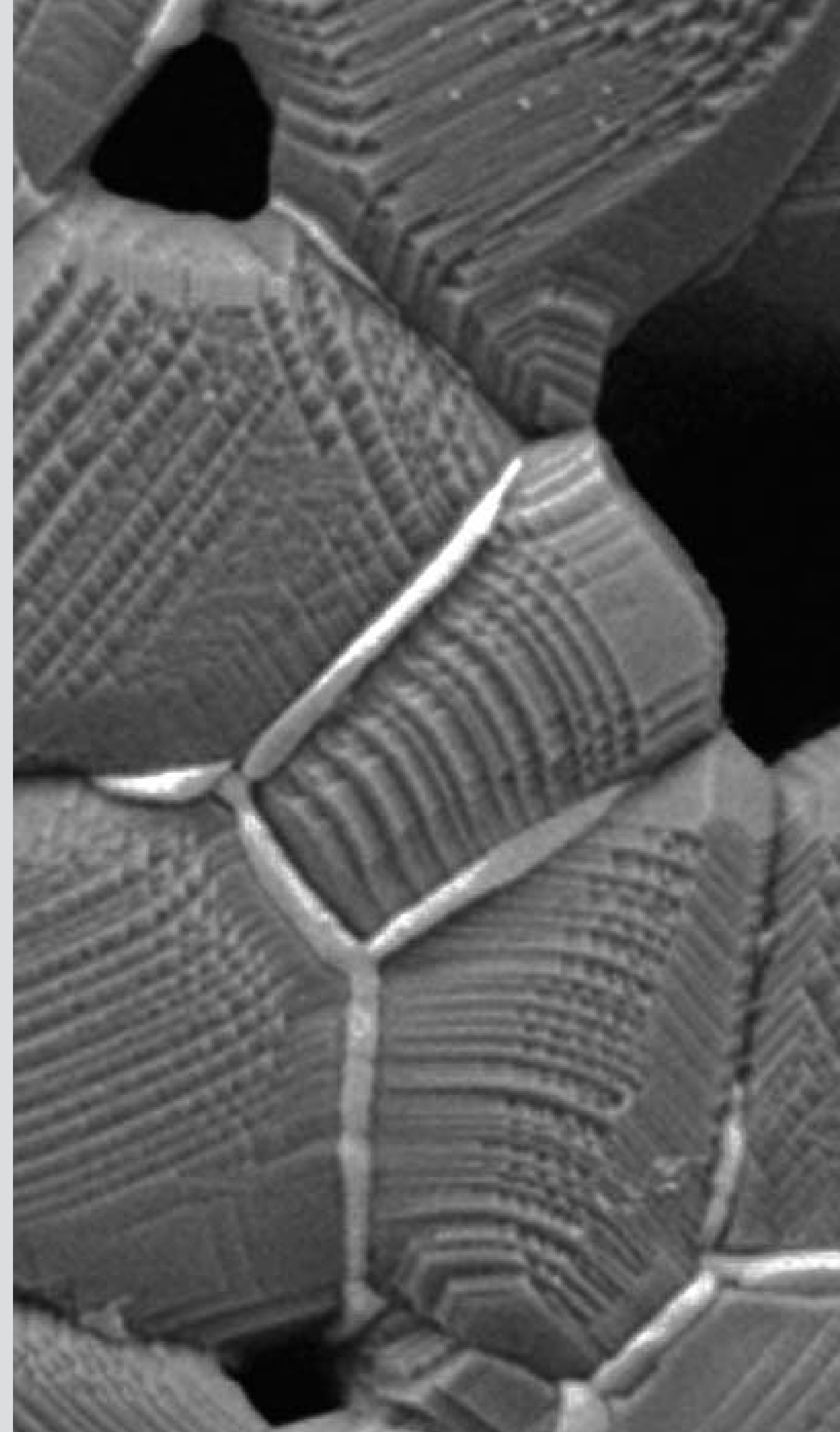
SEM
Scanning Electron Microscopes

FE-SEM
Field Emission - Scanning Electron Microscopes

HIM
Helium Ion Microscopes

CrossBeam®
CrossBeam® Workstations (FIB-SEM)

TEM
Transmission Electron Microscopes



SUPRA® Series

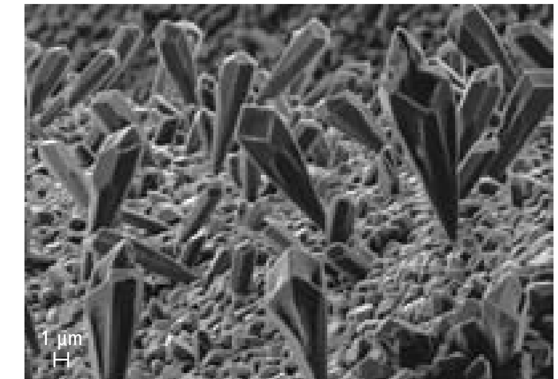
The flexible FE-SEM concept – comprehensive ultra high resolution and analytical solutions for Materials Analysis, Life Sciences and Semiconductor Applications

See page 12 for the original application image.

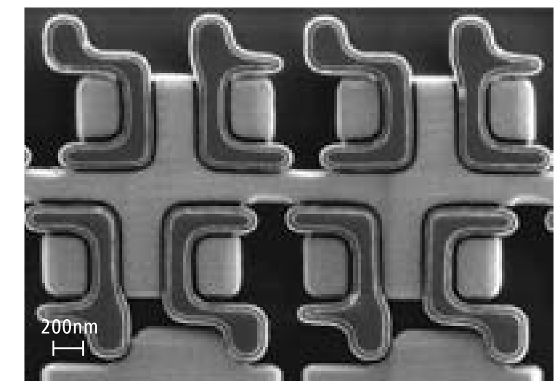
SUPRA® Series

True Reliability – Focus on Highest Resolution

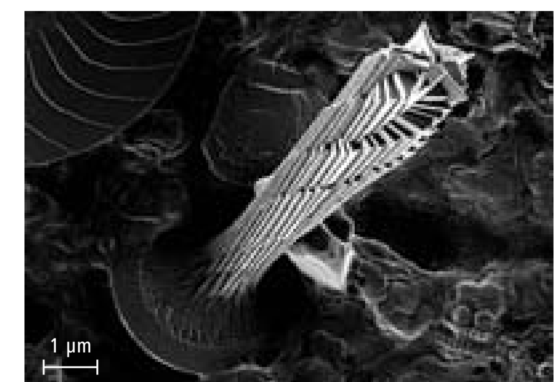
One for all – the most versatile FE-SEM family currently available



Facing the daily challenge – the workhorse for routine examinations, failure analysis, process control and cryo applications



High end research – superb imaging and excellent analytical capabilities with unsurpassed long term probe current stability



Adaptable to all tasks – flexible design concept with versatile GEMINI® column and unique specimen chamber design

High comfort with easy operation mode – intuitive graphical user interface combined with ease of use GEMINI® column

The versatile SUPRA® instrument family

Ultra high resolution with superb image quality, wide range of operating voltages, excellent probe current stability combined with fully analytical specimen chambers and easy operation through Windows® based SmartSEM® user interface.

The SUPRA® family benefits from the improved GEMINI® column, new stage concepts, hardware control panel and the new high efficiency in-lens detector.

SUPRA® 40/40 VP

The SUPRA® 40 is an ideal solution for many applications such as failure analysis, process control, cryo, and nanoanalysis. With the well balanced combination of a large eucentric stage, analytical multi-ported chamber, extended performance GEMINI® column and variable pressure capabilities it represents the versatile workhorse of the SUPRA® family.

The variable pressure technology for FE-SEM, together with the unique VPSE detector allows high voltage imaging and analysis of non-conducting specimens without prior preparation.

SUPRA® 55/55 VP

The SUPRA® 55 offers the highest resolution available today, comparable with „in-lens instruments", com-bined with a superb large fully eucentric 5" stage and a large multi-functional specimen chamber.

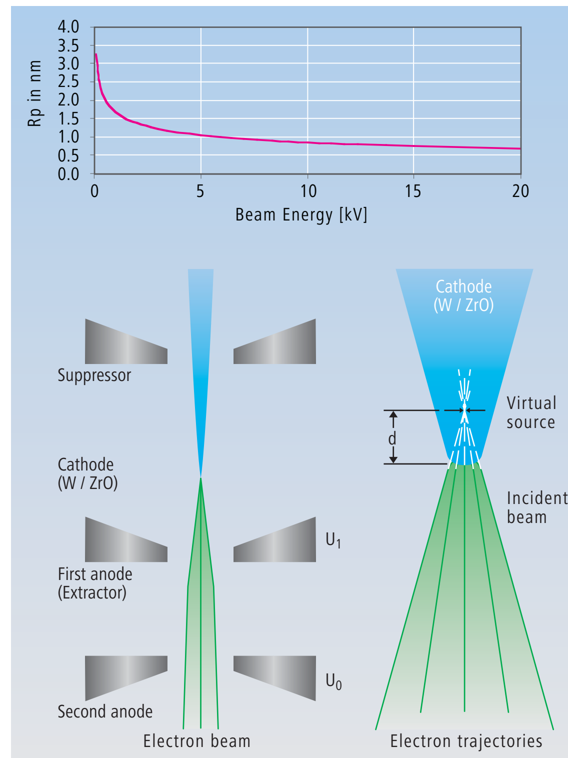
The SUPRA® 55 has been designed for the most demanding applications in nanotechnology with sub-nm resolution readily attainable.

SUPRA® 60/60 VP

The large cylindrical chamber with a refined 6" super eucentric stage and 8" integrated airlock offers the perfect solution for full wafers and cross sectional semiconductor applications, and for users who need to image a variety of large samples.

The SUPRA® 60VP makes it possible to image non-conducting specimens without specimen coating, therefore minimising preparation time and increasing throughput.

GEMINI® core technology for the SUPRA® range



The high brightness SFE source combined with the innovative GEMINI® column enables the small spot sizes for ultra high resolution combined with high contrast and high probe currents.

The SFE incorporated in the GEMINI® column provides excellent beam brightness, unsurpassed probe current stability and probe current suitable for quantitative analytical applications.

Advanced SFE

The Schottky field emission (SFE) source used in the GEMINI® column has been developed to overcome the weaknesses of the cold field emission (CFE) source, whilst maintaining its strengths in the form of high beam brightness and low energy spread. Because of their many advantages, Schottky emitters are used for high precision imaging and measurement. The table below shows the operating parameters and performance of various electron emitter types.

The Schottky emitter combines the high brightness and low energy spread of the cold field emitter with the high stability and low beam noise of the thermal emitters. As the emitting area is approximately 100 times larger than that of the cold field emitter, it has the capability to deliver the much higher probe currents required. Moreover, the SFE source achieves a similar energy spread as the CFE source, but at an emission current level over 50 times higher. The larger size of its virtual source gives the SFE source another advantage: Its susceptibility to vibration is much reduced.

Due to the direct link of the SFE source with the beam booster, the dynamic ratio at the emitter level is only about 3:1 and the U0/U1 ratio is always larger than unity. This allows a column beam path without any intermediate cross-over of electrons.

The classical designs are therefore prone to electron energy broadening in beam cross-overs and have difficulty operating at the very low beam energies which are now increasingly required for many applications.

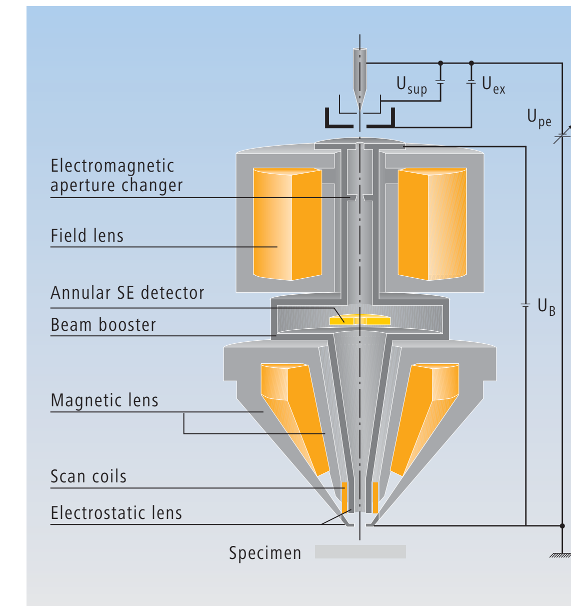
Electron Source Performance Comparison

Emitter type	thermionic	thermionic	cold FE	Schottky FE
Cathode material	W	LaB_6	W (310)	ZrO/W (100)
Operating temperature [K]	2,800	1,900	300	1,800
Cathode radius [nm]	60,000	10,000	≤100	≤1,000
Effective source radius [nm]	15,000	5.000	2.5 (a)	15 (a)
Emission current density [A/cm^2]	3	30	17,000	5,300
Total emission current [µA]	200	80	5	200
Normalised brightness [A/cm^2.sr.kV]	1.10^4	1.10^5	2.10^7	1.10^7
Maximum probe current [nA]	1000	1000	0.2	20
Energy spread at the cathode [eV]	0.59	0.40	0.26	0.31
Energy spread at the gun exit [eV]	1.5 - 2.5	1.3 - 2.5	0.3 - 0.7	0.35 - 0.7
Beam noise [%]	1	1	5 - 10	1
Emission current drift [%/h]	0.1	0.2	5	< 0,5
Operating vacuum [hPa]	$≤1.10^{-5}$	$≤1.10^{-6}$	$≤1.10^{-10}$	$≤1.10^{-8}$
Cathode life [h]	200	>500	>2000	>2000
Cathode regeneration	not required	not required	every 6 to 8 h	not required
Sensitivity to external influence	minimal	minimal	high	low

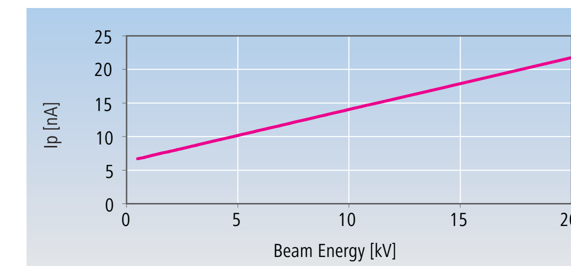
(a) virtual source

Electron Source Performance Comparison.

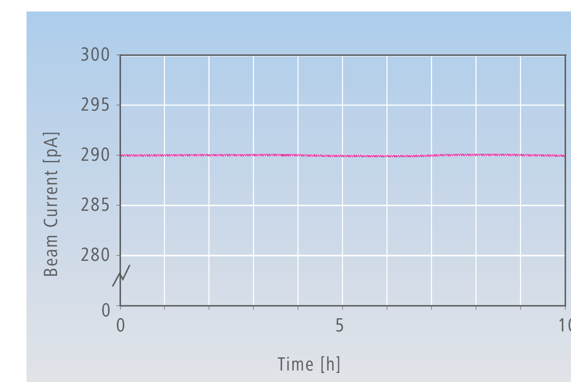
GEMINI® innovative electron optical system



Operating principle of the GEMINI® field emission column.
U_1 - extractor voltage at first anode
U_0 - accelerator voltage at second anode
U_B - booster voltage



Probe current in nA related to landed beam energy.



Ultra high stable GEMINI® electron optics.

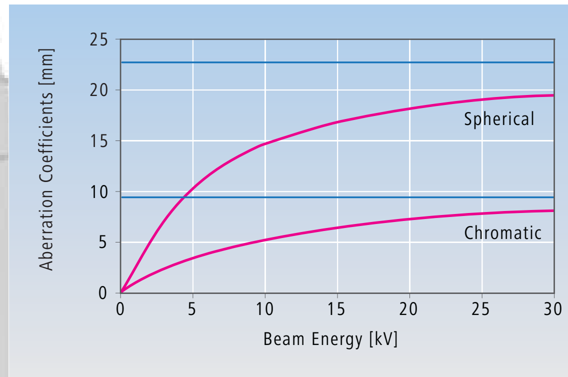
The innovative GEMINI® column concept provides superior beam brightness with ultra high resolution over the complete voltage range together with high probe currents for analytical applications.

GEMINI®

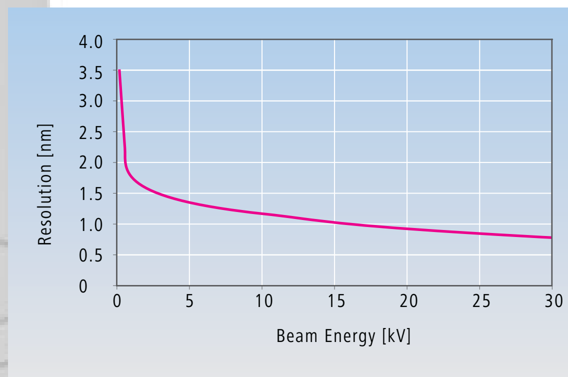
A beam booster is an integral part of the GEMINI® electron optical column. The beam booster always maintains a high beam energy throughout the entire column, regardless of the electron beam energy selected by the operator. Only after passing through the scanning system is the electron beam decelerated to its selected landing energy. The electron beam path has been designed to eliminate cross over of beam electrons between source and specimen. Furthermore, the high beam energy throughout the column ensures that the GEMINI® column is extremely well protected against stray magnetic fields, even when operated at very low voltages. The tolerable stray magnetic field limit is therefore independent of the selected voltages. An electro-magnetic, multi-hole aperture changer is incorporated close to the electron source, in combination with a magnetic field lens to select the optimum beam aperture angle and to tune the probe current. The combination of the high beam energy and cross-over free electron beam path also minimise the statistical Coulomb interactions between beam electrons, which tend to reduce the brightness and hence the resolution limit of the microscope. As a result, the GEMINI® column always provides optimum beam brightness, especially when needed at the lowest electron probe energies.

In the GEMINI® column the electron beam rays only intersect once: at the focusing point on the specimen surface. Therefore, the broadening of beam energy spread, a problem with all electron optic configurations featuring one or more intermediate cross-over – irrespective of the electron source – has been completely eliminated. This is especially significant when ultra high resolution is needed at low voltage applications.

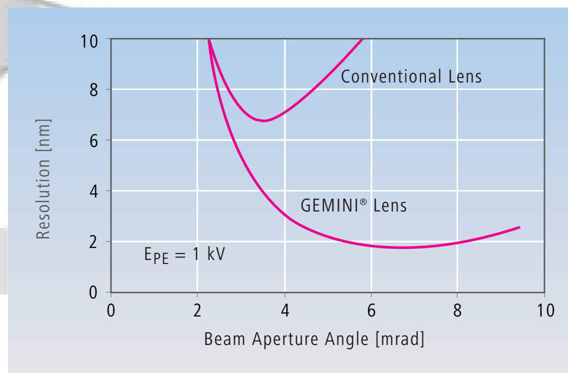
Ultra high performance objective lens



Dramatic reduction of objective lens aberrations in the low kV range.



Improvement in image resolution at an accelerating voltage of 1kV due to the increased beam aperture.



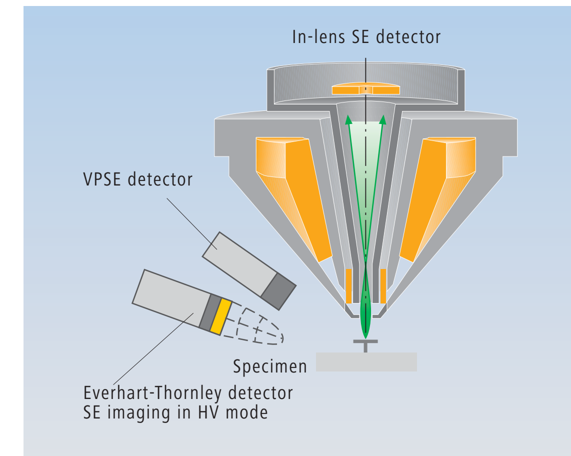
Guaranteed image resolution on test sample

The GEMINI® objective lens provides outstanding resolution and image quality, especially at low beam voltages, without any compromise in operational convenience.

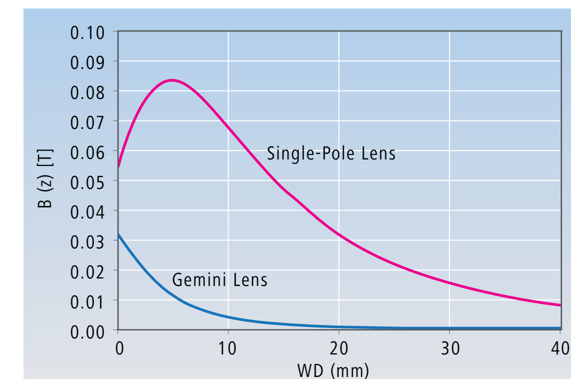
GEMINI® Objective lens

The SUPRA® has been built around the unique GEMINI® lens design which has many advantages over classical lens designs:
The most important feature is the decreasing aberrations with decreasing beam energy. Therefore it delivers superb resolution down to 20 V and at 30 kV its resolving power is unsurpassed. The high-angled GEMINI® objective lens body allows 50° tilt of large specimens (e.g. 6" wafers) at a working distance as low as 6 mm. The analytical working distance for EDS analysis with a take-off angle of 35° is only 8.5 mm – suitable for high resolution imaging. The GEMINI® objective lens consists of a high performance magnetic lens with an inserted electrostatic lens. The GEMINI® concept has overcome the problem with classical objective lens designs which immerses the specimen in the magnetic field prohibiting imaging of magnetic samples. The GEMINI® magnetic lens is shaped to minimise the magnetic field at the specimen. Therefore high resolution imaging of dia-, para-, or ferromagnetic samples is possible with very short working distances.
The magnetic/electrostatic lens combination is equivalent to an optical lens triplet which increases the incident beam aperture angle at the specimen and hence improves resolution. The increase of the optimum beam aperture angle also provides a larger electron probe current and hence generates a superior signal to noise ratio of the image. The lens control system with integrated condenser control will always select the optimum beam aperture for any combination of working distance and/or selected energy.
Consequently the GEMINI® delivers excellent image contrast even at the resolution limit. A single-stage beam scanning system is integrated in the GEMINI® lens, just in front of the electrostatic lens gap. Therefore, the transverse chromatic and other scanning aberrations have been minimised. The instrument operates without distortion at TV-scanning speed from the lowest (12 x) to the highest (1,000,000 x) magnification. In particular, no switch-over is required between a low magnification mode and a high resolution mode.

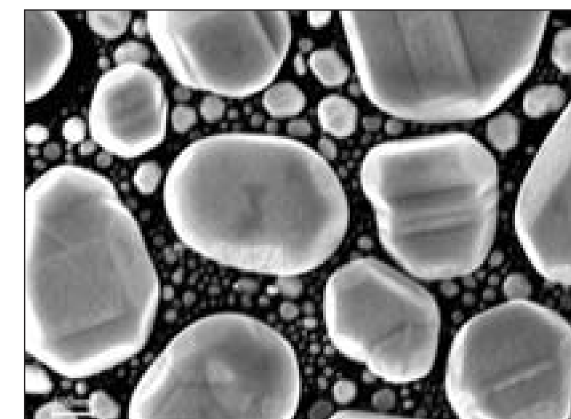
High efficiency SE signal detection



Principle of secondary electron signal detection with the high efficiency in-lens detector and the lateral detector in the sample chamber.



The extremely low magnetic field of the GEMINI® column, compared to single pole FE-SEM instruments, allows distortion-free high resoluti-on imaging of magnetic materials at short working distances.

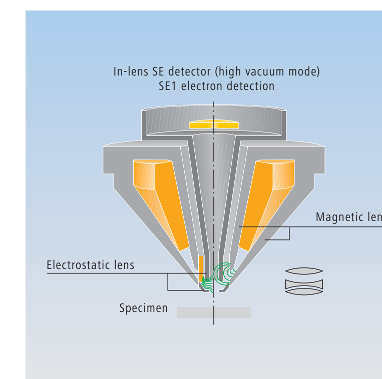


In-lens high resolution SE image at 5 kV.

The GEMINI® objective lens concept allows optimum detection of all signals generated at the specimen.

SE

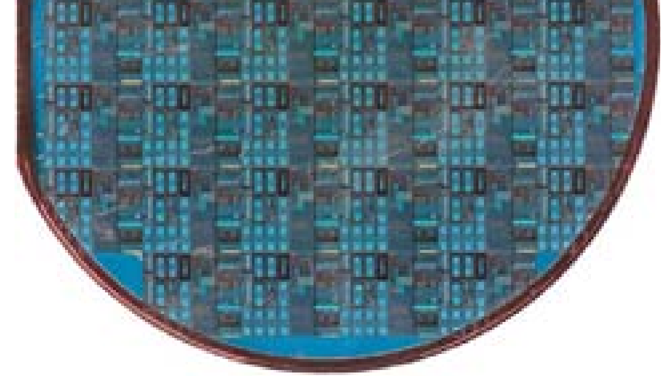
Excellent efficiency detection of the secondary electron (SE) signal is another benefit of the GEMINI® lens concept. The low energy, secondary electrons generated at the impact point of the primary electron beam are intercepted by the weak electrical field at the sample surface. They are then accelerated to a high energy by the field of the electrostatic lens and focused on the annular in-lens detector inside the beam booster located above the objective lens. The GEMINI® column used with the SUPRA® range of FE-SEMs now benefits from the 3rd generation of in-lens detectors with increased signal to noise ratio, improved dynamic range and no aging effect on the detection material. While the in-lens detector provides the best high resolution information, a lateral SE detector in the specimen chamber provides optimum topographical information. Signals from both detectors may be mixed to deliver optimum image quality.



For the variable pressure (VP) instruments ZEISS has developed the unique VPSE detector to enable SE imaging at pressures in the 2 to 133 Pa range combined with the standard Everhart-Thornley detector for imaging in high vacuum (HV) mode.

The GEMINI® column allows optimum detection of back-scattered electrons (BSE) because of the absence of an immersion field of the objective lens. Classical FE columns tend to condense the BSE on the optical axis in the same way as it condenses the primary electrons. With the GEMINI® column a high probe current can be focused on a small spot, even at low beam energies, allowing BSE images and X-ray mapping with much better resolution than ever before.

Ultra high precision



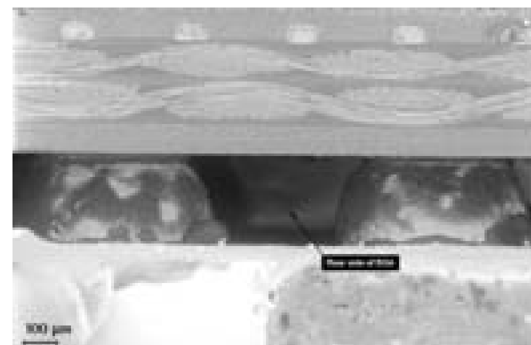
Semiconductor applications

The SUPRA® range delivers extraordinary results for semiconductor applications. The SUPRA® 40/40VP and the SUPRA® 55VP models are designed to meet the most demanding applications of semiconductor failure analysis and process development. Imaging of non-conducting specimens, cross sections or assemblies present no problems for the SUPRA® FE-SEM.

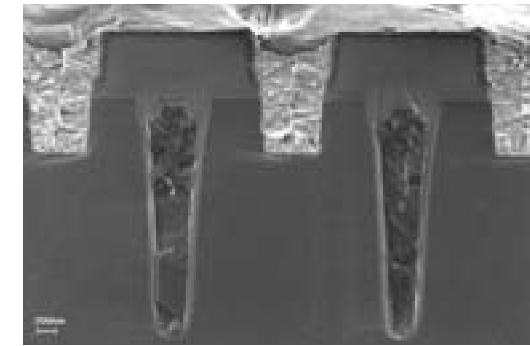
- Ultra high resolution imaging at low kV to avoid charging. The high efficiency in-lens detector with its large dynamic range and short acquisition times enables contrasts never seen before.
- Variable pressure at the specimen level to neutralise charging of the specimen. True SE imaging with the unique enhanced VPSE detector.

The ultra high resolution GEMINI® column delivers a resolution level comparable with "in-lens" instruments, but with the versatility of examining large specimens. The large 5-axes motorised stage gives full flexibility to handle large awkwardly shaped specimens or to load a number of small samples to increase productivity. The SUPRA® 60 and 60VP models with the 6" super eucentric stage, the large specimen chamber and the 8" airlock are designed to handle 6" and 8" wafers. With the VP model the pressure at the specimen level can be controlled between 2 and 133 Pa to neutralise specimen surface charging and to avoid any surface damage.

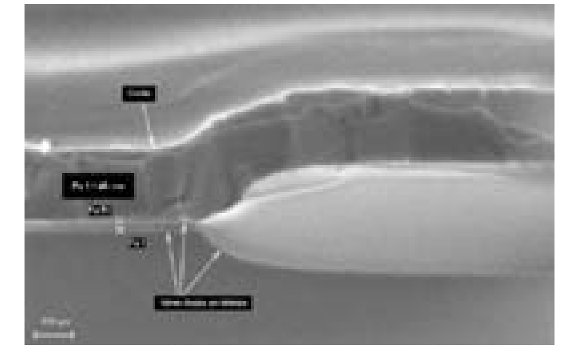
Low magnification SE image of a PCB with SMD in VP mode (16 kV and 36 Pa chamber pressure). True SE imaging without destroying the PCB.



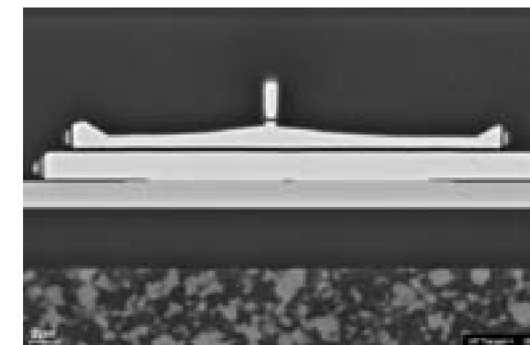
High tilt (85°) image to show BGA (ball grid array) contacts (16 kV and 36 Pa chamber pressure) to illustrate effective signal detection combined with large stage movements.



High resolution low kV SE image using the in-lens detector at 1.3 kV. Sample is a cleaved uncoated cross section of an IC.

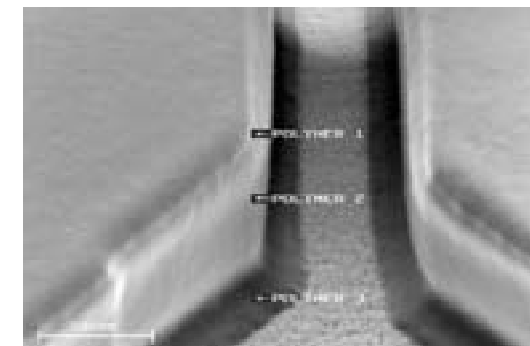


Uncoated, non-etched cleaved semiconductor capacitor cross section. The image acquisition time was 1.5 sec at 1.77 kV showing excellent signal to noise ratio and high contrast to visualise the silicon, silicon-oxide and silicon-nitride layers.



Cross section of uncoated MR head imaged with the BSE detector in VP mode at 30 Pa. No charging in VP mode and distortion-free imaging due to the low magnetic field outside the GEMINI® objective lens.

Two examples of potential contrast imaging with the SUPRA® 55. Images on the left are of the same area showing signal flow, with the top image through 2 µm passivation layer.
Image top left topographic of the IC surface. Image bottom right shows active components in voltage contrast.



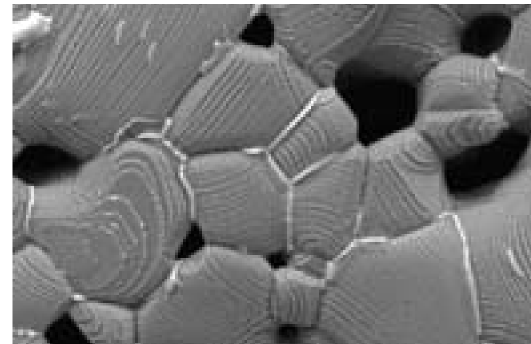
High resolution low kV SE image of PMMA on silicon with the GEMINI® in-lens detector at 1 kV. The excellent image contrast shows 3 different formulations of the PMMA.

Analytical imaging tool

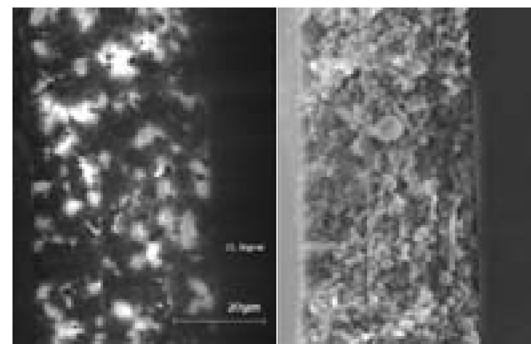
For material analysis applications in nano technology, developing new materials and materials characterisation the SUPRA® offers the most versatile ultra high resolution analytical FE-SEM available. The GEMINI® column technology is now capable of resolving structures on a resolution level comparable with "in-lens" instruments. With the same column in high current mode, probe currents are delivered to meet any analytical application ranging from BSE, CL, EDS, EBSD to WDS without sacrificing resolution capabilities. The new SUPRA® combines four instruments in one: ultra high resolution FE-SEM over the complete voltage range, FE-SEM for handling large awkwardly shaped specimens, full analytical FE-SEM with probe currents up to >20 nA achievable and the VP (variable pressure) technology to investigate non-conducting specimens without prior preparation.

Another unique benefit of the GEMINI® technology is the extremely low magnetic field outside the objective lens compared to the single pole FE-SEM electron optics. The GEMINI® column enables ultra high resolution distortion free imaging of magnetic specimens.

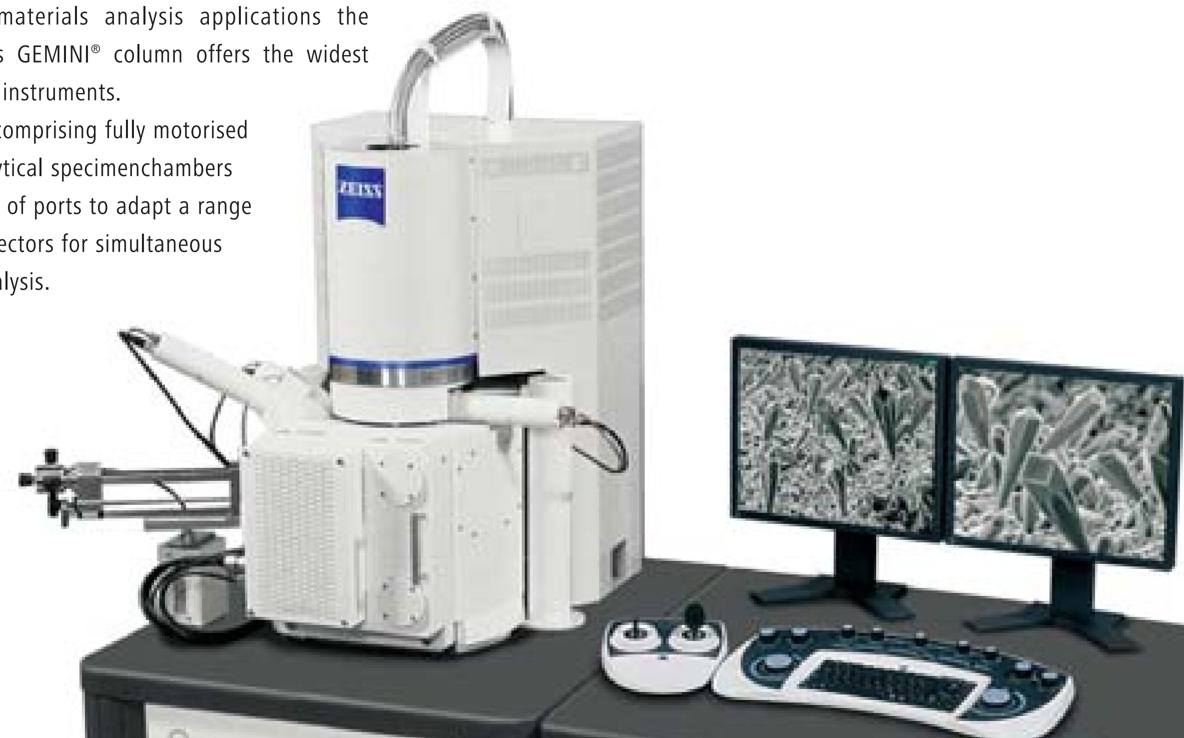
Especially for materials analysis applications the SUPRA® with its GEMINI® column offers the widest configuration of instruments.
All instruments comprising fully motorised stages and analytical specimenchambers with a multitude of ports to adapt a range of analytical detectors for simultaneous imaging and analysis.



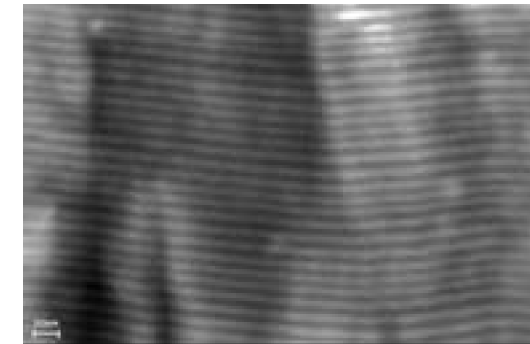
BSE image of uncoated magnetic chromite specimen at the analytical WD 8.5 mm (8 kV).



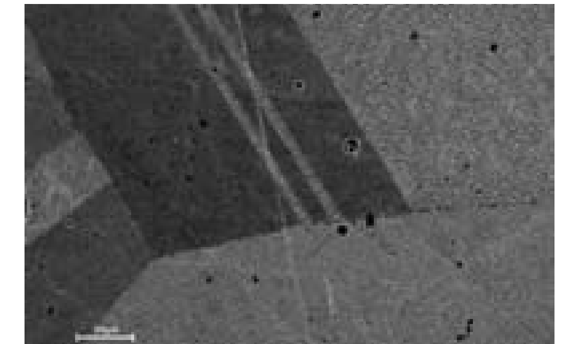
Simultaneous CL imaging (left) and SE imaging (right) of uncoated fluorescent material on glass with 20 kV and VP mode with a pressure of 56 Pa. CL detector situated under the objective lens, VP mode to avoid any charging.



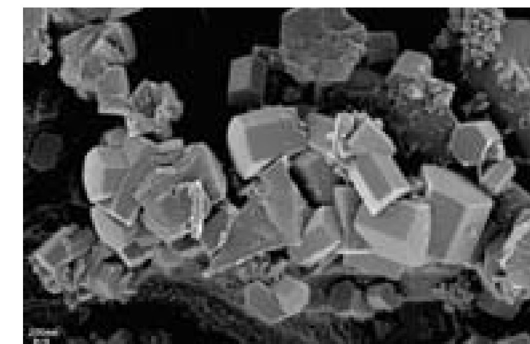
Materials Analysis applications



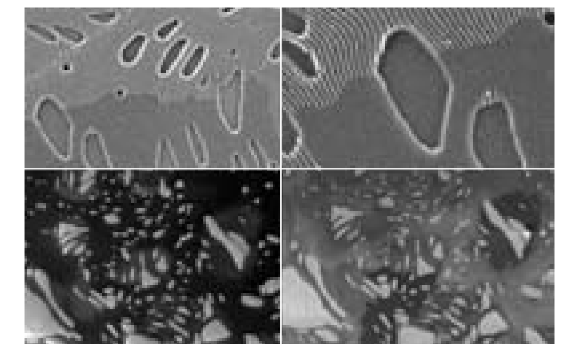
Ultra high resolution SE imaging with the GEMINI® in-lens detector of ferromagnetic material showing the TiN and YbN super lattice structure.



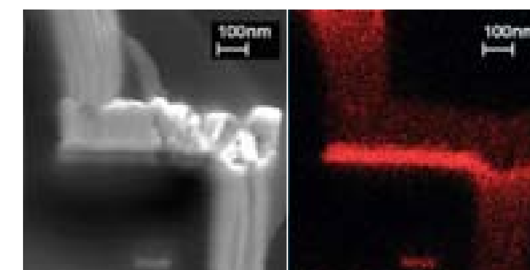
High vacuum BSE imaging of orientation contrast on twins of a Co-Cr-Mo alloy.



Low voltage SE imaging of uncoated concrete specimen at 2.1 kV with the GEMINI® in-lens detector.



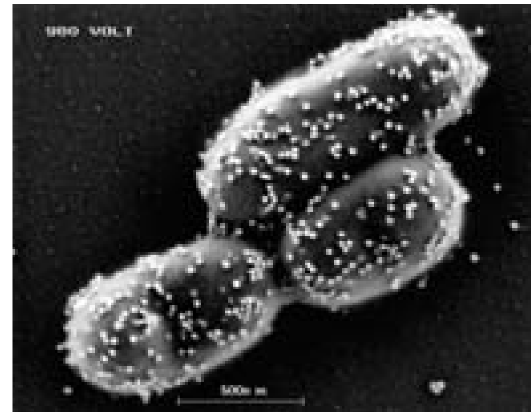
Two examples of ultra low voltage imaging of uncoated polymers with the GEMINI® in-lens detector.
Top images show high resolution of surface structure of copolymer foil at 620 V.
Bottom images show changes of contrast introduced by different voltages in a cross section of 3-block copolymer revealing the various types of polymer.



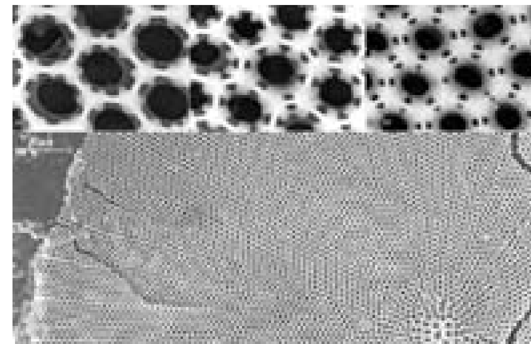
High resolution mapping of 60 nm TiN layer at the analytical WD 8.5 mm. Left SE image, right WDS mapping of TiK_{α}.

Excellence in diagnostics

The SUPRA® series with the GEMINI® field emission column has excellent low voltage imaging capabilities. Low voltage imaging with low dose energy avoids surface damaging of delicate biological samples. The efficient signal collection and the high contrast dynamic range of the GEMINI® column is particularly useful for low contrast biological samples. With the VP (variable pressure) mode on the SUPRA® 40VP or SUPRA® 55VP non-conducting biological samples can be imaged without prior preparation saving time and avoiding possible artefacts introduced with specimen preparation like drying, fixation and conductive coating. Another major application for biological specimens or colloid chemistry is cryo-FE-SEM. The SUPRA® range has a large cryo port for adaptation of cryo systems on the chamber or a cryo shuttle with off-chamber cryo preparation. With the SUPRA® superb high resolution imaging capabilities it is now possible to image details previously only seen with replicas in the TEM.



Immuno gold labelling of antibodies with 10 - 20 nm Au. Imaging voltage 980 V on uncoated specimen; the gold labelling is clearly visible on the outside of the membrane.



Overview of diatom with digitally zoomed details. The fine spot size of the GEMINI® column combined with the large 307 2 x 2304 pixel frame store allows high resolution imaging at low magnification.
The three insets show details of the centre (right inset), middle (middle inset) and outer area of the diatom.
Image courtesy of Prof. Dr. Manfred Sumper, Inst. of Biochemics I, University of Regensburg, Germany.

Life Science applications

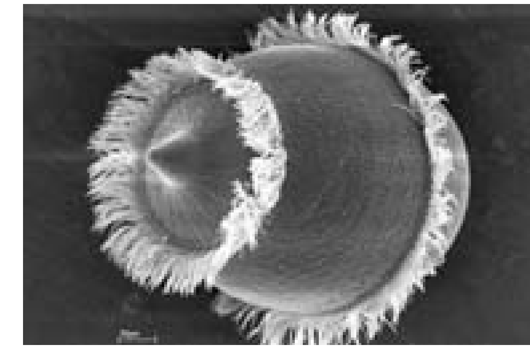
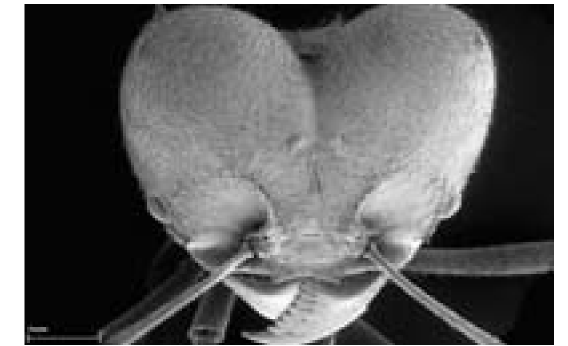
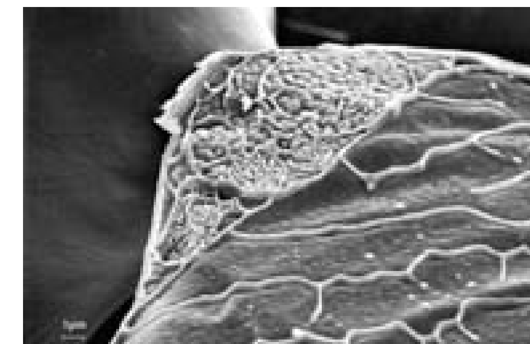


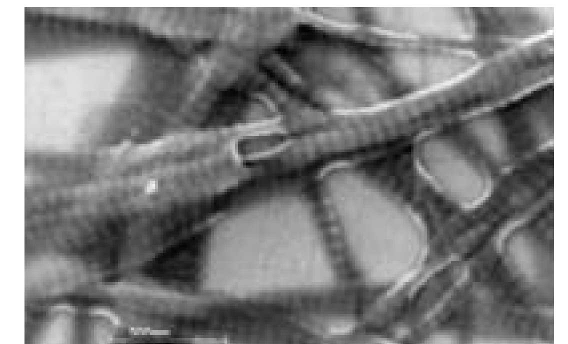
Image of ciliate with the in-lens detector at 4 mm WD showing fine details and high depth of focus.



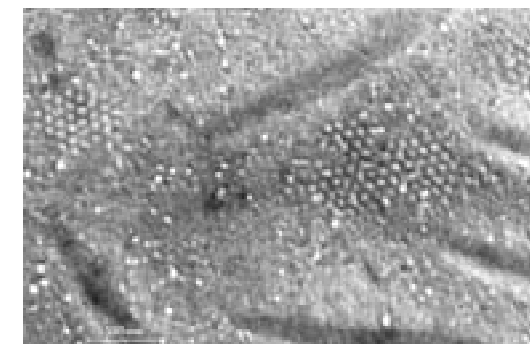
Low magnification image at a long working distance.
This image illustrates the excellent high signal level in VP mode at 20 Pa without any shadowing on this highly topographic sample.



Cryo fracture of tobacco leaf, showing excellent contrast at 2.6 kV with the in-lens detector. The Cryo preparation system was interfaced via the cryo port onto the SUPRA® 40 chamber.



Non coated proto-collagen grown on carbon.
The image was taken with 390 V in HV mode and shows the contrast between hydrocarbons and carbon foil.

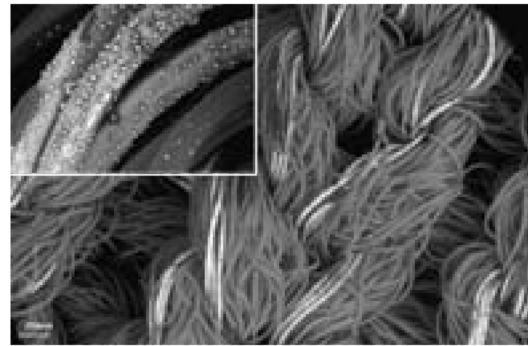


High resolution image of fresh yeast at 1.5 kV with the in-lens detector. Trans membrane protein crystals with layers of previously unseen protein arrays smaller than 3 nm. With the SUPRA® fast results can be achieved which are comparable with time consuming and complicated replica / TEM work.

Enabling solutions

The proprietary VP (variable pressure) technology for the GEMINI® column enables many applications for direct imaging of non-conductive or delicate specimens without complicated sample preparation techniques. The VP technology is available on the SUPRA® 40VP, SUPRA® 55VP and the SUPRA® 60VP. Operation of high vacuum mode or variable pressure mode is simply selected by mouse click.

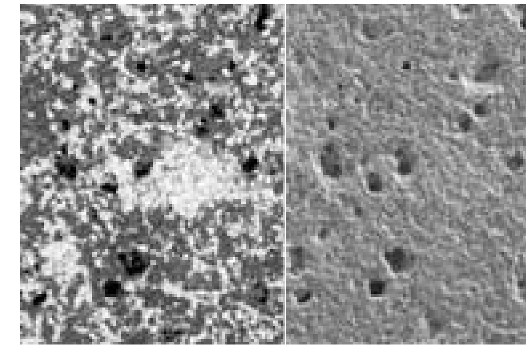
In high vacuum mode the SUPRA® VP instruments deliver the same excellent resolution as the non VP models. In variable pressure mode the enhanced VPSE detector enables true SE imaging even at longer working distances. A BSE detector positioned underneath the objective lens allows simultaneous SE and BSE detection for topographic and material contrast imaging.



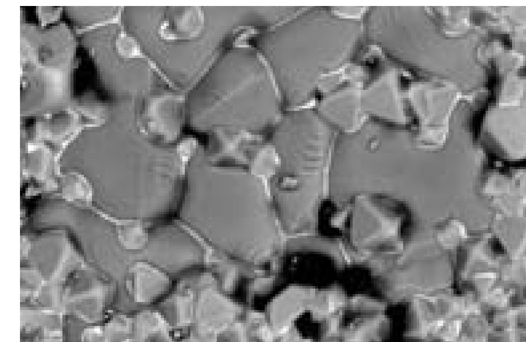
BSE imaging of corroded polymer fibres in VP mode (12kV/43Pa chamber pressure). Inset image showing 15x higher magnification.

SE image with the VPSE detector of uncoated paper with 7kV and a chamber pressure of 38Pa. The image shows the paper fibres with the filler material without any charging.

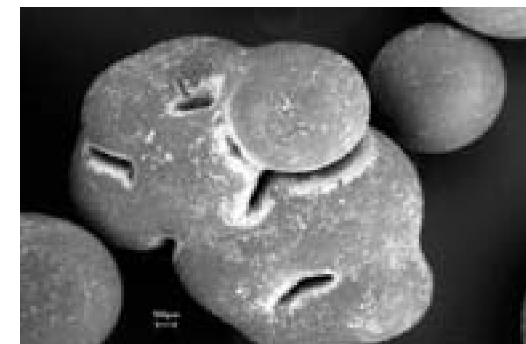
VP applications on non-conducting specimens



Simultaneous BSE (left) and SE imaging with the VPSE detector of an uncoated Viton O-ring at 12kV and a chamber pressure of 48Pa, showing a direct comparison of atomic number contrast (BSE) and topography (SE) without charging.

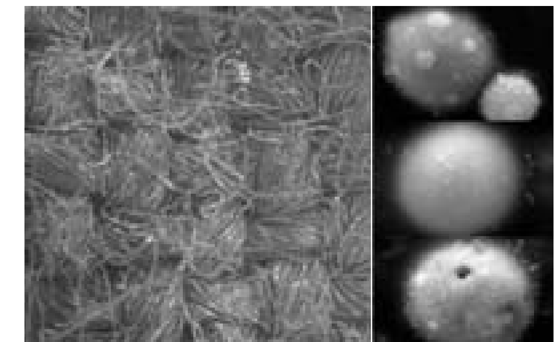


BSE image of an uncoated semi-conductive varistor material (zinc-oxide grains with bismuth-oxide at the grain boundaries) at 10kV and a chamber pressure of 20Pa.



Uncoated styro-foam sample imaged with the VPSE detector at 12kV and a chamber pressure of 24Pa. This delicate sample can be imaged without beam damage.

Simultaneous BSE (left) and SE imaging with the VPSE imaging of uncoated particles of fly-ash (7kV and 34Pa chamber pressure). The BSE image shows strong material contrast which is not visible in the SE image.



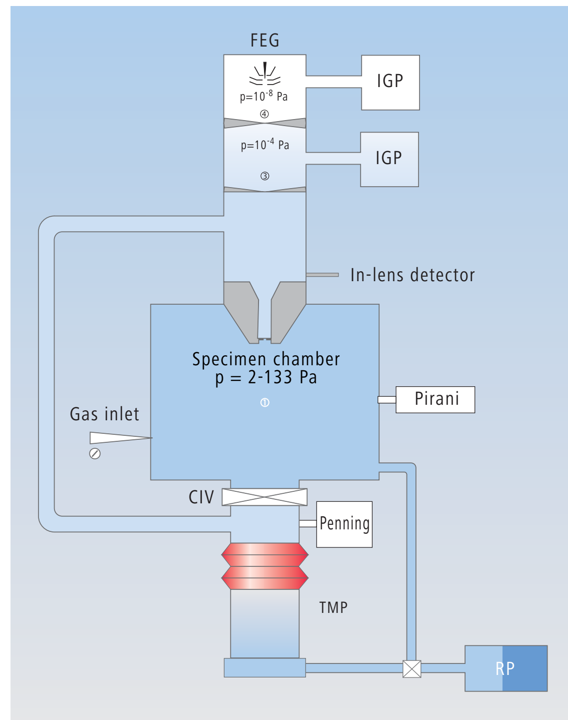
SE imaging with the VPSE detector of uncoated GSR (gun shot residue) sample with gun shot particles on textile. The 3 inset micrographs on the right show individual GSR particles with an approx. 400x higher magnification. All images taken with 10kV and 8Pa chamber pressure.

The extra dimension with variable pressure FE-SEM technology

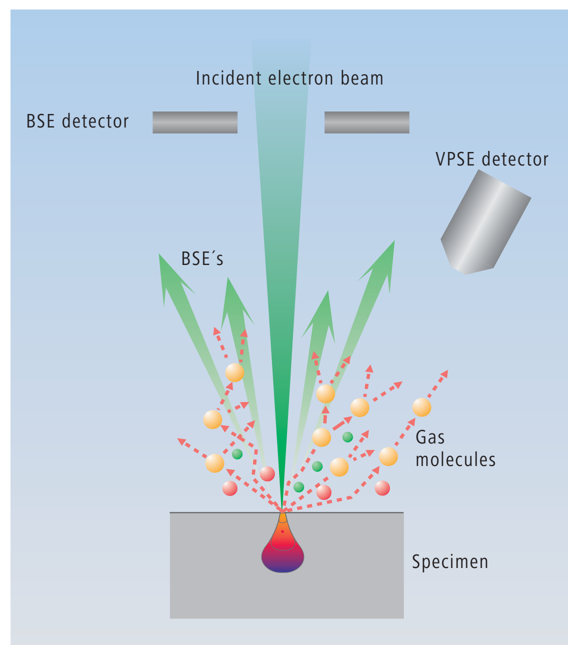
VP FE-SEM

Explore the extra dimension with the unique variable pressure (VP) mode for the GEMINI® field emission column which brings many advantages for imaging non-conducting specimens, without charging artefacts:

- Superb ultra high resolution in high vacuum mode.
- Ultra high resolution in variable pressure (VP) mode – 2.0 nm @ 30 kV.
- Non destructive artefact free imaging and analysis of samples in their natural state.
- Increased productivity, saves costs by eliminating complicated preparation.
- Optimum secondary electron detection in all modes with high efficiency in-lens detector in high vacuum mode and enhanced VPSE detection in VP mode.
- Fully automated vacuum system, with simple click selection of mode and desired pressure.
- Non-charging imaging of insulating specimens using analytical conditions - 15 to 30 kV.
- Investigation of moist samples using a Peltier cooling stage.



The VP vacuum System of the SUPRA® FE-SEM.



On an insulating sample, the surface charge that would normally build up causing imaging artifacts is neutralised by the ions formed during the electron collisions with the introduced gas molecules.

SUPRA® VP vacuum system

The specimen chamber and the GEMINI® column are divided into four pressure regions separated by pressure limiting apertures. The vacuum in the field emission emitter area and the upper part of the GEMINI® column is maintained by two ion getter pumps, the lower part of the column is pumped by a turbomolecular pump (TMP). The specimen chamber can be separated from the TMP vacuum by a chamber isolation valve (CIV). As soon as VP mode is selected, the system automatically regulates the chamber pressure and additionally selects the variable pressure SE detector for you. An automatic feed back loop ensures that the new pressure is accurately set and regulated in the specimen chamber. With a single mouse click high vacuum can be selected if required.

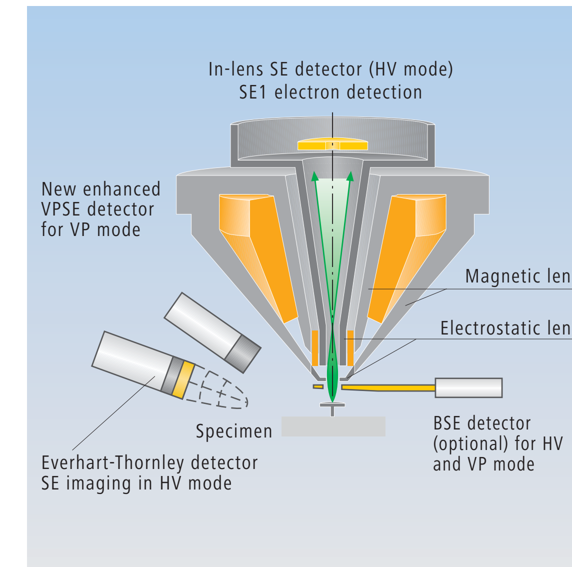
Collision of the Secondary electrons with Gas molecules produces positive Ions near the sample surface. The ions are combined with excess electronic charge on the surface. This leads to a neutralisation of the charging surface.

- SE
- Ions
- Gas, (Air)

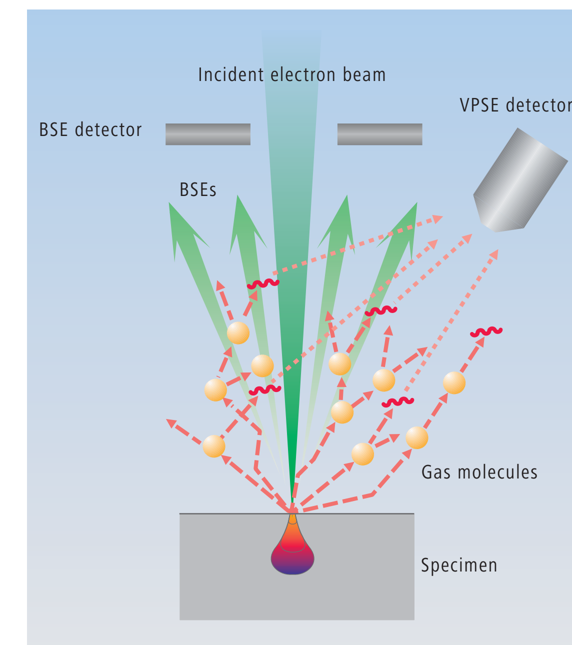
VPSE Detector

Principles of VP operation

In variable pressure (VP) mode, the gaseous pressure in the specimen chamber is raised whilst the GEMINI® column vacuum is maintained at a high level. With a gas pressure (2 - 133 Pa) in the vicinity of the specimen, electrons leaving the specimen collide with gas molecules causing ionisation to occur. Ions created as a consequence of the gaseous collisions are responsible for neutralising any charge build up in insulating specimens. In general, the more insulating the specimen the greater the gas pressure required. Another advantage of the elevated pressure is the capability to investigate moist specimens. Together with a Peltier cooling stage water can be retained in moist samples to avoid artifacts caused by dehydration. VP mode enables imaging of specimens in their natural state without the need for time consuming and expensive preparation techniques.



The SUPRA® series VP detection system configuration offers four imaging detectors available at any time.
1 In-lens SE detector for SE1 electron detection in HV mode
2 Enhanced VPSE detector for true SE imaging in VP mode
3 Everhart-Thornley detector for SE imaging in HV mode
4 BSE detector (optional) for imaging in HV and VP mode



VPSE - Variable Pressure SE detector

Since the standard lateral secondary electron detector (Everhart-Thornley type) and the high efficiency in-lens detector are both designed for use in high vacuum, secondary electrons cannot be detected by these detectors in VP mode. The solution has been to develop the unique enhanced VPSE (Variable Pressure Secondary Electron) detector to allow true secondary imaging under both normal and variable pressure conditions. An optional BSE (Backscattered Electron) detector can be used to obtain additional image information.

Secondary electrons are accelerated away from the sample surface and collide with the gas molecules in a collision zone to create further electrons which are also accelerated in the electrical field. The avalanche of secondary electrons provides amplification of the SE signal.
In addition to ions, secondary electron collisions also produce photons.
These photons are collected by the VPSE detector to produce a true secondary electron image.
Although BSE also cause collisions their contribution is less than 1% of the low energy SE, ensuring that the VPSE is genuinely secondary electron imaging.

- Secondary electrons
- Photons
- Gas (Air)

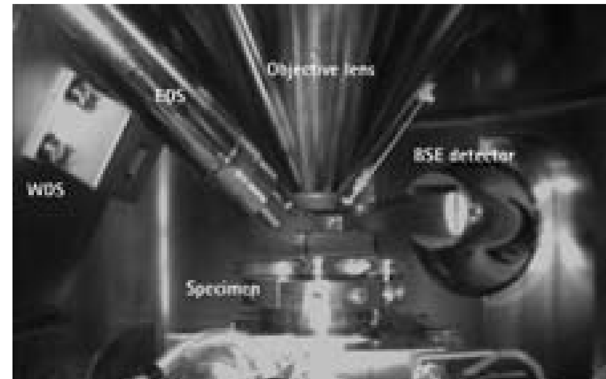
SUPRA® ultra high resolution analytical FE-SEM

EDS

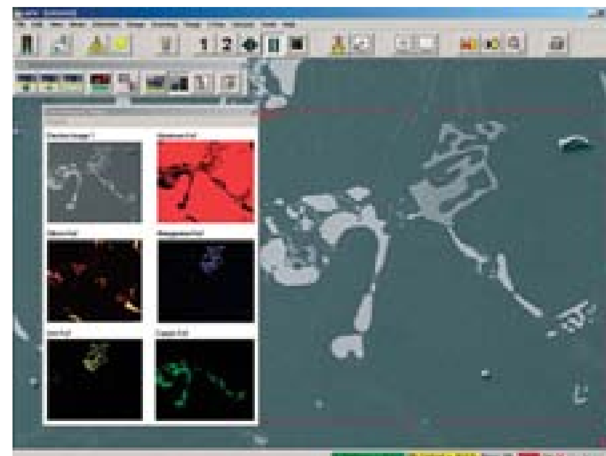
The SUPRA® series of field emission SEMs all combine ultra high resolution imaging with full analytical capabilities. The compact GEMINI® objective lens enables an analytical working distance of only 8.5 mm with a take-off angle of 35°. The short working distance together with the high take-off angle are ideal to combine high resolution imaging with full quantitative EDS analysis.

SUPRA® plus EDS offers:

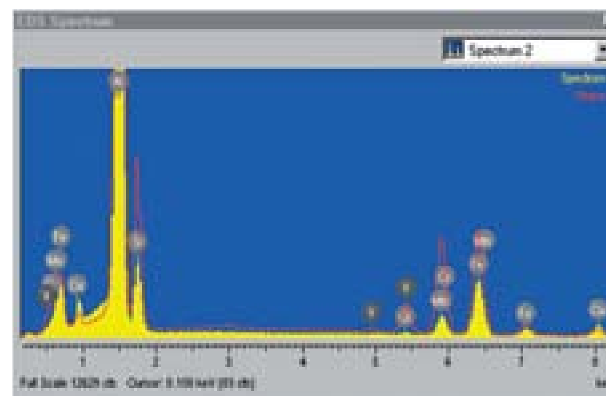
- EDS analysis fully compatible with other imaging detectors
- Simultaneous EDS/WDS, either fully focussing or compact X-ray optics type
- Fully quantitative EDS analysis
- Fully automatic inclusion 8 particle analysis with elemental mapping
- EDS analysis on non-conducting specimens in VP mode



Chamber view of SUPRA® 55WDS showing EDS, WDS and BSE detector for simultaneous imaging and analysis.



SEM image with EDS mappings.



Spectrum display shown with spectrum overlay.

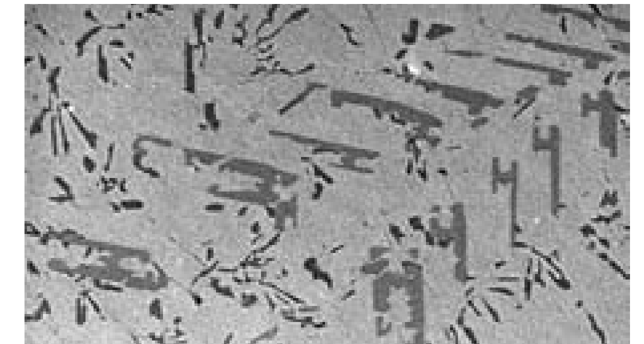
The SUPRA® 40 with EDS detectors installed.

Full WDS analysis capabilities with the SUPRA® 55

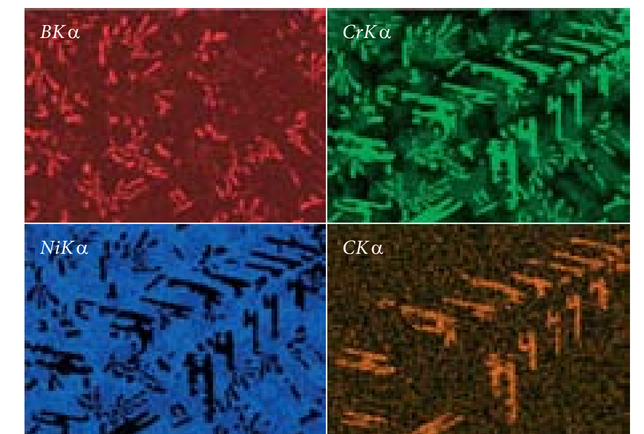
WDS

The SUPRA® 55WDS has been designed to meet the most demanding analytical applications. The new anode configuration combined with the high current mode lens control provide sample probe current to perform WDS analysis. The chamber design with 35° take-off angle allows simultaneous WDS and EDS analysis with SE, BSE, STEM, CL and SCM imaging.
The GEMINI® column enables WDS analysis with a high current in a small spot combined with a superb beam stability. The WDS spectrometer with high sensitivity for light elements, superior energy resolution (3-20 eV), low background and 10x higher intensity for elemental analysis offers analytical solutions beyond EDS analysis.

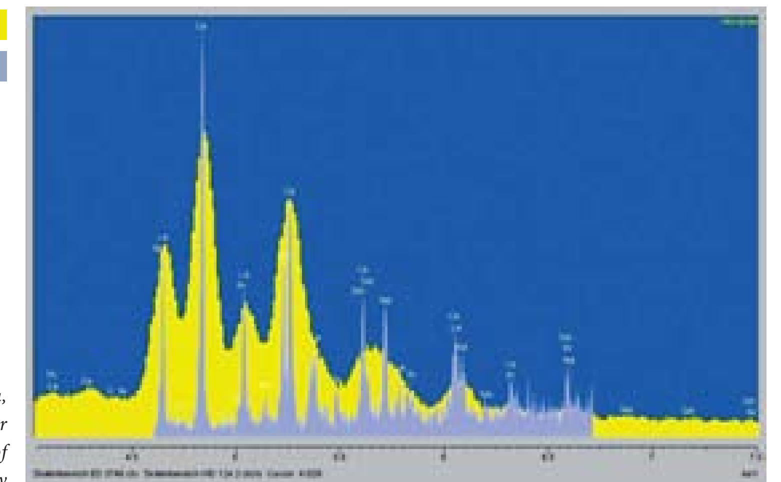
The combination of the SUPRA® 55 together with the WDS spectrometer opens new fields of applications for high spatial resolution X-ray analysis.
With the SUPRA® 55 VP-Version even non-conducting samples can be imaged and analysed with EDS in variable pressure mode, however WDS analysis has to be performed in high vacuum mode.



BSE image of Nimonic steel.

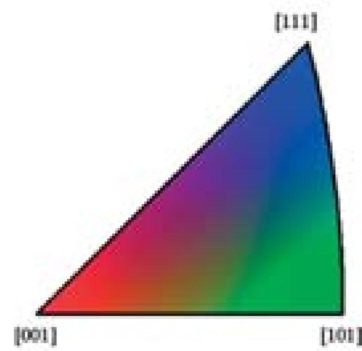


Combined EDS/WDS element mappings.



EDS/WDS spectra, showing superior energy resolution of WDS without any

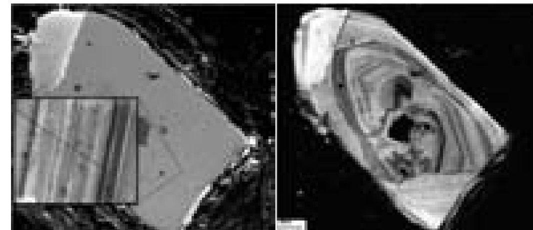
CL and EBSD applications



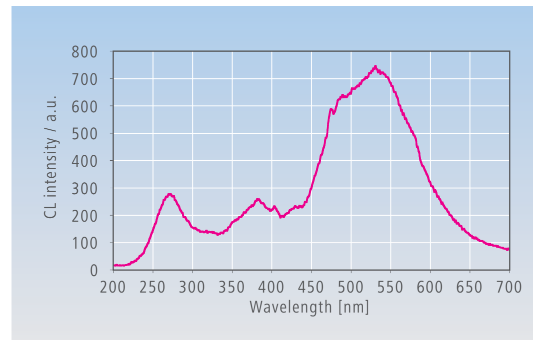
CL

Cathodoluminescence (CL) imaging and spectroscopy has found many applications in the field of mineralogy, geology, ceramic materials research and the development of luminescent materials.

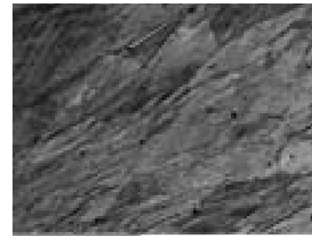
The results shown on this page were produced using the SUPRA® 40 and the SEM CL spectrometer system with an ellipsoide mirror collector. The high current density of the GEMINI® column delivered in the fine probe enables high resolution CL imaging at low kV. The stage and specimen chamber design of the SUPRA® series offer ample space to adapt the SEM CL system without blocking other detectors.



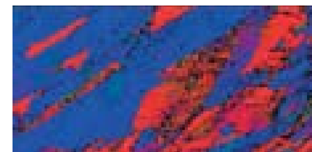
Micrographs with SE (top) and polychromatic CL (bottom) of a cross section of a magmatic Zircon (age ~560 million years) taken at 5 kV.
The CL micrograph clearly shows the zone structure due to Zircon growth at the time of formation.
CL micrographs and spectrum courtesy of Joachim Huth, MPI for Chemistry, Mainz, Germany



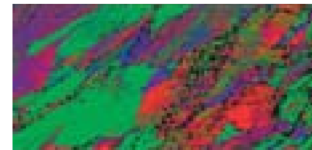
CL spectrum of the detailed area using the SUPRA® 40 with the SEM CL spectrometer.



Forward scattering BSE image of heavily deformed extruded copper.

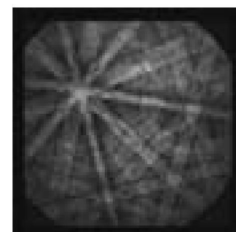


COM in normal direction



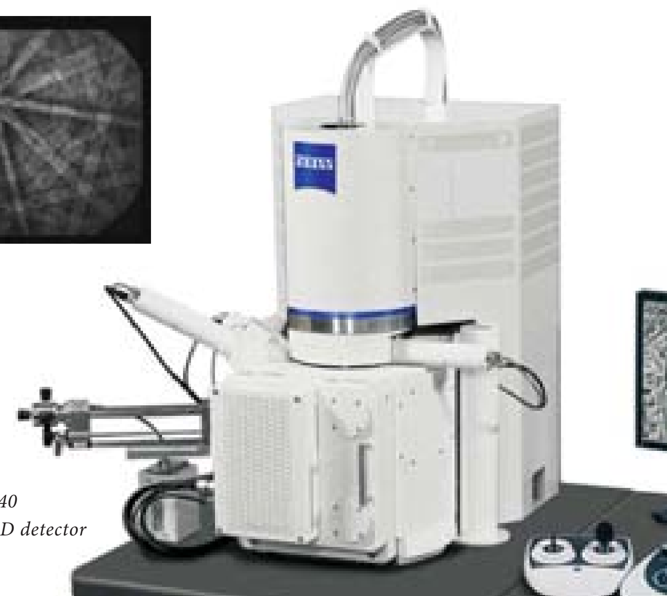
COM in rolling direction

COM in transverse direction



EBSD

EBSD is an important tool for materials characterisation today showing the crystal structure and the texture of polycrystalline materials in the form of crystal orientation maps (COM). The SUPRA® with the large analytical chamber and the high current GEMINI® column is ideally suited to perform EBSD. All SUPRA® specimen stages offer high stage tilt needed for EBSD investigation with the EBSD detector mounted on the left of the specimen chamber normal to the tilt axis. The EDS detector is positioned above the EBSD detector at 35° take-off angle to allow simultaneous data collection. For this important analytical application the SUPRA® is the perfect tool combined with unparalleled ultra high resolution imaging.



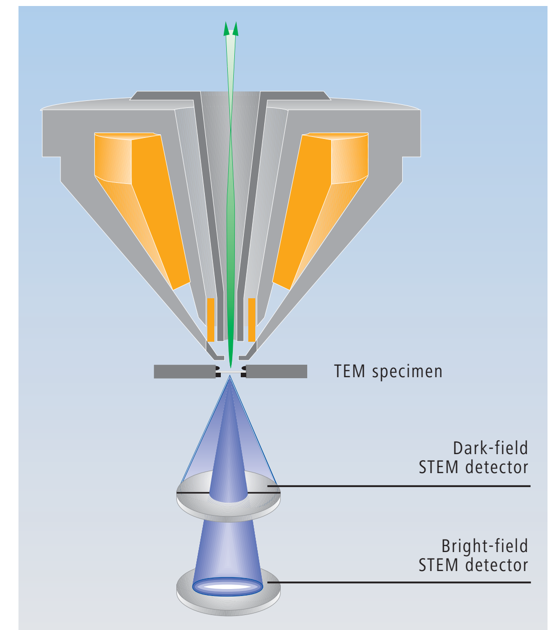
SUPRA® 40 with EBSD detector installed.

GEMINI® Multi-mode STEM detection system

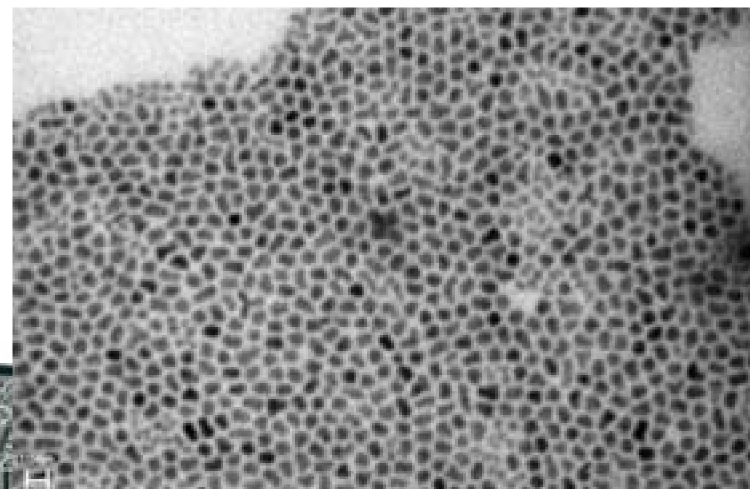
By using the GEMINI® Multi-mode STEM detection system, the information limit for the SUPRA® FE-SEM can be extended beyond the nanometer range. A resolution of 0,8 nm is now readily attainable and gives additional nano scale information. The quality of the image obtained with the STEM unit are similar to images obtained by a TEM with a scanning attachment.

The GEMINI® Multi-mode STEM unit unique features are:

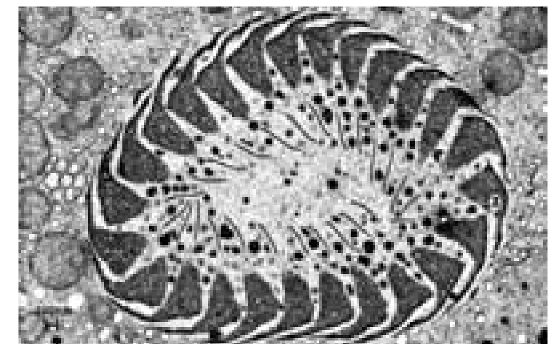
- Improved resolution by reducing the excited volume and compared with TEM imaging no chromatic aberration introduced by the projection lens system.
- Contrast enhancement due to increased cross sections for lower accelerating voltage.
- Unique contrast tuning for low contrast specimens.
- Parallel detector arrangement allows simultaneous Real-time imaging and mixing of BF, DF and orientated DF signals.
- Small excited volume in thin sections results in dramatic improvement of resolution for EDS analysis, enabling nano-particle analysis.



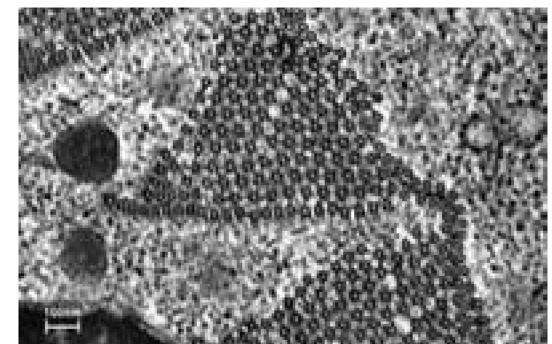
SUPRA® STEM unit in bright-field mode.



STEM image of polymer to illustrate the resolving power of the STEM detector.



STEM image of the oral basket of Pseudomicrothorax spec. Ciliata nasulida.



STEM image of microtubals forming nematodesmal rods. Both specimen by courtesy of Institut for special Zoology Tübingen

Integrated Computer Environment

ICE

More than simply a digitally interfaced add-on PC, ICE merges the hardware and software of the microscope so that every operating parameter is available for control or automation. ICE means real-time response to operator command, true self-monitoring and the practical realisation of remote microscopy through NetSEM™.

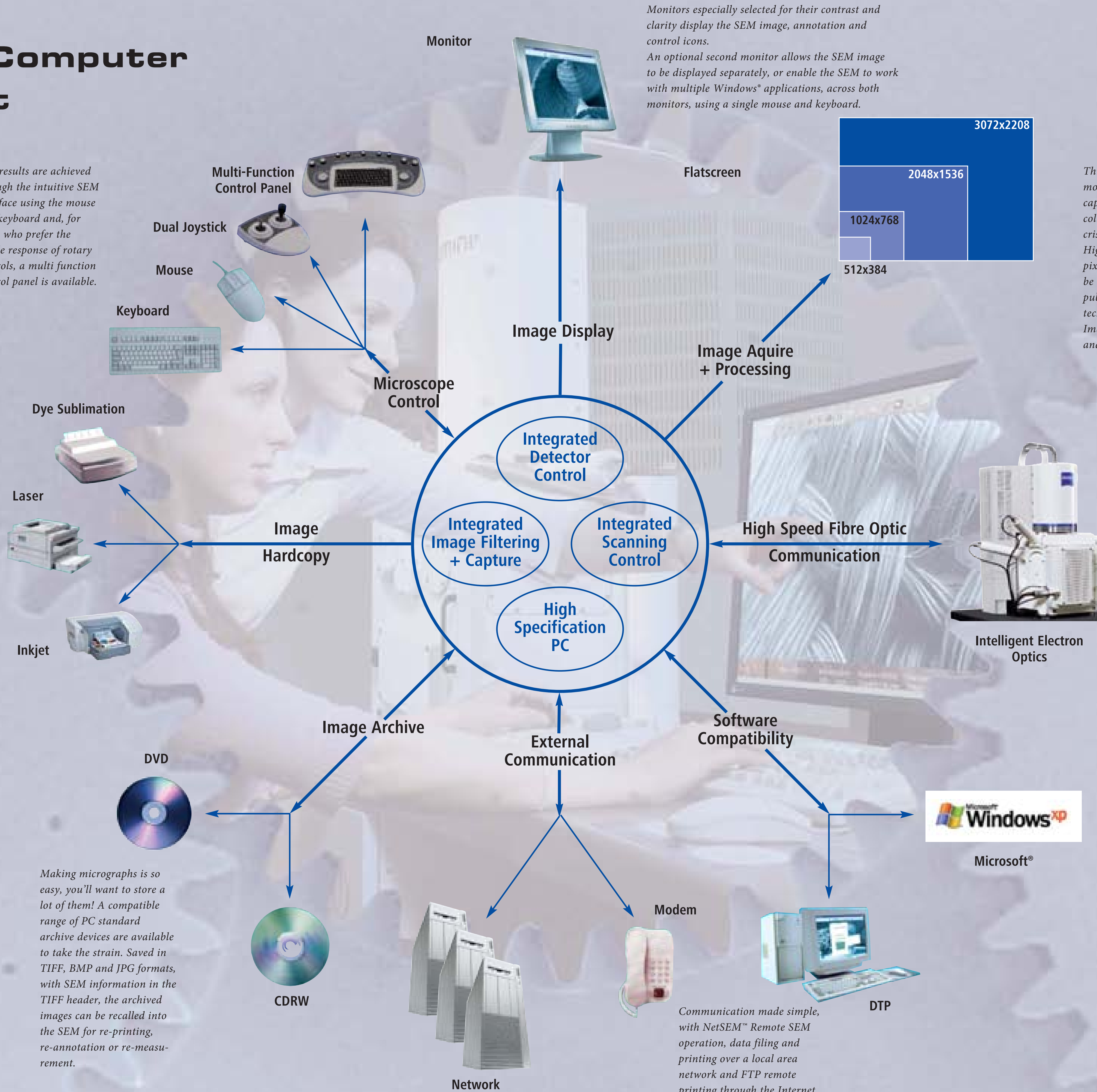
Fast results are achieved through the intuitive SEM interface using the mouse and keyboard and, for those who prefer the tactile response of rotary controls, a multi function control panel is available.

Monitors especially selected for their contrast and clarity display the SEM image, annotation and control icons.
An optional second monitor allows the SEM image to be displayed separately, or enable the SEM to work with multiple Windows® applications, across both monitors, using a single mouse and keyboard.

Three real-time image filtering modes and further image processing capabilities ensure that even images collected from difficult samples are crisp and incredibly detailed.
High resolution images, with square pixel, of up to 3 k x 2 k in size can be captured, essential for desk top publishing and image analysis techniques.
Images can also be stored in BMP and JPG format.

Photo, laser, dye sublimation, monochrome, coloured, small or large, the direct Windows® printing, allows those important images to be quickly, and exactly, reproduced on a full range of media.

Great results can only come from a self monitoring system that responds immediately and intelligently to operational changes. Setting the imaging parameters to their optimal value always delivers performance.



Making micrographs is so easy, you'll want to store a lot of them! A compatible range of PC standard archive devices are available to take the strain. Saved in TIFF, BMP and JPG formats, with SEM information in the TIFF header, the archived images can be recalled into the SEM for re-printing, re-annotation or re-measurement.

Communication made simple, with NetSEM™ Remote SEM operation, data filing and printing over a local area network and FTP remote printing through the Internet.

It couldn't be simpler, load a template - press F9 and instantly generate a report including the image.
This possibility can only exist when the SEM control software is totally Windows® compatible, and all of the SEM parameters are available through the PC.

Global Sales and Service Network

Would you like to have a product demonstration? Are you looking for application support? Please do not hesitate to contact us for an appointment to visit one of our superbly equipped demo centers. You can find us in the following locations: Germany (Dresden and Oberkochen), USA (Peabody), France (Nanterre), UK (Cambridge), Japan (Yokohama) and in Singapore. We look forward to seeing you! You can find an overview with contact details online at www.smt.zeiss.com/democenter

For more information please visit us at www.smt.zeiss.com/nts

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Enabling the Nano-Age World®

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