thermo scientific

DATASHEET

Helios G4 UX DualBeam System

Enabling breakthrough innovations with DualBeam technology—faster and easier than ever before.

The Thermo Scientific Helios G4 DualBeam product family redefines the standard in sample preparation and three-dimensional characterization through the most advanced focused ion- and electronbeam performance, exclusive software, and an unprecedented level of automation and ease-of-use.

The Thermo Scientific™ Helios™ G4 UX DualBeam™ System is part of the fourth generation of the industry-leading Helios DualBeam family. It is carefully designed to meet the needs of scientists and engineers, combining the innovative Elstar™ electron column with high-current UC+ technology for extreme high-resolution imaging and the highest materials contrast with the superior Thermo Scientific Phoenix™ Focused Ion Beam (FIB) column for the fastest, easiest, and most precise high-quality sample preparation. In addition to the most advanced electron and ion optics, the Helios G4 UX DualBeam System incorporates a suite of state-of-the-art technologies that enable simple and consistent high-resolution S/TEM and Atom Probe Tomography (APT) sample preparation, as well as the highest-quality subsurface and 3D characterization, even on the most challenging samples.

Highest quality ultra-thin 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 Helios G4 UX DualBeam System, in combination with the easiest to use, comprehensive software and Thermo Fisher Scientific application expertise, allow for the fastest and easiest preparation of site-specific, ultra-thin HR-S/TEM samples for a wide range of materials. In order to achieve the highest quality results, final polishing with very low energy ions is required to minimize surface damage on the sample. Our most advanced Phoenix FIB column not only delivers high-resolution imaging and milling at high voltages, it now extends unmatched FIB performance down to accelerating voltages as low as 500V, enabling the creation of ultra-thin TEM lamella with sub-nm damage layers.

Key benefits

Fastest and easiest preparation of the highest-quality, site-specific, ultra-thin TEM and APT samples using the new Phoenix ion column with unmatched low-voltage performance

Shortest time to nanoscale information using best-in-class Elstar electron column

Reveal the finest details with the next generation UC+ monochromator technology with higher current, enabling sub-nanometer performance at low energies

The most complete sample information with sharp, refined, and charge-free contrast obtained from up to 6 integrated in-column and below-the-lens detectors

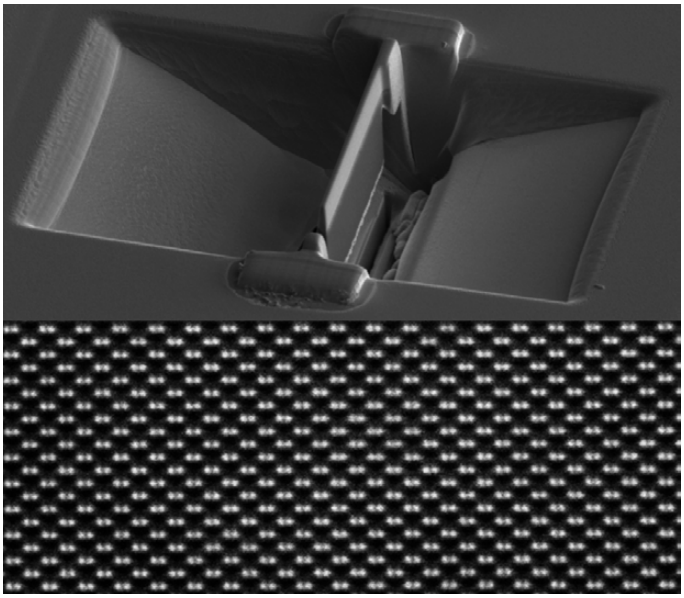
The highest quality, multi-modal subsurface and 3D information with the most precise targeting of the region of interest using optional Auto Slice & View™ 4 (AS&V4) Software

Fast, accurate, and precise milling and deposition of complex structures with critical dimensions of less than 10 nm

Precise sample navigation tailored to individual application needs thanks to the high stability and accuracy of 150 mm Piezo stage and in-chamber Thermo Scientific Nav-Cam™ Camera

Artifact-free imaging based on integrated sample cleanliness management and dedicated imaging modes such as DCFI and Thermo Scientific SmartScan™ Modes

ThermoFisher SCIENTIFIC



Highest quality ultra-thin TEM lamella produced with Helios G4 UX
(top: lamella ready for in-situ lift out, bottom: HR S/TEM image of the lamella).

Highest resolution, most precise materials contrast

The Helios G4 UX DualBeam System 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 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 a 30 keV in STEM mode to access structural information or at lower energies to obtain charge-free, detailed information from the surface. With its unique triple 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 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 column design of the Elstar, which includes advanced auto alignments, constant power lenses for higher thermal stability, and electrostatic scanning for higher deflection linearity and speed.

Highest quality subsurface and 3D information

Subsurface or three-dimensional characterization is often required to better understand the structure and properties of a sample. The Helios G4 UX DualBeam System with optional AS&V4 Software allows for the highest-quality, fully automated acquisition of multi-modal 3D datasets, including, among others, BSE imaging for maximum materials 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 solution for highest-resolution, advanced 3D characterization and analysis at the nanometer scale.

Productivity for all users

the unique column design of the Elstar streamlined performance, allowing them to obtain highest-quality, reproducible results faster and easier. It includes our easiest-to-use and most comprehensive hardware and software, including advanced auto alignments and system optimization, AS&V4 Software, and our guided TEM sample preparation workflow for unmatched ease of use and throughput. This interactive workflow automatically manages parts of the process while guiding users through the creation of high-quality samples in less than an hour. Its Phoenix FIB low-energy final polishing minimizes sample damage, producing highest quality TEM lamellas suitable for HR S/TEM, even when samples are created by novice users.

Enabling real-world experimentation

Designed for the most challenging electron microscopy tasks in materials science, the Helios G4 UX DualBeam System can be equipped with a fully integrated, extremely fast, MEMS-based heating stage for sample characterization in closer to real-world working conditions. The Helios G4 UX DualBeam System combines expanded deposition and etching capabilities, enhanced sample flexibility and control, and an extensive iFast automation suite to create the most advanced DualBeam system ever assembled—all backed by our expert application and service support.



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
- 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:
  - 0.6 nm at 30 kV STEM
  - 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
- 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
Phoenix ion column with superior high current and low voltage performance
- Ion beam current range: 0.1 pA – 65 nA
- Accelerating voltage range: 500 V – 30 kV
- 2-stage differential pumping
- Time-of-flight (TOF) correction
- 15-position aperture strip
- Max. horizontal field width: 0.7 mm at beam coincidence point
- Minimum source lifetime: 1,000 hours

Ion beam resolution at coincident point
- 4.0 nm at 30 kV using preferred statistical method
- 2.5 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)
- Elstar in-column BSE detector (MD)
- Everhart-Thornley SE detector (ETD)
- IR camera for viewing sample/column
- High performance ion conversion and electron (ICE) detector for secondary ions (SI) and electrons (SE)
- Sample navigation with in-chamber Nav-Cam 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
High precision 5-axis motorized stage, with XYR axis Piezo driven:
- XY range: 150 mm
- Z range: 10 mm
- Rotation: 360° (endless)
- Tilt range: -10° to +60°
- XY repeatability: 1 µm
- Max sample height: Clearance 55 mm to eucentric point
- Max sample weight: 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: < 2.6×10^{-6} mbar (after 24 h 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
- High-resolution multi-stub mount holder
- 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 × 4096 pixels
- File type: TIFF (8, 16, 24-bit), BMP o JPEG standard
- SmartSCAN Modes (256 frame average or integration, line integration and averaging, interlaced scanning)
- DCFI (Drift Compensated Frame Integration)

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

thermo scientific

- 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 mode for advanced, real-time SEM and FIB process monitoring and endpointing
- Patterns supported: lines, rectangles, polygons, circles, donut, cross-section and cleaning cross-section
- 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

Accessories*

- GIS (Gas Injection System) Solutions:
  - Single GIS: up to 5 independent units for enhanced etching or deposition
  - Thermo Scientific MultiChem™: up to 6 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™ (iodine, patented)
  - Insulator enhanced etch (XeF2)
  - Thermo Scientific Delineation Etch™ (patented)
  - Selective carbon mill (patented)
  - Empty crucibles for Thermo Fisher Scientific approved user supplied materials
  - More beam chemistries available upon request
- Thermo Scientific EasyLift™ for precise *in situ* sample manipulation
- FIB Charge Neutralizer
- Analysis: EDS, EBSD, WDS
- Thermo Scientific QuickLoader™: Loadlock for fast sample exchange without breaking system vacuum
- Exclusive Thermo Scientific CryoMAT™ for material science cryo applications
- Cryo solutions from external vendors
- Thermo Scientific Acoustic Enclosure
- Thermo Scientific CryoCleaner™

Software options*

- Guided TEM sample preparation workflow
- Thermo Scientific iFast advanced automation suite for DualBeam Systems
- Thermo Scientific MAPS™ Software for automatic acquisition of large images and optional correlative work
- Thermo Scientific AutoTEM™ Wizard automated sample preparation with section wizard
- Thermo Scientific NanoBuilder™ – advanced proprietary CAD-based (GDSII) solutions for FIB and beam deposition optimized nanoprototyping of complex structures
- AS&V4 Software – automated sequential mill and view to collect series of slices images, EDS or EBSD maps for 3D reconstruction
- Avizo Software for 3D reconstruction and analysis
- CAD navigation
- Web enabled data archive software
- Advanced image 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™ Service (remote diagnostic support)
- Free access to online resources

* Optional

** Some Beam Chemistries may be available only on the MultiChem or on the Single GIS

Find out more at **thermofisher.com/EM-Sales**

ThermoFisher SCIENTIFIC

For current certifications, visit thermofisher.com/certifications. © 2018 Thermo Fisher Scientific Inc. All rights reserved. All trademarks are the property of Thermo Fisher Scientific and its subsidiaries unless otherwise specified. DS0204-EN-02-2018