ZEISS ZEN Connect

Overlay and Organize Images From Any Source to
Connect Your Multimodal Data in Materials Research

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Imagine the possibilities if you could combine multiple perspectives of your sample across scales and imaging modalities. It's easy now, using the ZEN Connect software module to bring all of your imaging technologies together – ZEISS or third party – to answer your scientific questions.

Simply acquire an overview image of your large sample on a low magnification system, then move to your confocal or electron microscope and align. Just once. You're now set to use the overview image for navigation and all subsequent images will automatically be shown in context. Or you can simply use ZEN Connect to align and overlay images from any source.

Your multimodal data is saved in well-organized projects with intuitive image labels. ZEN Connect always shows your data in context – you get unique insights, gain efficiency and save time.

▶ Click here to view this video
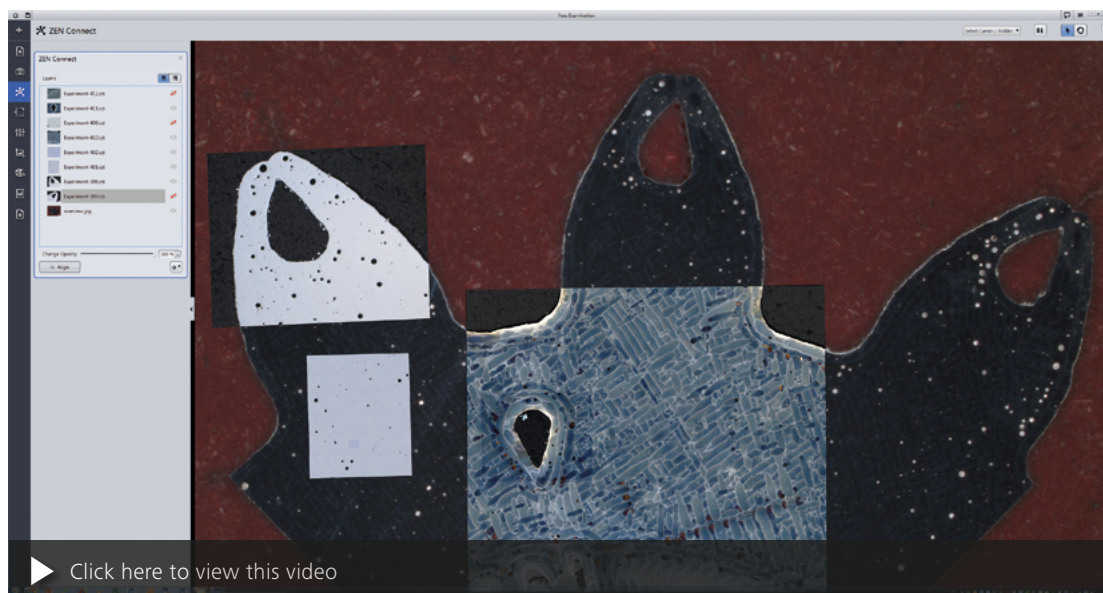
Take a look at a typical workflow done with ZEISS ZEN Connect on an additively manufactured gear wheel. Imaged on ZEISS Axio Zoom for overview and ZEISS Axio Imager for higher resolution. All images are aligned and well-structured in one ZEISS ZEN Connect project. Courtesy of T. Schubert, Aalen University, Germany.

Simpler. More Intelligent. More Integrated.

### Overlay and Align All Your Images

ZEN Connect is open to all your images: you can load complex multidimensional images as easily as simple overview images from your mobile phone. It makes no difference whether your imaging technology is from ZEISS or from third parties. All image data can be aligned and shown in context. So long as your external images adhere to the well-established Bio-Formats standard, ZEN Connect will even keep their metadata.

Acquire Overview Images for Easy Navigation

Image your sample with a ZEISS stereo microscope or any other low magnification system. Then move to your high-resolution system of choice. With ZEN Connect you only need to align it once, then use the overview image to navigate and find your regions of interest (ROIs). All subsequent high-resolution images will be shown in context as you zoom in and out across the borders of resolution domains and imaging technologies. A simple click on the overview image brings your stage to the right position to examine or re-evaluate any of your ROIs.

Smart Data Management

All the images you acquire with ZEN Connect are saved in well-structured database projects – complete with an intuitive label attached automatically to each image file. You'll always stay on top of things – during your experiments as well as months afterwards when analyzing your work. It's easy to find all your images and their connected datasets. You can even search for microscope type and imaging parameters with the new filter function.
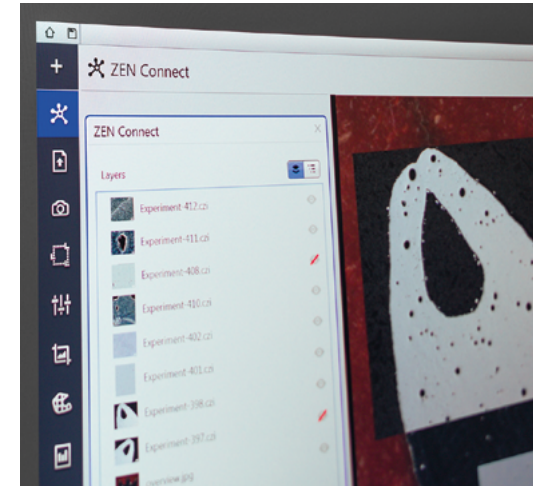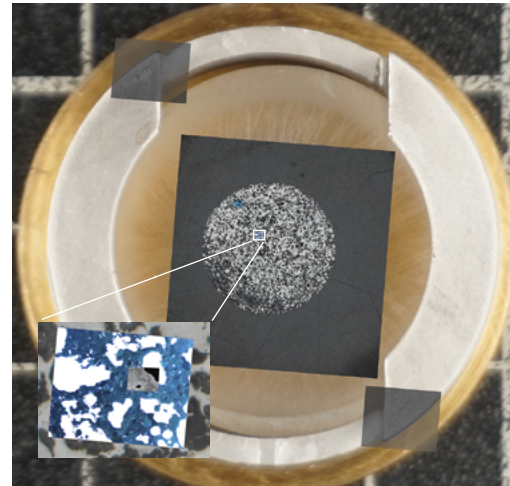
Your Insight into the Technology Behind It

**Connect Your Microscopes and Data**

Use the workflow of ZEN Connect to get from a quick overview image in a light microscope to advanced imaging with a high resolution system from ZEISS. Seeing all multimodal data in context, you'll save time and gain unique insights into your sample.

ZEISS ZEN Connect workflow illustrated for a permanent magnet material sample. An overview image was acquired on ZEISS Axio Imager (Step 1) and organized in a ZEISS ZEN Connect project (Step 2). More images using suitable contrast methods were added. Specimen and data were transferred to ZEISS Sigma 300 VP and aligned (Step 3). The existing data was used to relocate ROIs and guide the acquisition of high-resolution images (Step 4). All data is shown and stored in context throughout the workflow. Courtesy of T. Schubert, Aalen University, Germany.
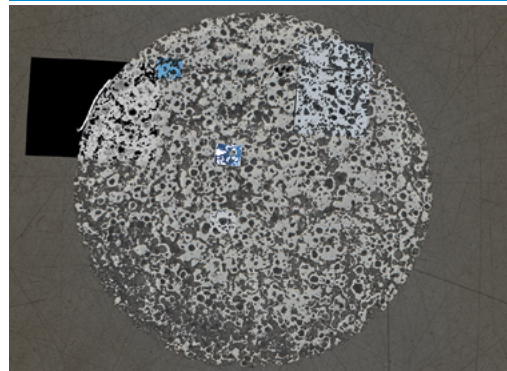
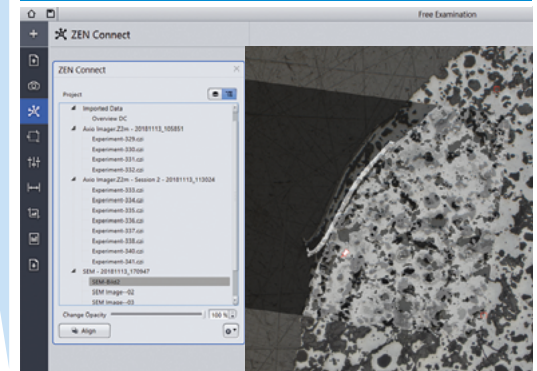**1.** Use your favorite low magnification system to acquire large fields of view.
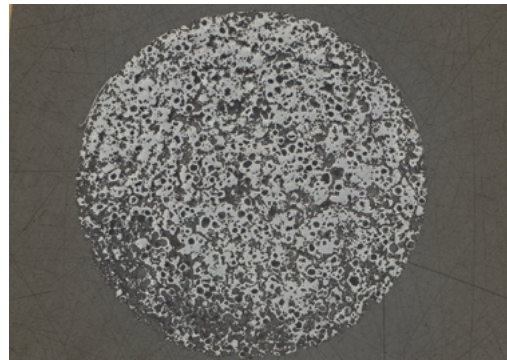
2. ZEN Connect organizes your images in a well-defined project.
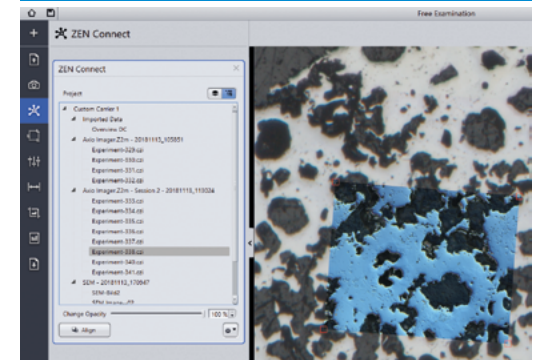
4. Use the overview image to navigate and observe your high-resolution data in context.

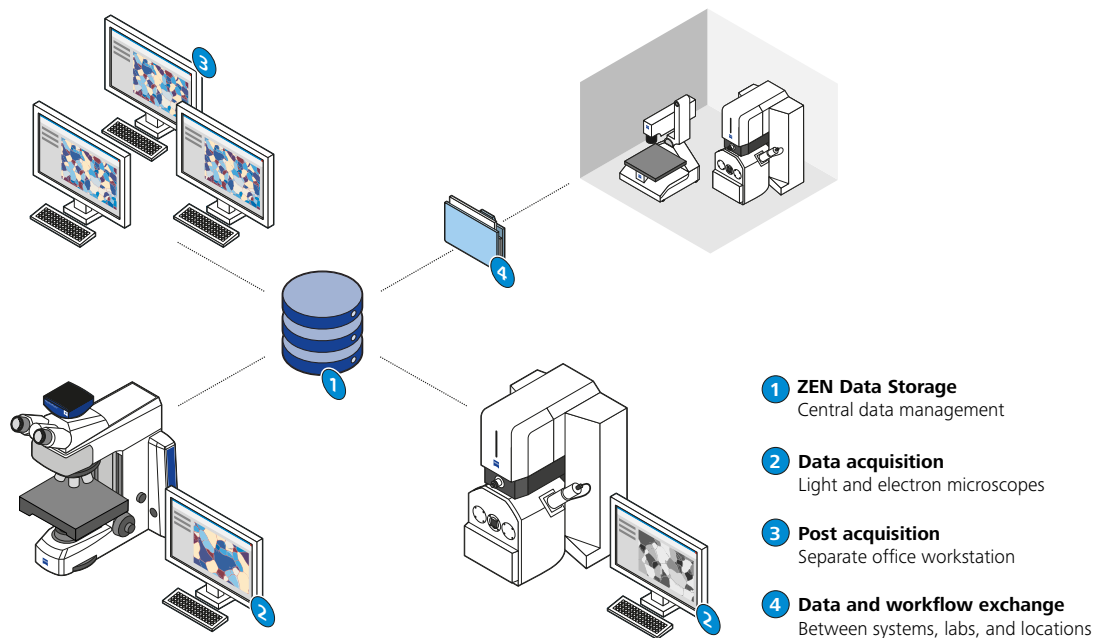**3.** Align your high-resolution system to the overview image.

Expand Your Possibilities

ZEN Data Storage for Central Data Management in the Connected Laboratory

As digitization continues to improve microscopic investigations, you're facing an ever-growing mass of images and data that needs to be managed, all the more so in multi-user laboratories. ZEN Data Storage enables you to separate image and data acquisition from postacquisition works, making everyone in the lab work more efficiently in a number of ways:

1. **ZEN Data Storage**
   Central data management

2. **Data acquisition**
   Light and electron microscopes

3. **Post acquisition**
   Separate office workstation

4. **Data and workflow exchange**
   Between systems, labs, and locations

- Experts and non-experts alike can share instrument presets, workflows, data and reports with ease.
- Access to all data from different systems is a given – from different locations, too.
- Your analyses are quality assured and reproducible.
- With effortless correlation of data from different microscopes, you can perform multi-modal workflows and gain maximum information from your samples.
- You'll also help your IT department implement security and backups.

Since ZEN Data Storage is part of our ZEN core software suite, it is compatible with all ZEISS microscopes

Expand Your Possibilities

**Correlative Microscopy
with Shuttle & Find**

The Shuttle & Find software module allows an easy-to-use, productive workflow to overlay data from your light microscope and scanning electron microscope. By combining the optical contrast methods of the light microscope with the analytical methods of your electron microscope, you will discover information about the function, structure and chemical composition of your sample.

How it works

Using a special specimen holder with three fiducial markers, a coordinate system is generated within seconds. Use the light microscope to define interesting regions in your sample. Then relocate the defined regions in the electron microscope where you will be able to improve the resolution by several orders of magnitude. Now you can continue examining the sample more extensively. Finally, use the Shuttle & Find software to correlate the images taken by the different microscopical techniques.
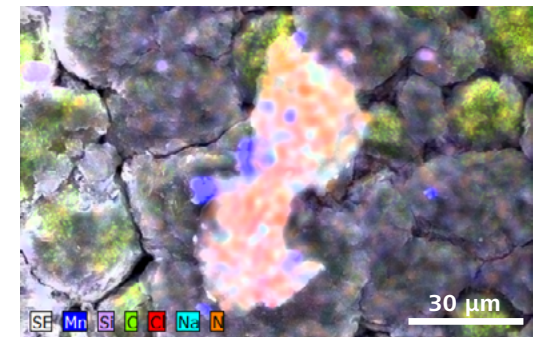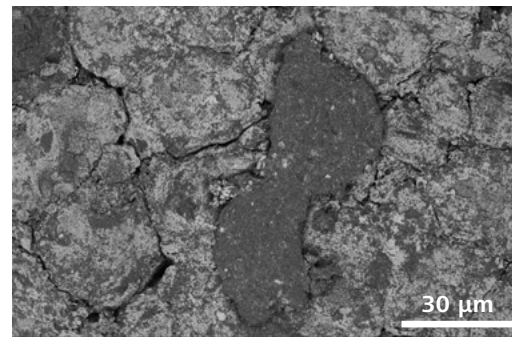

Lithium Ion battery. Light microscope image (left). SEM image (center). Overlay of both, combined with EDS analysis (right).

Tailored Precisely to Your Applications

Materials Research in E-Mobility

The very future of e-mobility depends on gaining a better understanding of permanent magnets. ZEN Connect lets you image large regions with ZEISS Axio Imager and visualize magnetic domains with Kerr microscopy so you can determine and identify promising magnetic phases. To reveal details you will need an SEM to increase resolution from micro- to nanometer scale. Using a ZEISS FE-SEM such as Sigma 300 VP, you can draw conclusions about the correlation between the sample morphology and magnetic parameters. As a scientist, ZEN Connect enables you to analyze your data in a wider context, connecting large field-of-view images with the best possible resolution. ZEN Connect will link data to context at all times during the experiment.

Axio Imager with ZEN Connect **Sigma 300 VP with ZEN Connect**
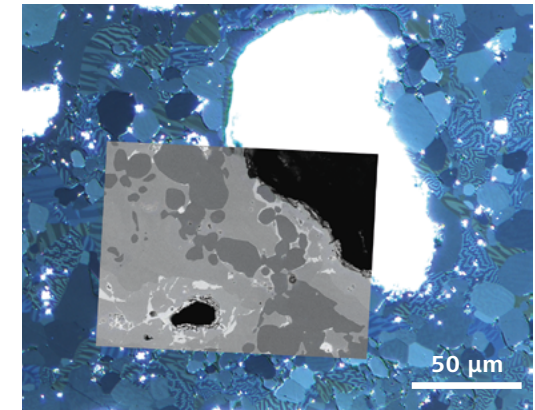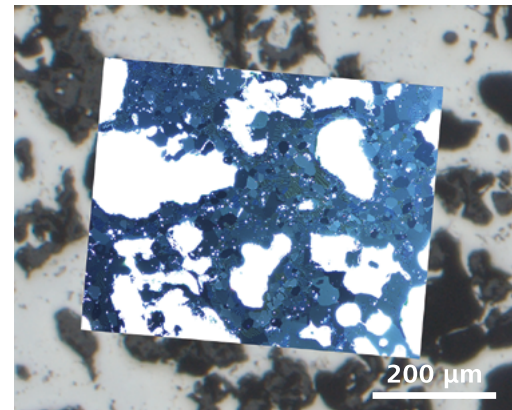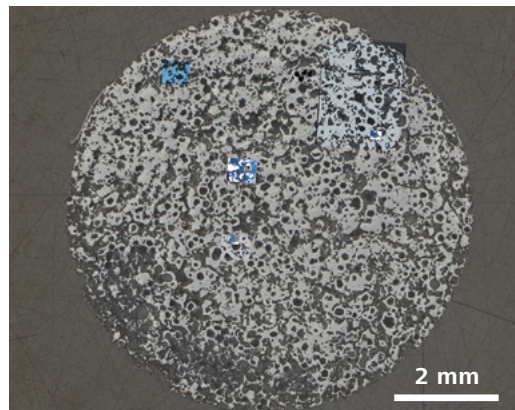
Large-scale overview, acquired with ZEISS Axio Imager (left), magnetic domain structure visualized by Kerr microscopy (center) and correlated high-resolution image acquired with ZEISS Sigma 300 VP (right). Courtesy of T. Schubert, Aalen University, Germany.

Tailored Precisely to Your Applications

Materials Research on Inclusions in Calcium-treated Steel

Calcium treatment prevents detrimental manganese sulfide (MnS) inclusions from forming in steel. These inclusions can elongate on rolling and cause anisotropy of the steel. When you modify MnS inclusions to form much harder calcium sulfide (CaS) inclusions, they will stay globular and help maintain the isotropy of the steel.

Using a widefield light microscope such as ZEISS Axio Observer, you can stitch images together into one large-scale overview image of the whole sample. This allows you to identify and screen large quantities of inclusions quickly. Subsequently, in your correlative workflow you will want to move from overview to detail.

Simply move to an SEM – for example, ZEISS GeminiSEM 500 or ZEISS Crossbeam 550 – for high resolution imagery. Then, relocate the region of interest with ZEN Connect to select specific inclusions for EDS analyses and investigate in detail how these inclusions are structured.

Axio Observer 7 with ZEN Connect

Crossbeam 550 with ZEN Connect
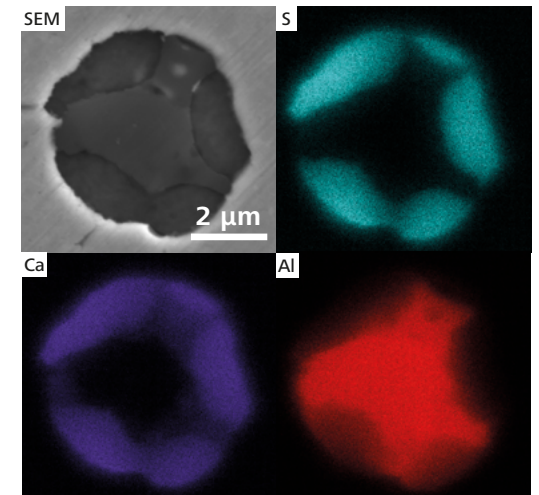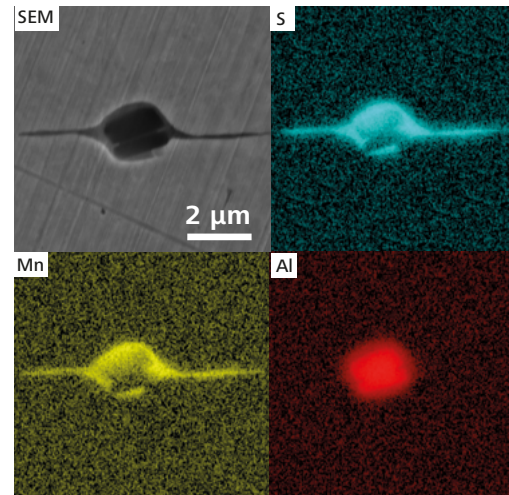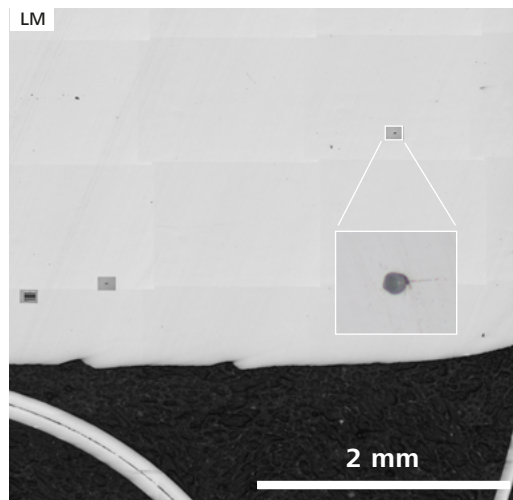
First sample, without Ca treatment: Sample Overview and detail of one inclusion (inset) acquired by ZEISS Axio Observer (left); Higher magnification SEM image (ZEISS Crossbeam 550) and EDS maps of an elongated MnS inclusion (center). Second sample with Ca treatment SEM image and EDS maps of a globular CaS inclusion (right) Courtesy of J. Russell, Swansea University, UK.
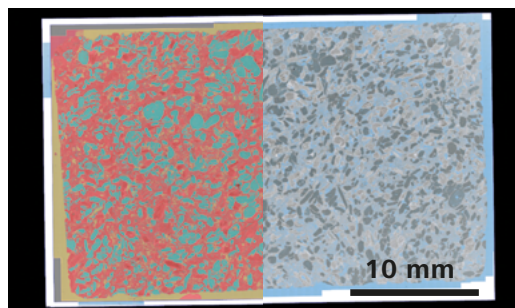
Tailored Precisely to Your Applications

Materials Research in Oil Recovery, Nuclear Waste Disposal, and Carbon Capture and Storage

The better you understand the pore structures exhibited by carbonate rocks, the better you will be able to characterize flow, reaction and transport in these systems: this becomes crucial during oil recovery, carbon capture and storage, and even nuclear waste disposal. These systems, however, typically exhibit pore structures across a wide range of length scales as well as strong structural heterogeneity.

To understand and characterize this heterogeneity, you can first image a large area by using automated light microscopy — for example, with either an automated ZEISS Axio Imager or ZEISS Axio Scan.Z1.
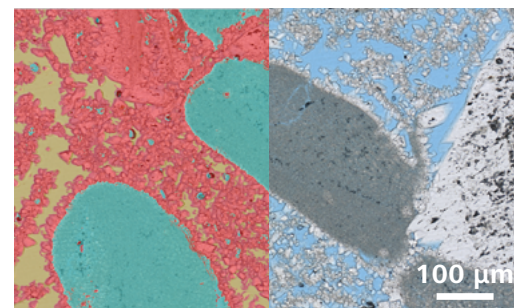
Then import the image into ZEISS ZEN Intellesis for full classification of the macro-structure, using variations in color, texture and intensity to identify macro-pores, solid rock grains and micro-porous grains.

These can now be used to identify regions of interest for high resolution field emission scanning electron microscopy (FE-SEM) for example on your ZEISS Sigma 300 or ZEISS GeminiSEM 300. You will see variations in local nanometer-scaled pore structure, viewed in the context of macroscopic heterogeneity.

ZEN Connect gives both scientists and engineers the freedom to examine structures across a range of length scales, diving deep into high resolution structure without losing information about its macroscopic heterogeneity.

Axio Scan.Z1   **GeminiSEM 300**

Correlative overlay of high resolution light microscopy data and nano-scale electron microscopy data.

10 mm

Overlay of macroscopic segmentation (left) and automated light microscopy image (right) showing the macroporosity and microporous grains.

100 µm

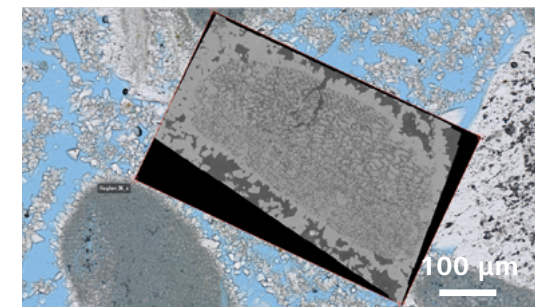*Overlay of segmented (left) high resolution light microscopy data (right) showing the pore structure in more detail.*

10 µm
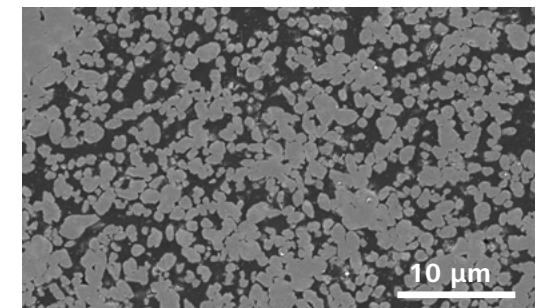
High resolution nanometer-scale electron microscope data

Your Flexible Choice of Components

Light Microscopes:

Axio Imager, Axio Observer, SteREO Discovery,
Axio Zoom, Axioscope, LSM 800 MAT, Axio Scan

Electron Microscopes:

EVO, Sigma, GeminiSEM, Crossbeam

Software:

- ZEN core or ZEN (blue edition)
- SmartSEM
- Atlas 5

Optional:

- Specimen holder CorrMic Materials Science
- ZEN Shuttle & Find
- ZEN Data Storage

Technical Specifications

Module	Functionality	Specification
ZEN Connect Entry	Correlative workspace	■ Correlative Workspace: zoom in from the full macroscopic view of your sample down to nanoscale details. ■ Combine data from any image source in ZEN imaging software. ■ A comprehensive, sample-centric correlative environment handles multiscale and multimodal images. ■ View multiple layers with adjustable transparency. ■ Multiresolution imagery ■ Manual alignment of images allows correction of xy-shift, rotation, re-scaling, shearing and mirroring.
	Data management	■ Automatic file labeling ■ Project-based file architecture
ZEN Connect Advanced*	Correlative workspace	■ Correlative Workspace: zoom in from the full macroscopic view of your sample down to nanoscale details. ■ Import and combine data from any image source in ZEN imaging software. ■ A comprehensive, sample-centric correlative environment handles multiscale and multimodal images. ■ View multiple layers with transparency including display of current stage position and field of view. ■ Multiresolution imagery ■ Manual alignment of images allows correction of xy-shift, rotation, re-scaling, shearing and mirroring. ■ Efficient stage navigation and correlation of images
	Data management	■ Import any microscope image including the metadata as supported by Bio-Formats (A list of supported formats is at: https://www.openmicroscopy.org/bio-formats/) ■ Automatic file labeling ■ Project-based file architecture ■ Provides a project-based data storage ■ Data storage filter search functionality using metadata (ZEN (blue edition) only)
	Project export	■ Export of merged images with different resolutions ■ Supported formats: CZI, TIF, JPG, BMP, RAW

Compatibilities	Specification
Software compatibility	■ Light microscopes: ZEN core 2.6 or higher, ZEN 2.5 (blue edition) or higher ■ Electron microscopes: ZEN core 2.6 or higher, ZEN 2.5 SEM or higher, SmartSEM 6.5 with API 5.4 or higher
Hardware compatibility	■ Light microscopes: Axio Imager M2m/Z2m, Axio Imager Vario, Axio Observer 3/5/7, SteREO Discovery.V12/V20, Axio Zoom.V16, Axioscope 7, LSM 800 MAT, Axio Scan.Z1 ■ Electron microscopes: EVO 10/15/25, Sigma300/500, GeminiSEM 300/450/500, Crossbeam 340/550

Optional Accessories
■ Software: ZEN Shuttle & Find, ZEN Data Storage ■ Hardware: Correlative sample holders, light- and electron microscope high precision stage, high-end workstation (recommended)

*Requires ZEN Connect Entry

Technical Specifications

Availability of Correlative Software Modules including Image Acquisition

Microscope Technology	Microscope	ZEN Connect	ZEN Shuttle & Find	Atlas 5
Widefield Microscopy	Smartzoom 5	–	●	–
	Axio Imager M2m / Z2m	●	●	–
	Axio Imager Vario	●	●	–
	Axio Observer 3 / 5 / 7	●	●	–
	SteREO Discovery.V12 / V20	●	●	–
	Axio Zoom.V16	●	●	–
	Axioscope 7	●	●	–
	Smartproof 5	–	–	–
Confocal Laser Scanning Microscopy	LSM 800 MAT	●	●	–
Automated Widefield Microscopy	Axio Scan.Z1	●	–	–
Electron Microscopy	EVO 10 / 15 / 25	●	●	●
	Sigma 300 / 500	●	●	●
	GeminiSEM 300 / 450 / 500	●	●	●
	Crossbeam 340 / 550	●	●	●
	MultiSEM 505 / 506	–	●	–
Ion Microscopy	ORION Nanofab	–	●	–
X-ray Microscopy	Xradia Context	–	–	–
	Xradia 410 / 510 / 610 / 620 Versa	–	–	–
	Xradia 800 / 810 Ultra	–	–	–

● available

– not available

Technical Specifications

Feature Comparison Correlative Microscopy Software

Microscope Technology	ZEN Connect (Advanced)	ZEN Shuttle & Find	Atlas 5
Semi-Automatic Calibration with Calibration Markers and Calibration Wizard	–	●	●
Automatic Relocation (After Calibration)	●	●	●
Navigation	●	● (restricted to one image)	●
Zoomable Sample-Centric Workspace View	●	–	●
Context Image (Overview, Multi-Modal, Multi-Resolution)	●	–	●
Project-Based File Architecture	●	–	●
Database Storage Functionality (Local and Remote)	●	–	● (local only)
Project List with Filter and Search Functionality	●	–	–
Use Of Ome Bio-Formats Metadata	●	–	–
Offline Version	●	–	●
Image Alignment	● (Scale, rotation, translation, shear, mirror)	● (Scale, rotation, translation, shear)	● (Scale, rotation, translation, shear, mirror)
Project Export	●	–	●
Open Platform	●	–	●
Tile Image Acquisition	only on LM via Tiles&Position module	–	●
Automatic Image Acquisition	–	–	●
Availability for ZEISS Microscopes	Widefield, LSM, SEM, Crossbeam	Widefield, LSM, SEM, Crossbeam, MultiSEM, HIM	SEM, Crossbeam

● included

– not available

Count on Service in the True Sense of the Word

Because the 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 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 ZEISS Protect Service Agreement lets you budget for operating costs, all the while reducing costly downtime and achieving the best results through the improved performance of your system. Choose from service agreements 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 service on-demand also brings you distinct advantages. ZEISS service staff will analyze issues at hand and resolve them – whether using remote maintenance software or working on site.

Enhance Your Microscope System.

Your 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.

Profit from the optimized performance of your microscope system with services from ZEISS – now and for years to come.

>> www.zeiss.com/microservice

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