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DATASHEET

Verios 5 XHR SEM

The ultimate SEM for nanomaterial imaging

The Verios 5 XHR SEM offers sub-nanometer resolution over the full 1 keV to 30 keV energy range with excellent materials contrast. Unprecedented levels of automation and ease-of-use make this performance accessible to users of any experience level.

For materials scientists, the Thermo Scientific™ Verios 5 XHR SEM enables important new insights by extending sub-nanometer characterization to novel materials being developed today (e.g., catalyst particles, nanotubes, porosities, interfaces, biological objects and other nanoscale structures). High-resolution, high-contrast images are obtained without the need to transition to TEM or other imaging techniques. The Verios 5 XHR SEM offers all the flexibility required from research applications to accommodate large specimens such as full wafers or metallurgical samples, perform fast analysis thanks to its high current mode or work on precise prototyping applications such as electron beam-induced direct deposition of materials or lithography.

In the semiconductor and data storage markets, the Verios 5 XHR SEM's unprecedented performance significantly extends SEM capability, offering a complete solution for basic research, process and material development, process control and failure analysis. It delivers accurate, repeatable measurement results, even on extremely sensitive materials. The Verios 5 XHR SEM's features industry leading performance without compromising the high throughput, sample flexibility and ease of traditional SEM.

Key Benefits

Best nanomaterial image resolution with UC+, a monochromated electron source for sub-nanometer performance from 1-30 kV

Best contrast on sensitive materials with excellent performance down to 20 eV landing energy and high-sensitive in-column and below-the-lens detectors and signal filtering for low-dose operation and optimal contrast selection

Shortest time to nanoscale information for users with any experience level using the best-in-class Elstar electron column featuring SmartAlign and FLASH technologies

Consistent measurement results with ConstantPower Lenses, electrostatic scanning and a choice of two piezoelectric stages

Flexibility for accessories with a large chamber

Unattended SEM operation with AutoScript 4 Software, an optional Python-based application programming interface

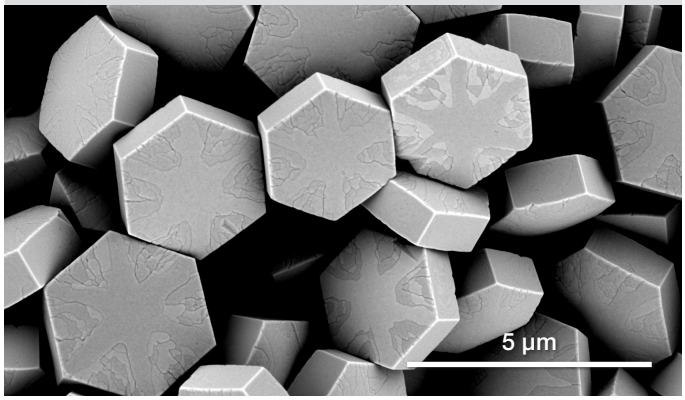


Figure 1. $NaYF_4$ crystals.

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Highest resolution, most precise materials contrast

The Verios 5 XHR SEM features an ultra-high-brightness electron source with next-generation UC+ monochromator technology to reduce the beam energy spread below 0.2 eV for beam currents up to 100 pA. This enables sub-nanometer resolution and highest surface sensitivity at low landing energies.

The innovative Thermo Scientific Elstar™ Electron Column provides the foundation of the system's unprecedented high-resolution imaging capability. It offers the best nanoscale details, using the widest 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. With its immersion mode and unique triple detection system located inside the column, the system is designed for simultaneous detector acquisition for angular and energy-selective SE and BSE imaging. Fast access to the most detailed nanoscale information is guaranteed, not only top-down, but also on tilted specimens or cross sections. Additional below-the-lens detectors and the electron beam deceleration mode ensure the fast and easy simultaneous collection of all signals to reveal the smallest features in material surfaces or cross sections. Fast, accurate and reproducible results are obtained thanks to the unique design of the Elstar Column, which includes constant power lenses for higher thermal stability and electrostatic scanning for higher deflection linearity and speed.

The Verios 5 XHR SEM introduces novel SmartAlign technology. It eliminates the need for any user alignments of the electron column, which not only minimizes the maintenance, but also increases the operator's productivity. In general, to achieve the best results on different materials, fine tuning of the beam would be required. It is typically done by the alignment sequence of focusing, lens centering and stigmation, which can be challenging and time consuming. To address this, the Verios 5 XHR SEM introduces FLASH technology, a new fine image tuning capability. With FLASH technology, you need to perform only a simple mouse-gesture in the graphical user interface, a procedure similar to focusing the image, and the instrument will introduce any necessary corrections "on-the-fly" to the stigmators and lens centering, as well as bring the image to focus. On average, FLASH technology can result in up to a 10× improvement in the time required to obtain an optimized image.

Electron optics

- Elstar extreme high-resolution field emission SEM column with:
  - Immersion magnetic objective lens
  - High-stability Schottky field emission gun to provide stable high-resolution analytical currents
  - UC+ monochromator technology
  - SmartAlign: user-alignment-free technology
- 60 degree dual objective lens with pole piece protection allows tilting larger samples
- Automated heated apertures to ensure cleanliness and touch free aperture exchange
- Electrostatic scanning for higher deflection linearity and speed
- ConstantPower™ lens technology for higher thermal stability
- Integrated Fast Beam Blanker*
- Beam deceleration with stage bias from 0 V to -4 kV
- Minimum source lifetime: 12 months



Electron beam resolution

- 0.6 nm at 30 kV STEM*
- 0.6 nm at 2-15 kV
- 0.7 nm at 1 kV
- 1.0 nm at 500 V

Electron beam parameter space

- Electron beam current range: 0.8 pA to 100 nA
- Accelerating voltage range: 350 V – 30 kV
- Landing energy range: 20 eV – 30 keV
- Maximum horizontal field width: 2.3 mm at 4 mm WD

Detectors

- Elstar in-lens SE/BSE detector (TLD-SE, TLD-BSE)
- Elstar in-column SE/BSE detector (ICD)
- Elstar in-column BSE detector (MD)
- Everhart-Thornley SE detector (ETD)
- IR camera for viewing sample/column
- Thermo Scientific Nav-Cam™ Sample Navigation Camera
- Retractable low voltage, high contrast directional solid-state backscatter electron detector (DBS)*
- Retractable STEM 3+ detector with BF/ DF/ HAADF segments*
- Integrated beam current measurement

Stage and sample

Model	Verios 5 UC	Verios 5 HP
Type	Door mounted, high precision 5-axis motorized stage, with XYR axis piezo driven	Chamber mounted, ultra stable 5 axis all piezo motorized stage.
Sample loading	Through chamber door	Through automated load lock
XY	150 × 150 mm^2	100 x 100 mm^2
Repeatability	< 1.0 µm	< 0.5 µm
Motorized Z	10 mm	≥ 20 mm
Rotation	360° (endless)	360° (endless)
Tilt	-10° / +60°	-10° / +60°
Max. sample height	55 mm to eucentric point (WD = 4 mm)	19 mm to eucentric point, including shuttle, via load lock 27.8 mm to eucentric point, via chamber door
Max. sample weight	500 g at 0° tilt, including sample holder	200 g for full motion range, including sample holder
Max. sample size	150 mm diameter with full rotation (larger samples possible with limited stage travel or rotation)	100 mm diameter with full rotation (larger samples possible with limited stage travel or rotation)

Vacuum system
- Complete oil-free vacuum system
- Chamber vacuum: < 2.6 × 10^{-6} mbar (after 24 h pumping)
- Evacuation time: < 5 minutes
- Optional CryoCleaner cold trap

Chamber
- Eucentric point and analytical working distance: 4 mm
- Ports: 21
- Inside width: 379 mm
- Integrated plasma cleaner

Sample holders
- High-resolution multi-stub mount holder
- STEM holder, included with retractable STEM3+ detector*
- Vise specimen holder to clamp irregular, large or heavy specimens to the specimen stage*
- Various wafer and custom holder(s) available by request*

System control
- 64-bit GUI with Windows 7, 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
- Two 24-inch widescreen monitors (1920×1200 pixels) for system GUI and full-screen image
- Microscope controlling and support computers seamlessly sharing one keyboard, mouse and monitors
- Joystick*
- Multifunctional control panel*
- Remote control and imaging*
- Image registration enabling sample navigation in an imported image

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

System options
- Integrated Fast Beam Blanker
- Thermo Scientific QuickLoader™ Vacuum Technology: load lock for fast sample transfer (Verios 5 UC only)*
- Joystick
- Analysis: EDS, EBSD, parallel beam WDS, CL, Raman
- Integrated 16-bit patterning engine
- Electron beam lithography modules from Raith, Nabity or other vendors*
- Thermo Scientific acoustic enclosure
- Specimen holder kit
- Acoustic enclosure for vacuum pump
- Oil-free pre-vacuum option (dual scroll pumps)
- GIS (Gas Injection System)
- Cryo SEM: Sample transfer and preparation, cryo stage
- NIST certified magnification calibration sample

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Software options

- MAPS™ for automatic large area acquisition using tiling and stitching; correlative work
- AutoScript 4, a Python-based Application Programming Interface (API)
- Pattern generation software
- TopoMaps for image colorization, image analysis and 3D surface reconstruction
- Cell Navigator™ for bit cell navigation
- Web-enabled data archive software
- Remote control software

Warranty and training

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

Documentation and support

- Online user guidance
- User operation manual
- Prepared for RAPID™ (remote diagnostic support)

* Optional

Notes

Find out more at **thermofisher.com/verios**

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