

Scios 3S FIB-SEM for materials science

Our most versatile high-performance FIB-SEM yet

The Thermo Scientific™ Scios™ 3S FIB-SEM delivers outstanding performance in sample preparation as well as subsurface and 3D characterization for a wide variety of samples, including magnetic and nonconductive materials. With innovative features designed to increase throughput, precision, and ease of use, the Scios 3S FIB-SEM meets the needs of scientists and engineers in advanced research and analysis across academic, government, and industrial research environments.

High-quality (S)TEM sample preparation

Scientists and engineers constantly face new challenges that require highly localized characterization of increasingly complex samples with ever smaller features. The latest technological innovations of the Scios 3S FIB-SEM—in combination with easy-to-use, comprehensive Thermo Scientific™ AutoTEM™ 5 Software and our application expertise—allow for fast and reliable preparation of site-specific HR-(S)TEM samples for a wide range of materials.

To achieve high-quality results, it is essential to minimize surface damage on the sample. That's why final polishing with low-energy ions is a critical step in the sample preparation workflow. The Tomahawk HT focused ion beam (FIB) column delivers both high-resolution imaging and milling at high voltages, as well as excellent low-voltage performance, to help you create high-quality TEM lamella.

Key features

Fast and easy preparation of high-quality, site-specific TEM and atom probe samples using the Tomahawk HT ion column

Ultra-high-resolution imaging using the NiCol electron column with best-in-class performance on a wide range of samples, including magnetic and nonconductive materials

Complete sample information with sharp, refined, and charge-free contrast obtained from a variety of integrated in-column and below-the-lens detectors

High-quality, multi-modal subsurface and 3D information with precise targeting of the region of interest using optional Auto Slice & View 5 Software

Fast access to subsurface information using Auto Cross Sectioning Software

Flexible configuration can be optimized to meet specific application requirements



Thermo Scientific Scios 3S FIB-SEM

Ultra-high resolution with complete sample information

The electrostatic immersion NiCol electron column provides the foundation of the system's ultra-high-resolution imaging and detection capabilities for a variety of samples, including bulky magnetic and non-conductive samples. It offers excellent nanoscale details using a wide range of working conditions, whether operating at 30 keV in STEM mode to access structural information or at lower energies to obtain charge-free, detailed information from the surface. The column also features fully automatic alignments to help you collect fast, accurate, and consistent results.

With its unique in-lens Thermo Scientific™ Trinity™ Detection Technology, the system is designed for simultaneous acquisition of angular and energy-selective SE and BSE images. It delivers fast access to detailed nanoscale information, not only with top-down imaging but also on tilted specimens or cross sections, which are the core FIB-SEM application. Optional below-the-lens detectors and an electron beam deceleration mode offer fast, easy, and simultaneous collection of all signals to reveal the smallest features in material surfaces or cross sections.

High-quality subsurface and 3D information

Cross sectioning, which makes it possible to image and analyze subsurface features in a material, is the core functionality of a FIB-SEM instrument. Thermo Scientific Auto Cross Section (AXS) Software automates both FIB preparation of cross sections and SEM imaging of the prepared sites. With a focus on ease of use and reliability, this software allows novice users to obtain high-quality results easily and helps experienced users increase throughput and optimize tool use by automating data acquisition.

Three-dimensional characterization is often required to better understand the structure and properties of a sample. The Scios 3S FIB-SEM with optional Thermo Scientific™ Auto Slice & View™ 5 Software allows for high-quality, fully automated acquisition of multi-modal 3D datasets, including, among others, simultaneous multi-detector SEM imaging for maximum material and topography contrast, energy dispersive spectroscopy (EDS) for compositional information, and electron backscatter diffraction (EBSD) for microstructural and crystallographic information. Combined with Thermo Scientific™ Avizo™ Software, it delivers a unique workflow for high-resolution, advanced 3D characterization and analysis at the nanometer scale.

Enabling real-world experiments

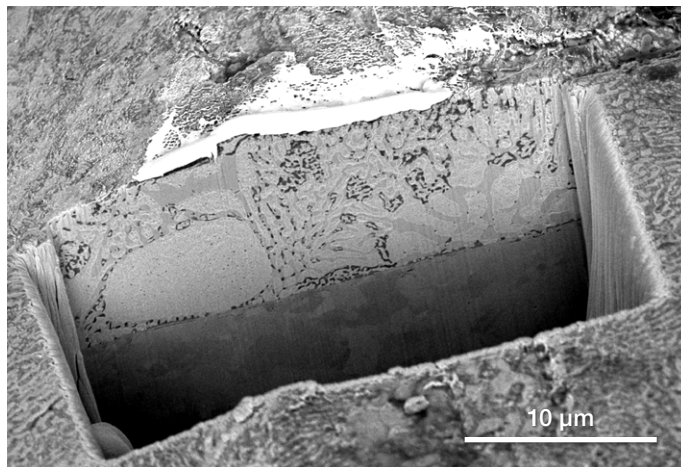
The Scios 3S FIB-SEM is a universal platform, supporting versatile applications and analyses of challenging materials science samples. It has an optional low-vacuum mode and easily accommodates a wide range of sample types and data collection.

The optional Thermo Scientific™ CleanConnect™ Sample Transfer System is used to load air-sensitive samples into the microscope chamber under a protective Ar gas environment without exposing them to air. The Scios 3S FIB-SEM can be equipped with a μ Heater, a fully integrated, extremely fast, MEMS-based heating stage for sample characterization in closer to real-world working conditions.

The optional Thermo Scientific™ MultiChem™ Gas Delivery System supports advanced chemistry. It features a compact design with integrated process control, gas mixing, and a wide selection of deposition and etching chemistries.

Productivity for all users

No matter your experience level, the Scios 3S FIB-SEM's streamlined performance can help you obtain high-quality, reproducible results faster and easier. Automated SEM and FIB alignments help ensure that the tool is always ready to acquire data. Plus, the built in User Guidance makes it easy for novice users to be productive quickly.



Cross section of a Zn-based coating used in the automotive industry to enhance corrosion resistance and extend the durability of steel components.

Specifications

Electron optics

Ultra-high resolution NICol field-emission SEM column

High-stability Schottky field emission gun provides stable, high-resolution analytical currents

- 60° dual objective lens allows for tilting of larger samples
- Automated heated apertures help ensure cleanliness and touch-free aperture exchange
- Continuous beam current control and optimized aperture angle
- Easy gun installation and maintenance—auto bakeout, auto start, no mechanical alignments
- Double stage scanning deflection
- Dual objective lens combining electromagnetic and electrostatic lenses
- Fast electron beam blanker (optional)
- User guidance and column presets
- Minimum source lifetime: 24 months

Electron beam resolution

Optimum WDs

- 0.7 nm at 30 keV STEM
- 1.4 nm at 1 keV
- 1.2 nm at 1 keV with beam deceleration (optional)

Electron beam parameter space

- Beam current range: 1 pA to 400 nA
- Landing energy range: 20 eV (optional) to 30 keV
- Accelerating voltage range: 200 V to 30 kV
- Maximum horizontal field width: 3.0 mm at 7 mm WD and 7.0 mm at 60 mm WD
- Extra wide field of view (1×) available through standard navigation montage

Ion optics

- Tomahawk HT ion column with outstanding high-current performance
- Ion beam current range: 1 pA to 100 nA
- Accelerating voltage range: 500 V to 30 kV
- Two-stage differential pumping
- Time-of-flight (TOF) correction
- 23-position aperture strip
- Max. horizontal field width: 0.9 mm at beam coincidence point.
- Minimum source lifetime: 1,500 hours

- Ion beam resolution: 2.5 nm at 30 kV using selective edge method
- Ion beam resolution: 4.0 nm at 30 kV using preferred statistical method

Detectors

- Trinity Detection System (in-lens and in-column)
 - T1 segmented lower in-lens BSE detector
 - T2 upper in-lens SE detector
 - T3 retractable in-column SE detector (optional)
 - Up to four simultaneously detected signals
- Everhart-Thornley SE Detector (ETD)
- High-performance ion conversion and electron (ICE) detector for secondary ions (SI) and electrons (SE) (optional)
- Retractable low-voltage, high-contrast, segmented solid-state backscatter electron detector (DBS) (optional)
- Retractable STEM 3+ detector with BF/DF/HAADF segments (optional)
- IR camera for viewing sample and chamber
- In-chamber Thermo Scientific™ Nav-Cam™ Sample Navigation Camera (optional)
- Integrated beam current measurement
- Retractable cathode luminescence detector (CLD), EDS, EBSD (optional)
- ToF-SIMS detector (optional)

Stage and sample

Flexible 5-axis motorized stage:

- XY range: 110 mm
- Z range: 65 mm
- Rotation: 360° (endless)
- Tilt range: –38° to +90°
- XY repeatability: 3 µm
- Max sample height: Clearance 85 mm to eucentric point
- Max sample weight at 0° tilt: 5 kg (including sample holder)
- Max sample size: 110 mm with full rotation (larger samples possible with limited rotation)
- Compucentric rotation and tilt

Vacuum system

- Complete oil-free vacuum system
- Chamber vacuum: < 6.3 × 10^{–6} mbar (after 72 hours pumping)
- Evacuation time: < 3.5 minutes
- Optional low-vacuum mode: up to 500 Pa chamber pressure

Chamber

- E- and I-beam coincidence point at analytical WD (7 mm SEM)
- Ports: 21
- Inside width: 379 mm

Sample holders

- Standard multi-purpose holder uniquely mounts directly onto the stage, hosts up to 18 standard stubs (Ø12 mm), three pre-tilted stubs, two vertical row-bar holders, and two optional pre-tilted row-bar holders (38° and 90°) and does not require tools to mount a sample
- Each optional row-bar accommodates six STEM grids
- Various wafer and custom holders available by request (optional)

System control

- 64-bit GUI with Windows 11, keyboard, optical mouse
- Up to four live images showing independent beams and/or signals; live color signal mixing
- Local language support: Check with your local Thermo Fisher Scientific sales representatives for available language packs
- 32-inch widescreen monitor 3840 × 2160 pixels (second monitor optional)
- Joystick (optional)
- Multifunctional control panel (optional)
- Remote control and imaging (optional)

Image processor

- Dwell time range from 25 ns to 25 ms/pixel
- Up to 64k × 64k pixels
- File type: TIFF (8, 16, 24-bit), BMP, or JPEG standard
- SmartSCAN System (256 frame average or integration, line integration and averaging, interlaced scanning)
- DCFI (drift-compensated frame integration)

Supporting software

- “Beam per view” graphical user interface concept with up to four simultaneously active quads
- Simultaneous FIB patterning and SEM imaging, intermittent SEM imaging and FIB patterning, integrated real-time monitor, and FIB immersion modes for advanced, real-time SEM and FIB process monitoring and endpointing
- Patterns supported: rectangles, lines, circles, cleaning cross-section, regular cross-section, polygons, bitmap, stream file, exclusion zones, arrays, and extended patterning capabilities
- Directly imported BMP file or stream file for 3D milling and deposition

- Material file support for “minimum loop time,” beam tuning and independent overlaps
- Image registration enabling sample navigation in an imported image
- Sample navigation on an optical image
- Undo and Redo functionality
- User Guidance for most common FIB-SEM operations and applications
- Drift suppression mode for FIB milling

Accessories (optional)

- GIS (gas injection system) solutions:
 - Single GIS: up to four independent units for enhanced etching or deposition
 - MultiChem Gas Delivery System: up to six chemistries on the same unit for advanced etching and deposition controls
- GIS – Beam chemistry options (optional)
 - Platinum deposition
 - Tungsten deposition
 - Carbon deposition
 - Insulator deposition II
 - Gold deposition
 - Thermo Scientific™ Enhanced Etch™ Gas Chemistry Solution (iodine, patented)
 - Insulator enhanced etch (XeF₂) – Thermo Scientific™ Delineation Etch™ Gas Chemistry Solution (patented)
 - Selective carbon mill (patented)
 - Empty crucibles for Thermo Fisher Scientific-approved user-supplied materials
 - More beam chemistries available upon request
- EasyLift System for precise in situ sample manipulation
- FIB charge neutralizer
- μHeater: high-vacuum compatible, ultra-fast heating stage up to 1200°C
 - μPolisher: Low energy ion polishing solution for localized surface cleaning
- Analysis: EDS, EBSD, WDS, CL
- Thermo Scientific™ QuickLoader™ Vacuum Technology: Load lock for fast sample exchange without breaking system vacuum
- CleanConnect System for safe sample exchange in an inert atmosphere

- Exclusive Thermo Scientific™ CryoMAT™ Kit for cryo applications
- Cryo solutions from external vendors
- Thermo Scientific Acoustic Enclosure
- CryoCleaner Decontamination Device
- Integrated plasma cleaner

Software options

- AutoTEM 5 Software for fast, easy, highly automated STEM sample preparation
- Auto Slice & View 5 Software: automated sequential mill and view to collect a series of slice images, EDS, or EBSD maps for 3D reconstruction
- Auto Cross Section Software: automated milling and imaging of cross sections
- Avizo Software for 3D reconstruction and analysis
- Thermo Scientific Maps Software for automatic acquisition of large images and optional correlative work
- Web-enabled data archive software
- Advanced image analysis software

Warranty and training

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

Documentation and support

- Online user guidance
- User operation manual
- Prepared for RAPID remote diagnostic support
- Free access to online resources

 Learn more at thermofisher.com/scios3

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