





Product Information

SIGMA Series

Your FE-SEM for Nanoscale Analytics

INTERNET-LINK 

VIDEO/ANIMATION 

Release 1.0



We make it visible.

Advanced Analytical Microscopy

SIGMA Series

Your FE-SEM for
Nanoscale Analytics

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› The Applications

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The SIGMA series of Field Emission Scanning Electron Microscopes (FE-SEM) delivers advanced analytical microscopy with the high performance you expect from Carl Zeiss. Equipped with the GEMINI column with its in-lens secondary electron detection, the SIGMA series brings you unparalleled resolution, contrast and brightness for imaging highly topographical samples. The SIGMA series features high vacuum and variable pressure modes of operation with high definition imaging of both conducting and non-conducting samples.



ΣIGMA: Simpler. More intelligent. More integrated.

ΣIGMA Series

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Analytical Performance

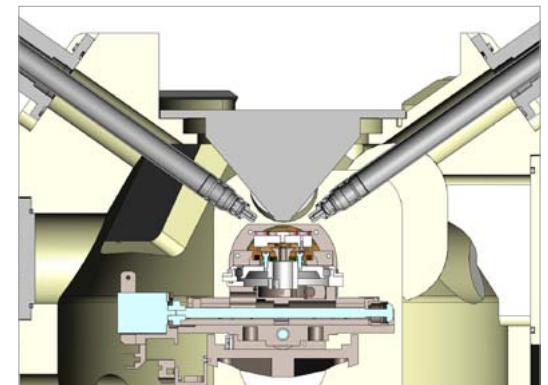
The market leading GEMINI column is at the core of the ΣIGMA series of Field Emission Scanning Electron Microscopes from Carl Zeiss. The GEMINI column design provides superb low voltage imaging and stability. ΣIGMA is able to resolve structures as small as 1.5 nm. ΣIGMA HD delivers a further increase in resolution up to 1.0 nm plus the ability to perform more rapid and accurate EDS analysis.

Integrated Workflows

The ΣIGMA series has been designed to provide seamless integration between workflows. Image navigation software is fully integrated into SmartSEM, the user interface for your scanning electron microscope. This facilitates navigation, orientation and positioning around your specimen in the chamber with the help of a digital overview image. Use manual and automated functions to capture images then view them and their associated analytical data in a uniquely contextualized way using SmartBrowse.

Highest Productivity

ΣIGMA HD takes the speed of analysis and accuracy of energy-dispersive X-Ray spectroscopy to new levels of performance. Increase productivity by mounting dual EDS detectors on the analytical chamber. Ultra fast scanning of the electron beam further facilitates rapid navigation around the sample.

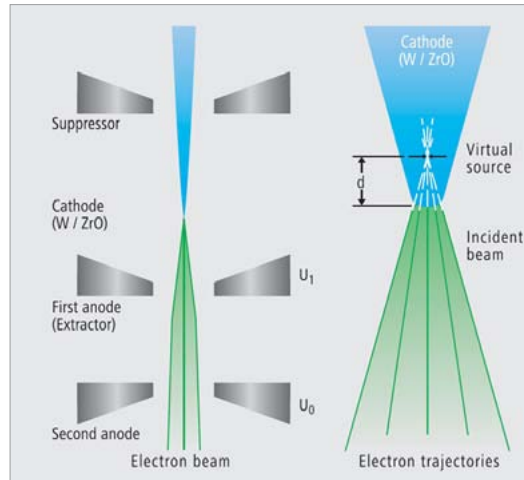


Your Insight into the Technology Behind It

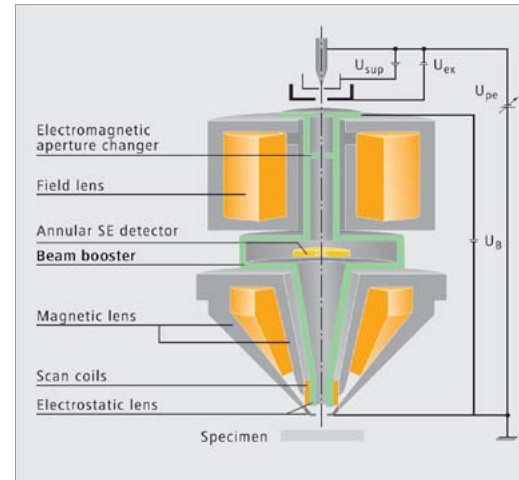
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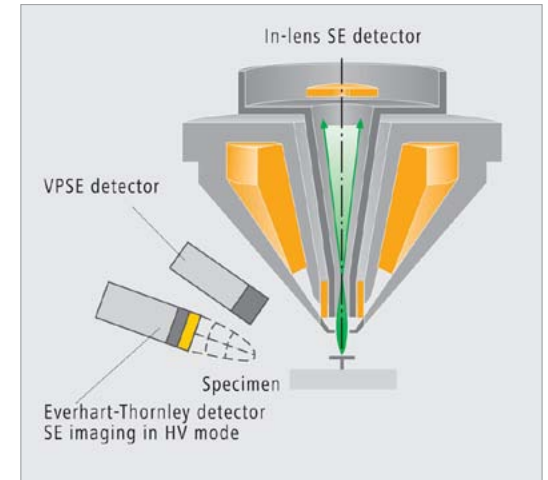
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The GEMINI column capitalizes on the Schottky emitter, a thermal field emission source which produces an ultra-stable probe current for sample imaging and analytical analysis. The Schottky emitter with its inherently long life span contributes significantly to the theoretical resolution of the column.



The beam booster inside the column ensures that electrons traverse the column in high vacuum and at high energy with no beam crossover. Decelerate the beam to generate high resolution images from electrons with landing energies as low as 20 V. To allow you to investigate magnetic samples, the GEMINI objective lens is designed to minimize the magnetic field at the specimen.



In high vacuum operation, use the in-lens secondary electron detector to achieve exceptional topographical imaging with unrivalled contrast and brightness. The optional variable pressure operation allows seamless imaging of non-conducting samples at the click of a button - without realigning the aperture. Upgrade your system with a variable pressure secondary electron detector.

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Tailored Precisely to Your Applications

Typical applications, typical samples	Task	ΣIGMA series provides
Engineered materials	Resolve nanostructured surface detail on non conducting samples	<ul style="list-style-type: none">■ high resolution images of non-conducting materials at low accelerating voltages■ exceptional surface topography for beam sensitive samples■ insights into crystalline structure, elemental distribution and quality of engineered materials
Material structure	Provide structural information on thin sections of metallic samples	<ul style="list-style-type: none">■ high resolution TEM-like images using a STEM detector enabling the identification of defects in metals
Particle analysis	Measure size of particles on non-conductive filters	<ul style="list-style-type: none">■ charge compensation using variable pressure mode that produces high contrast BSD images for further processing■ particle elemental makeup in combination with EDS detectors
Failure analysis	Investigate failure mechanisms in materials and identify fracture points	<ul style="list-style-type: none">■ visualize channeling contrast in materials using angular selective backscatter imaging■ high resolution view of the topography of failed engineered microstructures
Fundamental research	Image fine surface details of cryo-fixed biological and other vacuum sensitive samples	<ul style="list-style-type: none">■ outstanding low kV imaging of non-conducting biological samples

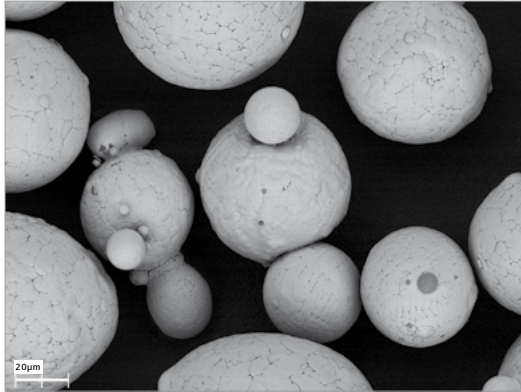
SIGMA Series at Work

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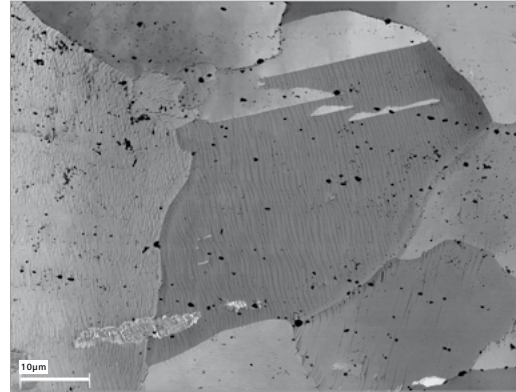
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Engineered Materials



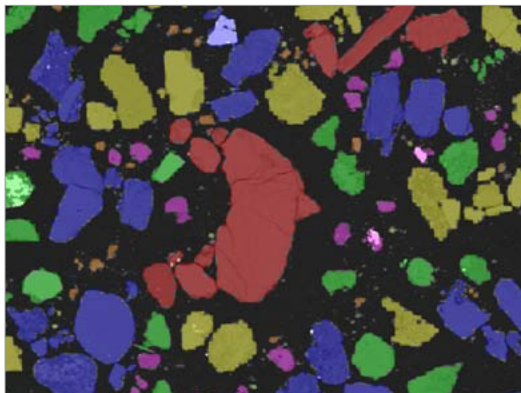
Ni-Cr-Fe metal spray powder coating imaged at 4kV accelerating voltage with 5S-BSD detector.

Engineered Materials



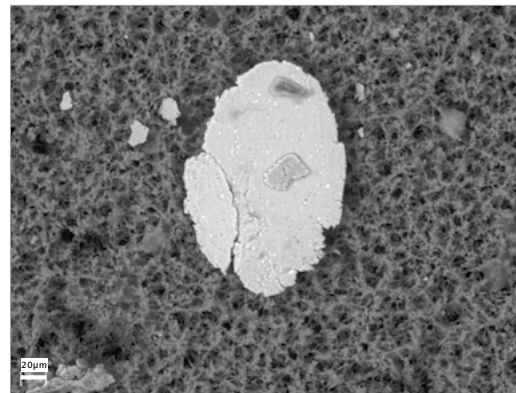
Platinum grains showing grain boundary slip planes. Imaged at 4kV with AsB detector.

Particle Analysis



Automated particle size measurement of wellsite chip-pings using SmartPI. Particles were detected using BSD image thresholding.

Particle Analysis



Steel particles on filter paper. Imaged at 20kV accelerating voltage with 5S-BSD detector.

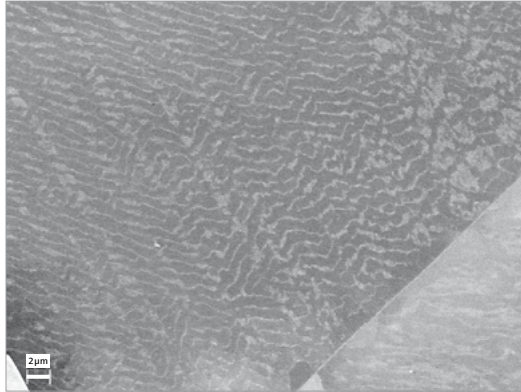
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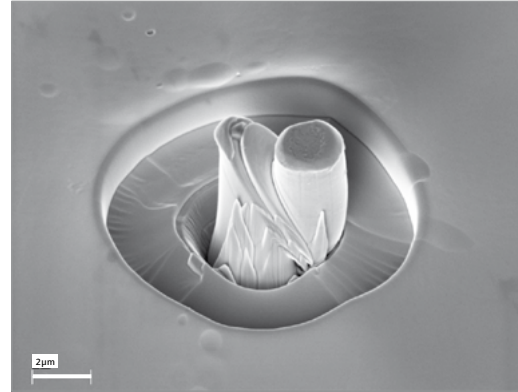
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Failure Analysis



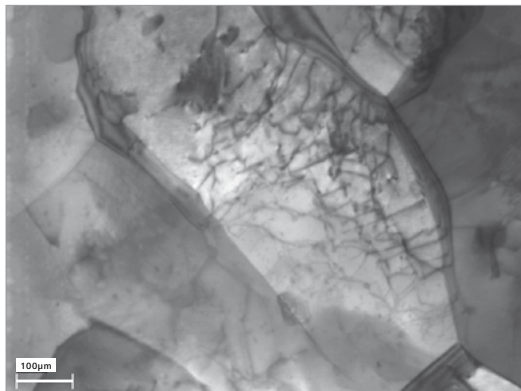
Dislocation forest in a nickel grain. Imaged at 20kV accelerating voltage with the AsB detector. Courtesy of University of Saarland.

Failure Analysis



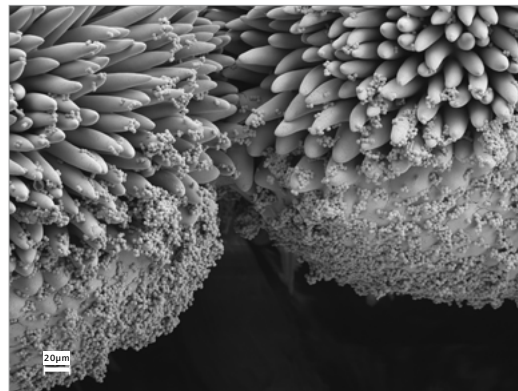
Crushed two micron diameter nickel pillar showing the slip planes. Imaged at 5kV accelerating voltage with in-lens SE detector. Courtesy of University of Saarland.

Materials Structure



Ultra fine grain nickel polished and mounted on a TEM grid showing individual dislocation lines. Imaged at 25 kV accelerating voltage with multimode STEM detector. Courtesy of University of Saarland

Fundamental Research



Cryo fixed and platinum coated forget me not flower pollen affixed to a petal. Imaged at 5kV accelerating voltage. Courtesy of University of Brighton, UK.

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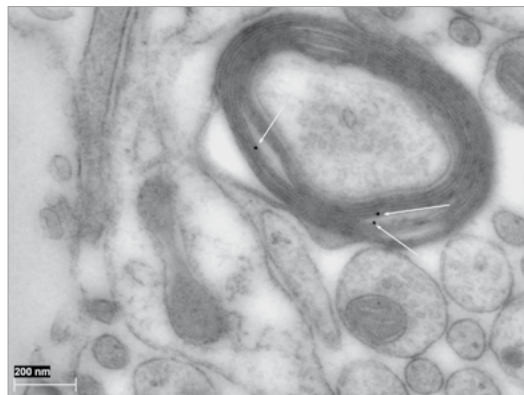
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SIGMA HD

Available in both high vacuum and variable pressure modes, the SIGMA HD FE-SEM incorporates advances in electronics, detectors and plinth design for imaging resolution as small as 1 nm.

High Definition Imaging

SIGMA HD brings you the advantages of a thermal field emission electron source, combined with an advanced high performance plinth, mechanically stabilized sample stage and a next generation backscatter detector. With a dwell time as short as 50 ns per pixel and a maximum framestore of 12288 x 9216 pixels, you acquire a 28 megapixel image in less than a second.



10nm gold particles immunolabelled in hypothalamus tissue. Sample courtesy of Texas A&M University.

Rapid Elemental Mapping at High Resolution

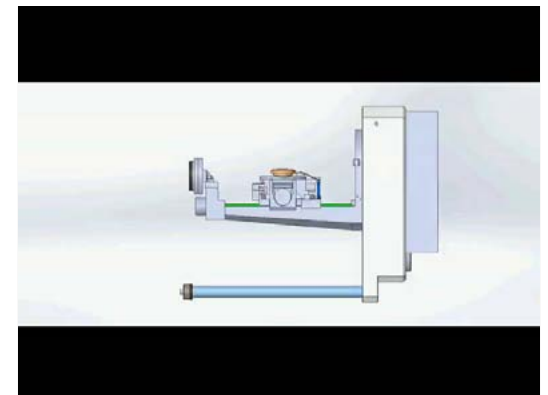
The large image framestore of SIGMA HD combined with high speed electron beam scanning permits the rapid, quantitative elemental mapping of high resolution fields of view. The chamber also enables the simultaneous use of two EDS detectors mounted diametrically opposite each other for maximum solid angle detection. For beam sensitive samples, the dual EDS setup allows low probe currents to be used while maintaining high X-ray count rates.



Range of image framestores available on SIGMA HD. From left to right: 512x384, 1024x768, 2048x1536, 3072x2304, 6144x4608 and 12288x9216

Large travel, versatile stage

A 5-axis eucentric stage comes as standard on SIGMA HD, making navigation around even large samples easy using both translational and tilted movement. The stage brings you the added benefit of mechanical stabilization, ensuring resolution of nanostructures on samples at large tilt angles.



5-axis eucentric stage: standard with SIGMA HD

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ZIGMA Series

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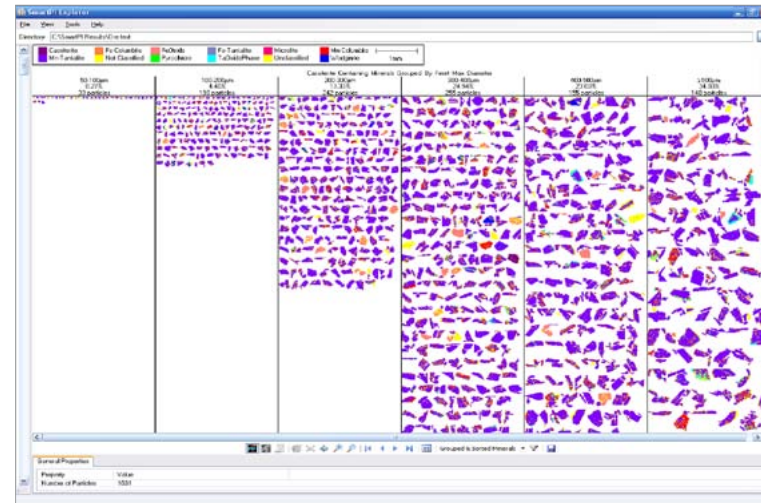
Particle Analysis

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

SmartPI

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

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



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

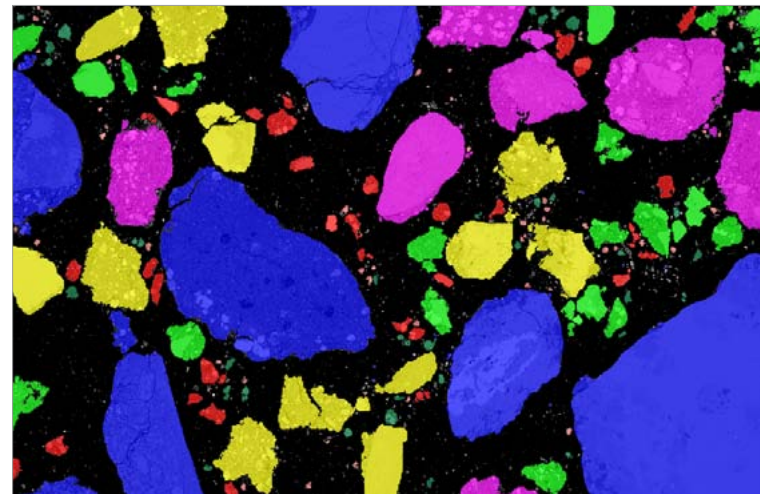


Image from SmartPI Image Analysis, displaying particles of different size ranges; in which the size range is defined by a unique colour

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SmartSEM Image Navigation

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

SmartBrowse

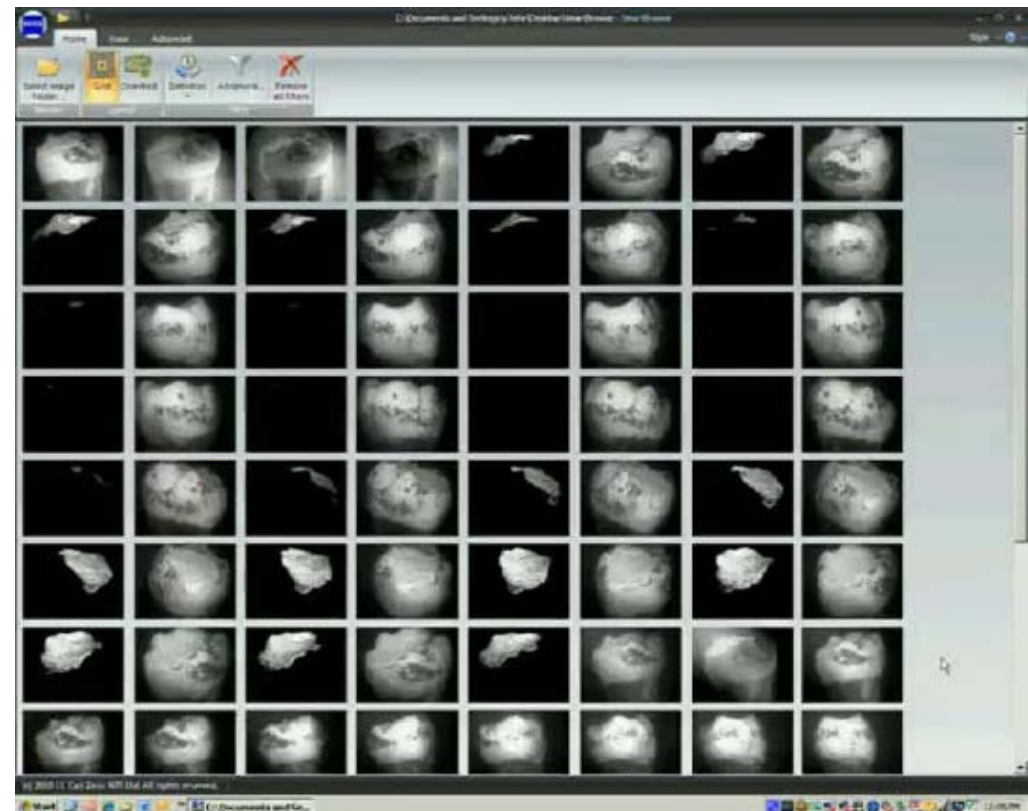
SmartBrowse is a contextual imaging tool for post image acquisition, capable of presenting images taken with multiple detectors at different magnifications in a single, interactive image.

Pre Image Acquisition



Post Image Acquisition

Smart Browse



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ATLAS - Large Area Imaging

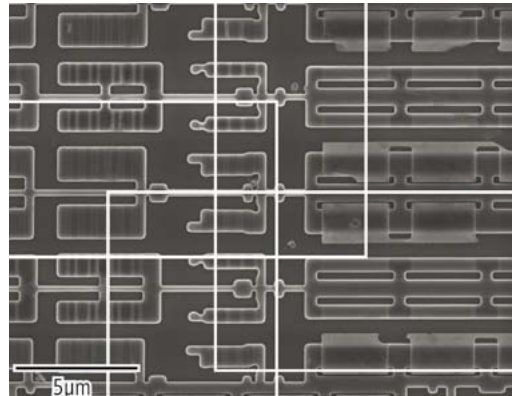
ATLAS combines a 16 bit scan generator and dual super-sampling signal acquisition hardware with image processing and control software for your electron microscope from Carl Zeiss. Acquire images with up to 32 k x 32 k pixels, with dwell times from 100 ns to > 100 s, adjustable in 100 ns increments. Save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

ATLAS provides:

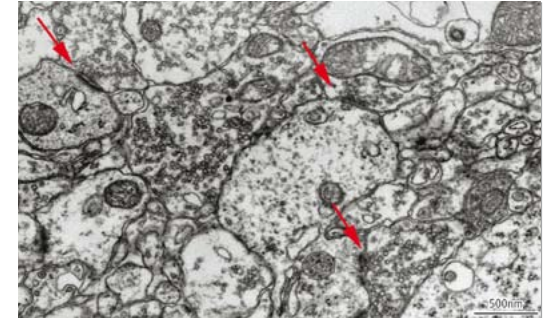
- A reduced number of tiles to acquire, reducing stage motion delay and areal fraction of each image lost to overlap
- A reduced number of overlap seams, leading to less beam damage and degradation of the sample
- A reduced computational complexity



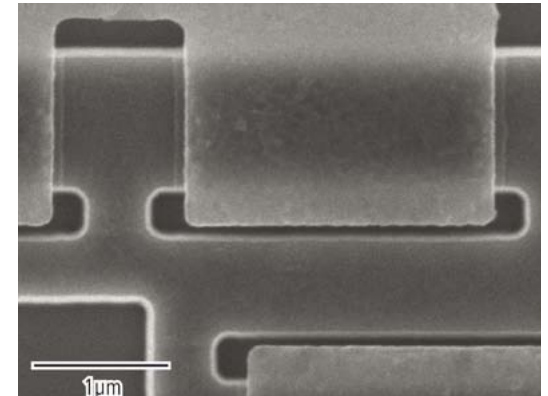
A 65 nm technology node graphics processor integrated circuit, stripped to its silicon substrate with HF acid etching. The mosaic consists of 49 images, each ~ 500 Mega-pixels, automatically stitched by the VE-Viewer into a ~ 1/3 mm x 1/3 mm mosaic.



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



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



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

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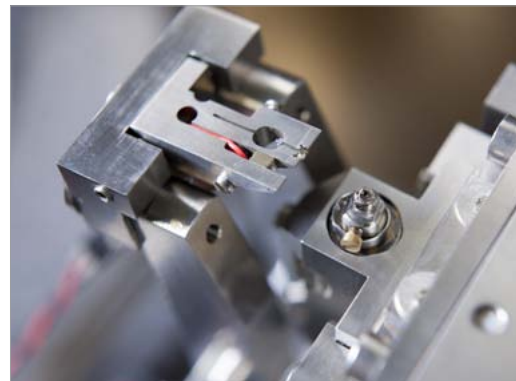
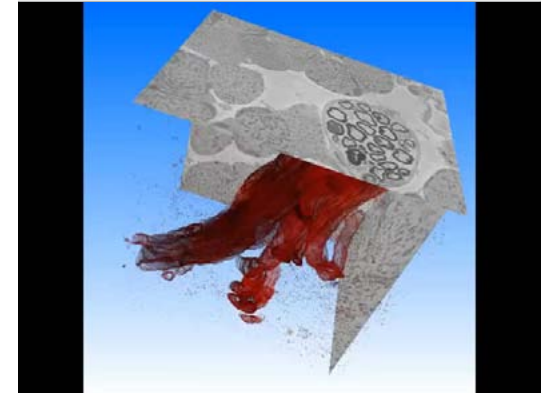
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Fast and Convenient 3D Imaging for Tissue Samples in the FE-SEM

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

3View® is an ultramicrotome inside the SEM chamber. The sample is continuously cut and imaged to produce thousands of serial images in a single day – each perfectly aligned because they are all generated from one fixed block.

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



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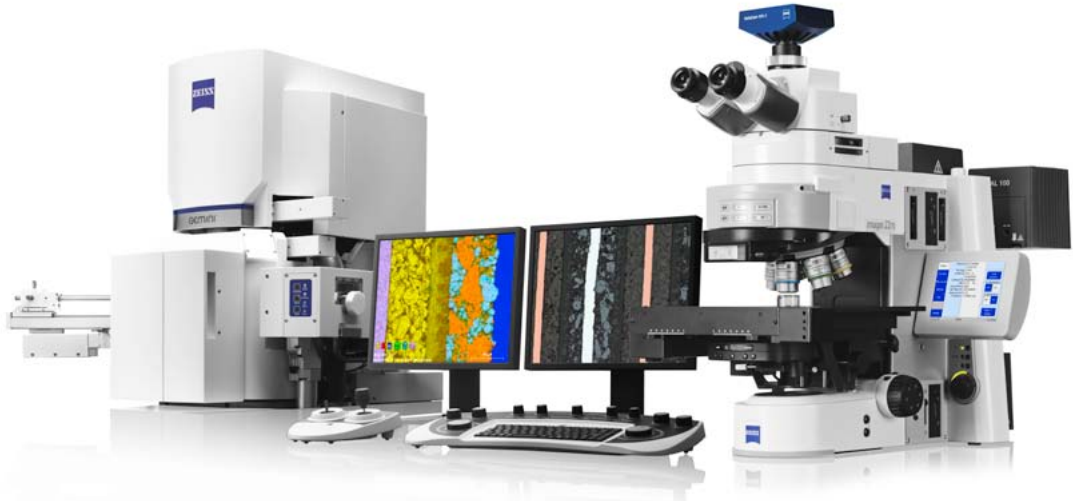
Correlative Microscopy with Shuttle and Find

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

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

How it works:

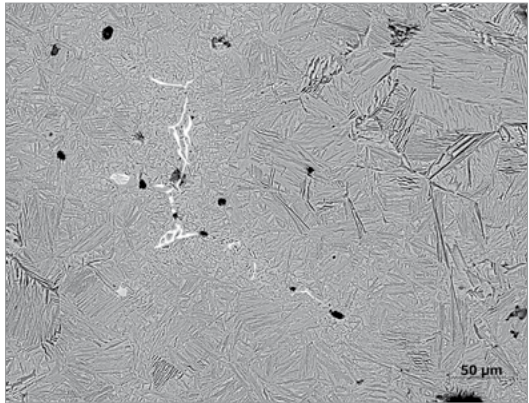
Using a special specimen holder with three fiducial markers, a coordinate system is calibrated semi-automatically within seconds using Shuttle & Find software. Use the light microscope to capture interesting regions of your sample. Then relocate a region in the electron microscope with significantly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



**Picture shows MERLIN, Shuttle&Find is available on all SEMs from Carl Zeiss*



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



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

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SIGMA: Your Flexible Choice of Components

SIGMA Platform

FE-SEM Column

- GEMINI
Features unrivalled ease of use, superb low voltage imaging and ultra stable probe currents for analytical applications

Vacuum Modes

- High Vacuum
- Variable Pressure

Stage Types

- Compucentric (SIGMA)
- Eucentric (SIGMA HD)

Ports

- Coplanar EDS and EBSD ports
- Dual EDS ports (SIGMA HD)

Imaging Detectors:

Standard:

- **In-lens SE** In-lens secondary electron detector
- **ETSE** Everhart-Thornley Secondary Electron detector for use in high vacuum
- **VPSE** (for VP mode only) Variable pressure secondary electron detector

Optional:

- **BSD** Backscattered detector providing Z contrast
- **Airlock** Enabling rapid sample transfer
- **AsB** Angular selective backscattered detector
- **WDS** Wavelength dispersive X-ray detector
- **CL** Cathodoluminescence detector
- **EDS** Energy dispersive X-ray detector
- **EBSD** Electron backscatter diffraction detector
- **STEM** Scanning transmission electron detector
- **SCD** Specimen current detector for EBIC imaging
- **SCM** Specimen current monitor
- **Chamberscope** Infrared camera in chamber



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Technical Specifications

	ΣIGMA	ΣIGMA HD
Electron Source	Schottky Thermal Field Emitter	Schottky Thermal Field Emitter
Resolution @ 1 kV	2.8 nm	1.9 nm
Resolution @ 15 kV	1.5 nm	1 nm
Backscatter detector (BSD)	Carl Zeiss BSD	Carl Zeiss High Definition BSD
Maximum Scan Speed	100 ns/pixel	50 ns/pixel
Acceleration Voltage	0.2 - 30 kV	0.02 - 30 kV
Magnification	10x - 1,000,000x	10x - 1,000,000x
Probe Current	4 pA - 20 nA (100 nA Option)	12 pA - 20 nA (100 nA option)
Image Framestore	3072 x 2304 pixels	12288 x 9216 pixels
Available Ports	10	15
Dedicated EDS Ports	1	2
Vacuum Modes		
High Vacuum	Yes	Yes
Variable Pressure	2 - 133 Pa	2 - 133 Pa
Stage Type	5 axis compucentric stage	5 axis eucentric stage
Stage travel X	125 mm	130 mm
Stage travel Y	125 mm	130 mm
Stage travel Z	50 mm	50 mm
Stage travel T	-10 - 90 degrees	-3 - 70 degrees
Stage travel R	360 Continuous	360 Continuous

Count on Service in the True Sense of the Word

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Because the Carl Zeiss microscope system is one of your most important tools, we make sure it is always ready to perform. What's more, we'll see to it that you are employing all the options that get the best from your microscope. You can choose from a range of service products, each delivered by highly qualified Carl Zeiss specialists who will support you long beyond the purchase of your system. Our aim is to enable you to experience those special moments that inspire your work.

Repair. Maintain. Optimize.

Attain maximum uptime with your microscope. A Carl Zeiss maintenance contract lets you budget for operating costs, all the while avoiding costly downtime and achieving the best results through the improved performance of your system. Choose from service contracts designed to give you a range of options and control levels. We'll work with you to select the service program that addresses your system needs and usage requirements, in line with your organization's standard practices.

Our standard preventative maintenance and repair on demand contracts also bring you distinct advantages. Carl Zeiss service staff will analyze any problem at hand and resolve it – whether using remote maintenance software or working on site.

Enhance Your Microscope System

Your Carl Zeiss microscope system is designed for a variety of updates: open interfaces allow you to maintain a high technological level at all times. As a result you'll work more efficiently now, while extending the productive lifetime of your microscope as new update possibilities come on stream.

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



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

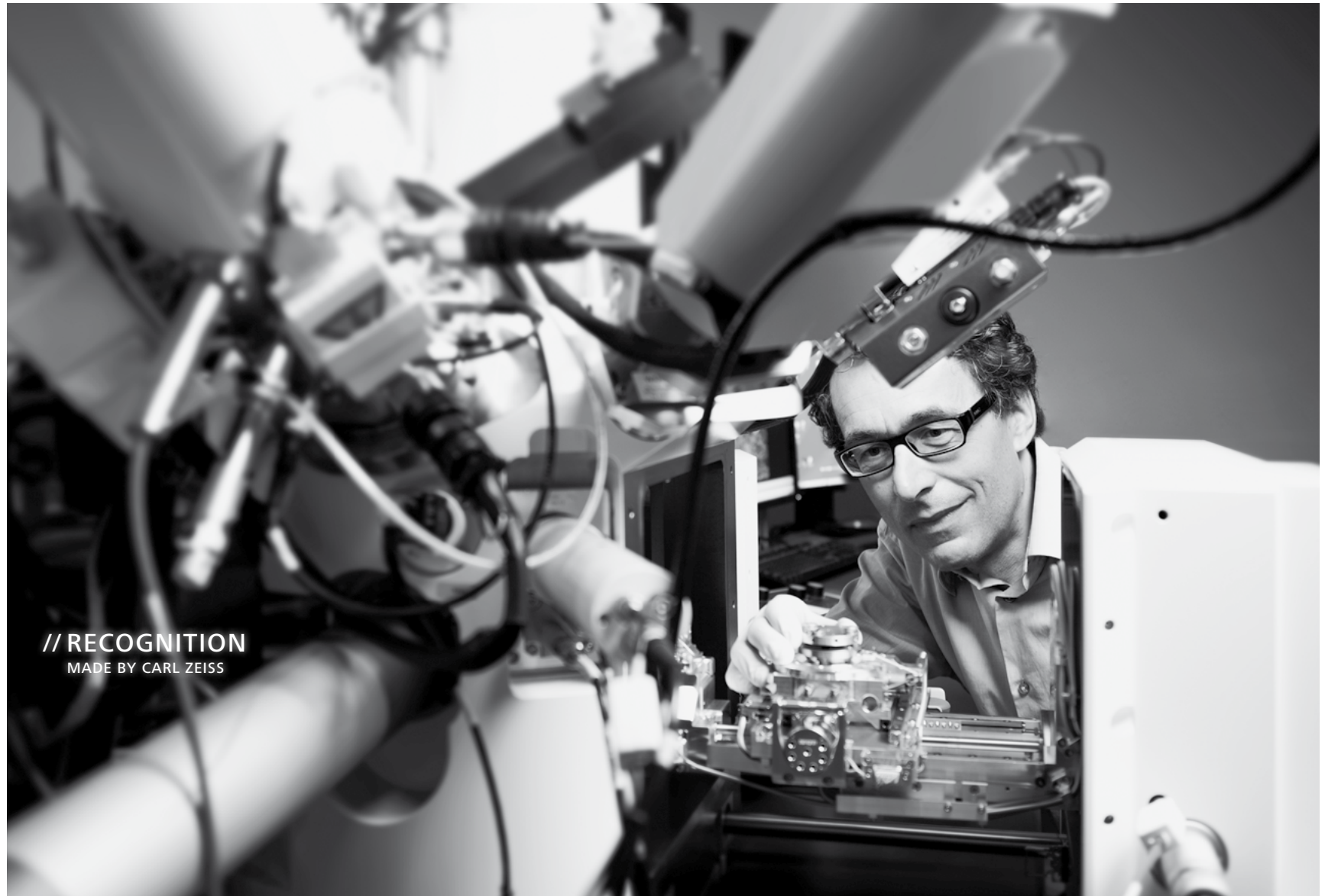
www.zeiss.com/microservice

The moment “I think” becomes “I know”.
This is the moment we work for.

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