

Axia ChemiSEM Scanning Electron Microscope

Instant fusion of chemistry and imaging

The Thermo Scientific™ Axia™ ChemiSEM™ Scanning Electron Microscope is the next generation of SEM. Always ready to image and with live quantitative chemical mapping, the system is the first choice for rapid analysis—even for users new to scanning electron microscopy.

The Axia ChemiSEM System is a reimagining of the SEM–EDS workflow. It introduces a new way of acquiring, processing, and presenting the compositional information of a sample. Unlike traditional EDS analyses, the Axia ChemiSEM System uses the secondary and backscatter electron signals to accelerate the EDS analysis, resulting in a faster time to data and results with less noise. The system introduces a streamlined implementation for both hardware and software, providing real-time chemical analysis. Imaging and chemical analysis of samples has never been easier, faster, or more accurate.

Live quantitative elemental mapping

The Axia ChemiSEM System generates fully quantitative, element X-ray maps, eliminating the artifacts associated with traditional gross count mapping such as peak overlaps and background variation. A proprietary shadow detection algorithm assists in providing information only from regions where X-rays are detected, while optional DCFI-based drift correction ensures the image and analytical data are always sharp. Reliable results are a reality for operators of all experience levels.

ChemiPhase phase analysis

ChemiPhase uses a big data approach to detect all statistically significant spectra within the datacube. It provides a simple probability that each pixel belongs to each detected significant spectrum. This makes interpretation of complex samples much more straightforward and intuitive because each pixel can only belong to a single phase.

Key Benefits

Live compositional information: Performs EDS by acquiring multiple signals simultaneously, detecting the morphology and elemental makeup of a sample in real time

Always ready to image: Lets you stay focused on data collection

Improved time to data: Offers several imaging and scanning strategies to optimize image acquisition and increase throughput

Flexible stage: Provides large sample capacity with a door that provides access to the entire chamber, as well as a stage with a capacity of 10 kg

Excellent imaging performance: Offers optional low-vacuum mode and charge-mitigation using beam deceleration mode



ChemiPhase is a comprehensive, unbiased statistical engine. This avoids problems with traditional methods, which often yield erroneous results if unexpected elements are missed due to overlapping peaks or insufficient intensities. Traditional phase determination is highly dependent on assumptions about the sample.

Easy to get started

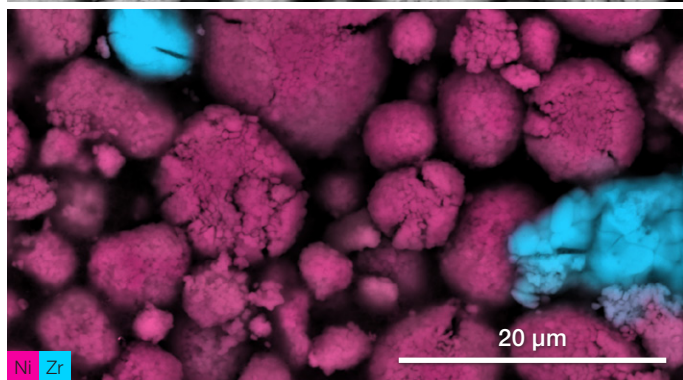
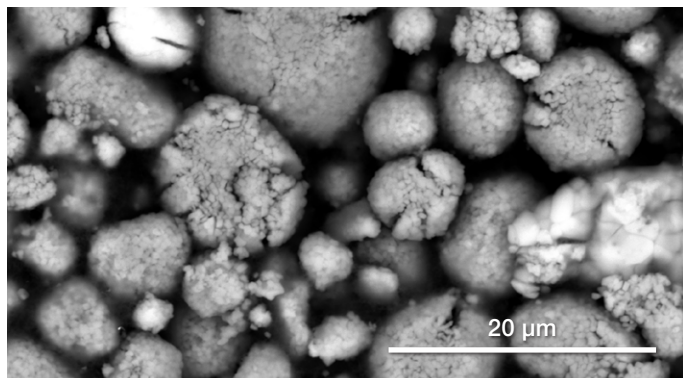
The ChemiSEM System incorporates unique column technology, enabling sample-focused data collection. A novel user interface with integrated user guidance seamlessly blends SEM and EDS modalities, instantly alerting you to areas of interest based on chemistry. The integrated EDS system automatically adjusts to changes in working distance, accelerating voltage, beam current, and magnification, freeing you to focus on the task at hand. The system enables high sample throughput, easy analysis, and better data collection.

Flexible sample loading

The Axia ChemiSEM System offers new levels of robustness and flexibility. It has a large sample capacity and a design that provides easy access to the entire chamber. The system accommodates the very high weight of up to 10 kg, saving time cutting samples and reducing time-consuming sample preparation.

Excellent imaging performance

The Axia ChemiSEM System offers remarkable all-round performance for characterization of the widest range of materials. It includes a full detector suite for SE, BSE, and EDS data collection. When configured with the optional low-vacuum mode, the system includes a LoVac SE as standard, with the ability to adjust the pressure up to 150 Pa. The low-vacuum mode is ideal for analyzing non-conductive samples, as it enables charge-free imaging, with an increase in the material contrast, allowing the use of higher beam currents to perform faster chemical analyses.



ChemiSEM image of an NCM battery electrode. The contribution of the EDS information given by ChemiSEM Technology highlights the presence of Zr contaminants in the matrix of the electrode. This would have otherwise gone unnoticed, as the compositional contrast in the CBS image in this case is insufficient to see the presence of unknown elements.

Advanced software options

The Axia ChemiSEM System can be configured with a variety of software options for full system automation. Thermo Scientific AutoScript™ Software allows for customized workflow development, interfacing directly with Python 3.x tools. Thermo Scientific Maps™ Software enables automated large-area analysis with tiling and stitching for correlative workflows. Thermo Scientific TopoMaps Software enables image colorization, image analysis, and 3D surface reconstruction. Automated particle analysis and classification can be performed based on our Thermo Scientific Perception Software. Full offline EDS data analysis is available via Thermo Scientific ChemiView Software to free up the system for data acquisition.

Flexible detector configuration

Optional detection technology includes a robust and easy-to-use RGB cathodoluminescence detector that provides more information than panchromatic CL systems, making it particularly useful for mineral identification. Optional EBSD provides full structural information and can be operated simultaneously with the TrueSight EDS detector for a complete analytical picture.



Easy maintenance

Source exchange in the Axia ChemiSEM System can be easily completed by users of any experience level in just a few minutes thanks to the automated alignment functions. Every aspect of the system has been optimized to achieve maximum uptime and ease of service. And to ensure that the system's software remains up to date, the MyMicroscope application offers automatic updates.

Technical highlights

Electron optics

- High-performance thermal emission SEM column with tetrode source emission geometry
- Stable electronically aligned column with fixed-objective aperture for ease of operation
- Fully automatic filament exchange alignment procedure
- 45° objective lens geometry
- Through-the-lens differential pumping reduces beam skirting for the most accurate analysis and highest resolution at low beam energies in low vacuum

Electron beam resolution

- High-vacuum imaging
 - 3.0 nm @ 30 kV (SE)
 - 8.0 nm @ 3 kV (SE)
- High-vacuum imaging with beam deceleration
 - 7.0 nm @ 3 kV (BD mode (optional) + BSED)
- Low-vacuum imaging (optional)
 - 3.0 nm @ 30 kV (SE)
 - 4.0 nm @ 30 kV (BSE)
 - 10 nm @ 3 kV (SE)

Electron beam parameter space

- Beam current range: up to 2 μ A, continuously adjustable
- Accelerating voltage range: 200 V – 30 kV
- Magnification: 5 to 1,000,000 \times (Polaroid)

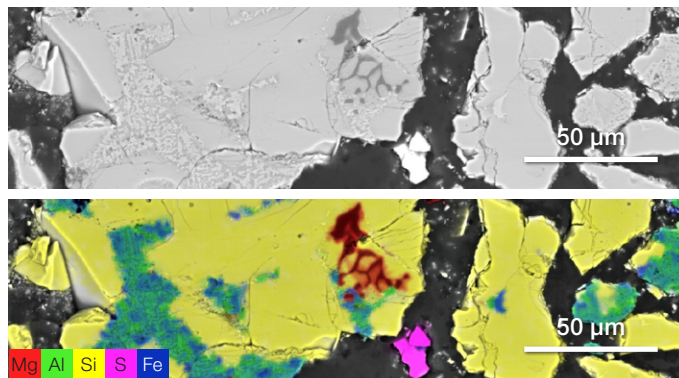
Chamber

- Inner width: 280 mm
- Analytical working distance: 10 mm
- Ports: an Axia ChemiSEM System configured with BSED and EDS offers five available ports
- EDS take-off angle: 35°
- Two opposing EDS detectors possible
- Coplanar EDS/EBSD orthogonal to the tilt axis of the stage

Detectors

Detects up to four signals simultaneously from any combination of the available detectors or detector segments:

- ETD: Everhart-Thornley SE detector
- Retractable under-the-lens backscatter detector
- TrueSight X EDS detector. Solid angle 13 mSr, resolution 129 eV, area 25 mm². Optional upgrade to TrueSight LX - 38 mSr, 132 eV, 70 mm²
- Low-vacuum SE detector (LVD), standard on LoVac model
- IR camera for viewing sample in chamber
- Thermo Scientific Nav-Cam™ Camera: color optical camera for sample navigation
- Photon Cathodoluminescence Detector for UI-integrated real color CL imaging (optional)
- Quasor II EBSD detector with Thermo Scientific Pathfinder™ X-ray Microanalysis Software (optional)
- Current measurement
- Third party detectors possible



ChemiSEM image of a cement sample, acquired in low vacuum with a pressure of 150 Pa. The image shows the distribution of different phases such as periclase (MgO) in red and ferrite in green/blue ($\text{Ca}_2(\text{Al,Fe})_2\text{O}_3$). The yellow phase is a mixture of both Ca and Si, so it is either alite (Ca_3SiO_5) or belite (Ca_2SiO_4). The image also shows the presence of an unexpected contaminant (in pink), which is sulfur-rich.

Vacuum system

- TMP, 1 \times PVP
- Patented through-the-lens differential pumping
- Evacuation time: ≤ 2 minutes to high vacuum (requires nitrogen venting) and ≤ 4.5 minutes to low vacuum (optional)

Sample holders

- Standard multi-sample SEM holder uniquely mounts directly onto the stage, hosts up to 7 standard stubs (\varnothing 12 mm), and does not require tools to mount a sample
- Single stub holder

Stage

- Type: 5-axis motorized
- XY: 120 \times 120 mm
- Motorized Z: 55 mm
- Rotation: $n \times 360^\circ$
- Tilt: $-15^\circ / +90^\circ$
- Max. sample height:
 - Clearance 72 mm to analytical working distance (10 mm), no sample holder
 - Clearance 128 mm to analytical working distance (10 mm) with ZTR axes removed
- Max. sample weight:
 - Up to 500 g XYZTR
 - Up to 2 kg XYZR
 - Up to 10 kg with ZTR axes removed
- Max. sample size:
 - 138 mm diameter with full XY moves, rotation, no tilt (larger samples possible with limited stage travel or rotation)

System control

- 64-bit GUI with Windows 10, keyboard, optical mouse
- 24-inch LCD display, WUXGA 1920×1200 (second monitor optional)
- Customizable graphical user interface, with up to four simultaneously active views
- Navigation montage
- Undo / Redo functionality
- User Guidance for basic operations / applications

Image processor

- Dwell time range from 50 ns to 25 ms/pixel
- Up to 6144×4096 pixels
- File type: TIFF (8-, 16-, 24-bit), JPEG or BMP
- Single-frame or 4-view image display
- SmartSCAN (256-frame average or integration, line integration and averaging, interlaced scanning)
- DCFI (Drift Compensated Frame Integration) (optional)

Optional accessories

- Beam deceleration with stage bias -4,000 V
- Manual user interface
- Joystick
- Analysis: EDS, EBSD, CL, Raman
- Specimen current meter
- Specimen holder kit
- Acoustic enclosure for vacuum pump
- 7- or 52-pin electrical feedthrough
- Oil-free pre-vacuum pumping
- SEM start-up kit
- Software controlled 1,100°C CleanHeater stage
- Electrical probing / multi-probing stations

Optional software

- Maps Software for automatic large area acquisition using tiling and stitching; correlative work
- AutoScript 4 Software—a Python-based application programming interface
- TopoMaps for image colorization, image analysis, and 3D surface reconstruction
- Remote control software
- ChemiView software for full EDS data processing

Documentation

- Video-guided training
- Online user guidance
- Operating instructions handbook
- Online help
- Prepared for Thermo Scientific RAPID™ Service (remote diagnostic support)

Warranty and Training

- One-year warranty
- Choice of service maintenance contracts
- Choice of operation / application training contracts

Installation requirements

(Refer to preinstall guide for detailed data)

- Power:
 - Voltage 100–120 V_{AC} or 200–240 V_{AC}
 - Frequency 50 or 60 Hz
 - Consumption: <2.0 kVA for basic microscope
- Environment:
 - Temperature 17–27 °C / 63–81 °F
 - Relative humidity below 70%
 - Stray AC magnetic fields <100 nT asynchronous, <300 nT synchronous for line times, 20 ms (50 Hz mains), or 17 ms (60 Hz mains)
- Minimum door size: 0.8 m wide × 1.63 m high
- Weight: column console 405 kg
- Dry nitrogen recommended for venting
- Acoustics: <68 dBC (site survey required, as acoustics spectrum relevant)
- Active vibration isolation table (optional)

Consumables (partial list)

- Pre-centered cathodes
- Tungsten filaments
- Apertures
- Rotary pump oil

 Learn more at thermofisher.com/Axia-ChemiSEM

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