

Helios Hydra UX DualBeam

Enabling breakthrough scientific insights with DualBeam technology

The Helios 5 Hydra UX DualBeam opens new, unexplored application space in life science. It delivers unmatched capabilities for accessing large volume, Ga-free sample characterization, and 3D visualization.

The Thermo Scientific™ Helios™ 5 Hydra UX DualBeam is part of the fifth generation of the industry-leading Helios DualBeam family. It combines the new, innovative multiple ion species PFIB column with the Thermo Scientific™ Monochromated Elstar™ SEM column to provide the most advanced focused ion- and electron-beam performance. Intuitive software and an unprecedented level of automation and ease of use allow observation and analysis of relevant subsurface volumes by scientists.

The unique multiple ion species PFIB column enables the four ion species (Xe, Ar, O, N) to be used as a primary beam with a patented, automated, fast and easy switching capability. This enables scientists to explore new application space and optimize existing use cases. For example, the O+ source provides superior results in terms of data acquisition efficiency and image quality for carbon-based materials and most used resins in life science. At the same time, the PFIB column provides superior performance at all operating conditions, enabling scientists to perform the most challenging and demanding tasks at the micro scale.

The Helios 5 Hydra UX DualBeam is an all-in-one instrument without the constraint of choosing between ion columns suited for limited applications or a requirement for complex accessories to improve cut-face quality (e.g., milling curtain mitigation). The innovative Elstar electron column with high-current UC+ technology provides extreme high-resolution imaging and the highest materials contrast. The newest chemistries developed by Thermo Fisher Scientific, which are available via the optional Thermo Scientific™ MultiChem™ or GIS gas delivery systems, further enhance the milling throughput, precision, and control.

In addition to the most advanced electron and ion optics, the Helios Hydra UX DualBeam incorporates a suite of state-of-the-art software that enables simple and consistent high-resolution S/TEM as well as the highest throughput and high-quality large volume subsurface and 3D characterization, even on the most challenging samples.

Key Benefits

Largest application space with unique ion source delivering four fast, switchable ion species: Xe, Ar, O, N

Highest sample compatibility addressing the challenges of sample preparation in life science

Highest throughput and quality 3D characterization, cross-sectioning using next-generation 2.5 μ A plasma FIB column

Highest quality Ga-free sample preparation with Xe, O, or Ar PFIB's superior performance at all operating conditions

Reveal the finest details using the best-in-class Elstar electron column with high-current UC+ monochromator technology, enabling sub-nanometer performance at low energies

Access high-quality, multi-modal subsurface and 3D information with precise targeting of the region of interest using optional auto slice and view software

The most complete sample information with sharp, refined, and charge-free contrast obtained from up to six integrated in-column and below-the-lens detectors

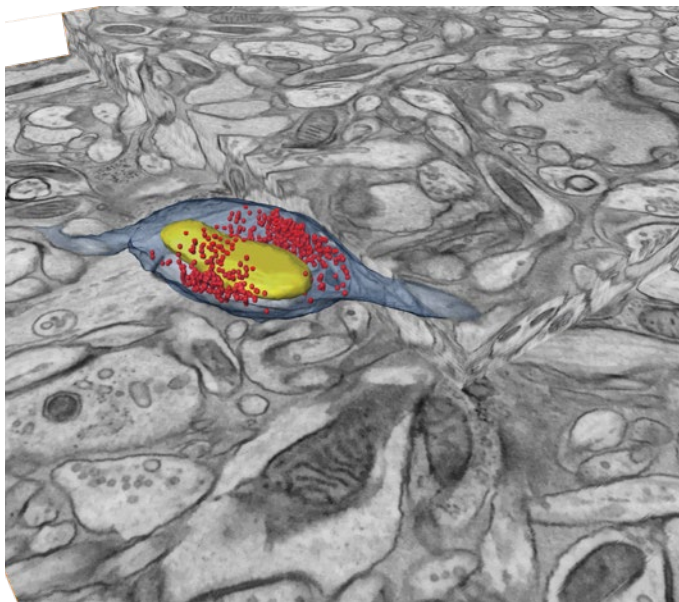
Precise sample navigation tailored to individual application needs due to the high stability and accuracy of the 150 mm piezo stage and optional in-chamber navigational camera

Most advanced capabilities for electron and ion beam-induced deposition and etching on DualBeam systems with optional MultiChem or GIS gas delivery systems

Highest sample compatibility

Our new multiple ion species PFIB column not only provides high-resolution imaging and milling at all operating conditions, it now extends the capabilities to address the challenges of complex samples.

The Helios Hydra DualBeam with a single ion source that delivers multiple ions enables unique, fast, and easy switching between the respective beams in less than 10 minutes. This technology will allow scientists to explore novel life science applications. For example, O⁺ allows for higher beam currents, higher removal rates, and obtaining smoother curtain-free surfaces for a wide variety of resin-embedded biological samples. Helios Hydra DualBeam is a versatile ion beam tool demonstrating increased sample preparation compatibility for biological samples. Further, the superior resin and sample processing compatibility allows for correlative light and electron microscopy (CLEM) studies. Thermo Scientific PFIB technology is expanding the horizons of the FIB application space to previously unavailable opportunities in life science.



3D reconstruction of a mouse hippocampal organotypic slice culture High pressure frozen after electrical stimulus of 5 ms. Freeze substituted in acetone, Os1%, UA 0.1%. Resin Epon. Focused ion beam O⁺, HFW 11.8 μm
Courtesy: Prof. Shigeki Watanabe, John Hopkins University Dr. Jing Wang, Thermo Fisher Scientific

Highest throughput, Ga-free, large-volume acquisition

This state-of-the-art instrument features a next-generation PFIB technology supporting multiple ion species as the primary beam. This enables high-throughput milling for large volumes, inaccessible by conventional Ga⁺ FIB instruments. The excellent high-current performance of the Helios Hydra UX DualBeam with optional Thermo Scientific™ Auto Slice and View™ 4 (AS&V4) software enables the highest quality, fully automated acquisition of 3D volume dataset. Experimentation with different ion species can help optimize the throughput and cut-face quality, especially compared with traditional Ga FIBs. The combination of the newest generation of PFIB technology delivers a unique solution for high-resolution 3D characterization at the nanometer scale.

High precision and resolution

The Helios Hydra UX DualBeam 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 the highest surface sensitivity, even below 1kV.

The innovative 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 to access structural information or at lower energies to obtain charge-free, detailed information from the surface. With its unique detection system located inside the column and its immersion mode, 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 fast and easy simultaneous collection of all signals to reveal the smallest features on sample surfaces or cross sections. Fast, accurate and reproducible results are obtained thanks to the Elstar column's unique design, which includes advanced auto alignments, constant power lenses for higher thermal stability, and electrostatic scanning for higher deflection linearity and speed. The Helios Hydra UX DualBeam is currently the most advanced DualBeam™ instrument.

Electron optics

- Extreme high-resolution field emission
- Elstar SEM column with:
 - Magnetic immersion objective lens
 - High-stability Schottky field emission gun to provide stable high-resolution analytical currents
 - UC+ monochromator technology
- SmartAlign: user-alignments-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
- Thermo Scientific™ 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

- At optimum WD:
 - 0.7 nm at 1 kV
 - 1.0 nm at 500 V (ICD)
- At coincident point:
 - 0.6 nm at 15 kV
 - 1.2 nm at 1 kV

Electron beam parameter space

- Electron beam current range: 0.8 pA to 100 nA at all accelerating voltages
- 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

Ion optics

High-performance PFIB column with unique inductively coupled plasma (ICP) source supporting four ion species with fast switching capability

- Ion species (primary ion beam): Xe, Ar, O, N
- Switching time <10 minutes, only software operation
- Ion beam current range: 1.5 pA to 2.5 μ A
- Accelerating voltage range: 500 V - 30 kV
- Maximum horizontal field width: 0.9 mm at beam coincidence point Xe Ion beam resolution at coincident point
- <20 nm at 30 kV using preferred statistical method
- <10 nm at 30 kV using selective edge method

Detectors

- Elstar in-lens SE/BSE detector (TLD-SE, TLD-BSE)
- Elstar in-column SE/BSE detector (ICD)*
- Everhart-Thornley SE detector (ETD)
- IR camera for viewing sample/column
- High-performance in-chamber electron and ion detector (ICE) for secondary ions (SI) and electrons (SE)
- In-chamber Thermo Scientific™ Nav-Cam™ Sample Navigation Camera*
- Retractable low-voltage, high-contrast directional solid-state backscatter electron detector (DBS)*
- Integrated beam current measurement

Stage and Sample

High-precision, five-axis motorized stage with piezo-driven XYR axis

- XY range: 150 mm
- Z range: 10 mm
- Rotation: 360° (endless)
- Tilt range: -38° to +60°
- XY repeatability: 1 μ m
- Max sample height: Clearance 55 mm to eucentric point

- Max sample weight at 0° tilt: 500 g (including sample holder)
- Max sample size: 150 mm with full rotation (larger samples possible with limited rotation)
- Compucentric rotation and tilt

Vacuum system

- Complete oil-free vacuum system
- Chamber vacuum: < 2.6 \times 10⁻⁶ mbar (after 24-hour pumping)
- Evacuation time: <5 minutes

Chamber

- E- and I-beam coincidence point at analytical WD (4 mm SEM)
- Ports: 21
- Inside width: 379 mm
- Integrated plasma cleaner

Sample holders

- Multi-purpose specimen holder with adjustable height
- Vise specimen holder to clamp irregular, large or heavy specimens to the specimen stage*
- Universal mounting base (UMB) for stable, flexible mounting of many combinations of samples and holders, such as flat and pretilt stubs and row holders for TEM grids*
- Various wafer and custom holder(s) available by request*

Image processor

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

System control

- 64-bit GUI with Windows 10, keyboard, optical mouse
- Up to four live images showing independent beams and/or signals and live color signal mixing
- Local language support: check with your local Thermo Fisher Sales representatives for available language packs
- Two 24-inch widescreen monitors (1920 \times 1200 pixels) for system GUI and full-screen image

- Microscope control and support computers seamlessly share one keyboard, mouse and monitors
- Joystick*
- Multifunctional control panel*
- Remote control and imaging*

Supporting software

- “Beam per view” graphical user interface concept with up to 4 simultaneously active quads
- Thermo Scientific™ SPI™ (simultaneous FIB patterning and SEM imaging), iSPI™ (intermittent SEM imaging and FIB patterning), iRTM™ (integrated real-time monitor), and FIB Immersion Modes for advanced, real-time SEM and FIB process monitoring and endpointing
- Patterns supported: lines, rectangles, polygons, circles, donuts, cross sections, and cleaning cross-sections
- 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 enables sample navigation in an imported image
- Sample navigation on an optical image

Accessories*

- GIS (Gas Injection System) – Solutions:
 - Single GIS: up to four independent units for enhanced etching or deposition
 - MultiChem: up to six chemistries on the same unit for advanced etching and deposition controls
- GIS – Beam chemistry options**
 - Platinum deposition
 - Tungsten deposition
 - Carbon deposition
 - Insulator deposition II
 - Gold deposition
 - Thermo Scientific™ Enhanced Etch™ System (iodine, patented)
 - Insulator enhanced etch (XeF2)
 - Thermo Scientific™ Delineation Etch™ System (patented)
 - Dx delayering
 - Empty crucibles for Thermo Fisher Scientific-approved user-supplied materials
 - More beam chemistries available upon request

- FIB charge neutralizer
- Analysis: EDS, EBSD, WDS
- Thermo Scientific™ EasyLift™ NanoManipulator for precise *in situ* sample manipulation
- Thermo Scientific™ QuickLoader™: Loadlock for fast sample exchange without breaking system vacuum
- Cryo solution for DualBeam
 - Exclusive Thermo Scientific™ CryoMAT Module for materials science cryo applications
 - Solutions from external vendors
- Thermo Scientific acoustic enclosure
- Thermo Scientific™ CryoCleaner Decontamination Device

Software options*

- Thermo Scientific™ AutoTEM™ Software: for automated S/TEM sample preparation
- Thermo Scientific™ AutoScript™ 4 Software advanced automation suite for DualBeams
- Thermo Scientific™ Maps™ Software for automatic acquisition of large images and optional correlative work
- Auto slice and view software – automated sequential mill and view to collect series of slices images, EDS, or EBSD maps for 3D reconstruction
- Amira Software – 3D reconstruction and analysis 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 Thermo Scientific™ RAPID™ Support (remote diagnostics)

* Optional

** Some beam chemistries may be available only on the MultiChem or on the Single GIS System

Find out more at thermofisher.com/helioshydra