

Helios NanoLab G3

FEI's exclusive DualBeam — Pushing the limits of extreme high resolution characterization, nanoprototyping, and sample preparation

Combining the most recent advances in focused ion and electron beams and expanding their combined use with the third generation of the Helios NanoLab.™

The Helios NanoLab G3 family is designed to explore the nanoscale dimension beyond any limit set by its predecessors, and adjust even more closely to the needs of scientists and engineers. New standards are set for characterizing samples with extreme high resolution (XHR), preparing samples with highest quality standards and rapidly fabricating functional prototypes, quickly and easily.

The Elstar™ FESEM provides 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 unique triple detection system located inside the column and immersion mode, the system is designed for simultaneous detector acquisition for angular and energy selective SE and BSE imaging. Fast access to very precise, clear information is guaranteed, not only top-down, but also on tilted specimen or cross-sections. Additional below-the-lens detectors and a beam deceleration mode ensures that all signal is collected and no information left behind. Fast, accurate, and reproducible results are obtained thanks to Elstar's unique technologies, including advanced auto alignments, constant power lenses for higher thermal stability, and electrostatic scanning for higher deflection linearity and speed. For unsurpassed fast, precise, and reliable milling, patterning, and ion imaging, the Helios NanoLab G3 relies on FEI's latest ion column, the Tomahawk™ FIB. The Tomahawk's exceptional low-voltage performance is proven to produce the world's best quality thin samples for high resolution S/TEM or atom probe microscopy.

The Helios family now offers a broader application space and focused instrumentation. The Helios NanoLab G3 CX extends characterization with a versatile 110 mm goniometer stage with tilt capability up to 90 degrees and optional triple in-column detection. The Helios NanoLab G3 UC provides

KEY BENEFITS

Shortest time to nanoscale information using best in class Elstar Schottky FESEM high resolution, stability and automation

Sharp, refined, and charge-free contrast obtained from up to 6 integrated in-column and below-the-lens detectors

Clear imaging based on integrated sample cleanliness management and dedicated imaging modes such as SmartScan™ or DCFI

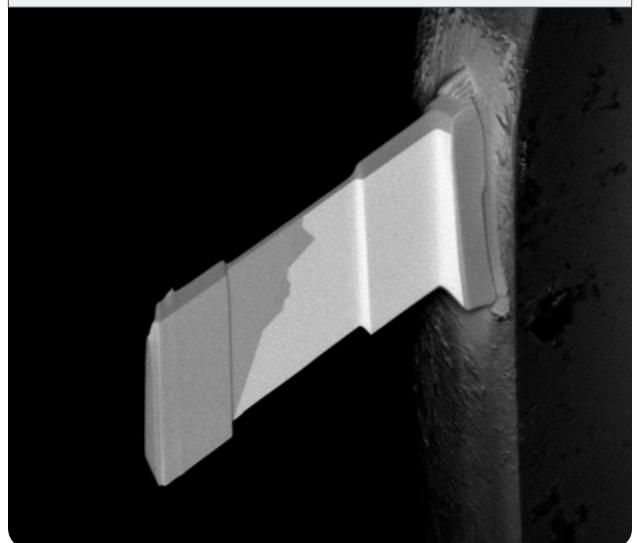
Rapidly prepare the highest quality ultra-thin and complex samples

Access high resolution multiscale, 3D and high temperature information

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

Sample management tailored to individual application needs, thanks to the high flexibility 110 mm and high stability 150 mm piezo stages

Reveal the finest details using Elstar monochromator (UC) and its sub-nanometer performance at low energies





best-in-class detection and resolution for the highest quality S/TEM samples and non-conductive materials.

Not only does it boast excellence in ion image resolution, with its integrated differential pumping and time-of-flight correction, the Helios also delivers a tighter beam and a more accurate scan profile for extremely precise work. Directly milling or depositing the most complex structures at the nanoscale is equally possible, thanks to FEI's own extensive range of beam chemistries (gas injection), 16-bit pattern generator and integrated CAD, script or library-based patterning. With the Helios NanoLab G3's highest automation, stability and robustness standards,

unattended sample preparation and 3D characterization and analysis are routinely performed, with even shorter time to the right data.

Empowered by its evolutionary xT software platform, the Helios NanoLab G3 addresses both the occasional user, with its easy-to-use yet robust and comprehensive interface, and the expert who can rely on the instrument's flexibility and extended controls for advanced SEM and FIB work. Join the Helios NanoLab and FEI FIB communities of scientists and technologists and be the next one to contribute to expanding the boundaries at the nanoscale with DualBeams.

Essential Specifications

Elstar XHR immersion lens FESEM column

- Elstar electron gun with:
 - Schottky thermal field emitter
 - Hot-swap capability
 - UC technology (monochromator) ⁽ⁱ⁾
- Landing energy range: 20 eV* - 30 keV
- 60 degree dual objective lens with pole piece protection
- Heated objective apertures
- Electrostatic scanning
- ConstantPower™ lens technology
- Beam deceleration with stage bias from 0 V to -4 kV ⁽ⁱⁱ⁾
- Integrated Fast Beam Blanker*

Tomahawk ion column

- Superior high current performance, with up to 65 nA max beam current
- Accelerating voltage range: 500 V-30 kV
- 2-stage differential pumping
- Time-of-flight (TOF) correction
- 15-position aperture strip

Source lifetime

- Electron source: 12 month lifetime
- Ion source: 1,000 hours guaranteed

Ion beam resolution @ coincident point

- 4.0 nm at 30 kV using preferred statistical method
- 2.5 nm at 30 kV using selective edge method

Maximum horizontal field width

- E-beam: 2.3 mm at beam coincident point (WD 4 mm)
- I-beam: 0.9 mm at 8 kV at beam coincidence point

Probe current

- E-beam: 0.8 pA up to 22 nA (CX); 0.8 pA up to 100 nA (UC)
- I-beam: 0.1 pA - 65 nA (15 position aperture strip)

ELECTRON BEAM RESOLUTION @ COINCIDENT POINT

	CX	UC
15 kV	0.8 nm	0.6 nm
1 kV	2.5 nm	1.2 nm

Detectors

- Elstar in-lens SE/BSE detector (TLD-SE, TLD-BSE)
- Elstar in-column SE/BSE detector (ICD) ⁽ⁱⁱ⁾
- Elstar in-column BSE detector (MD) ⁽ⁱⁱ⁾
- Everhart-Thornley SE detector (ETD)
- IR camera for viewing sample/column
- In-chamber sample navigation camera (Nav-Cam+™)*
- High performance ion conversion and electron (ICE) detector for secondary ions (SI) and electrons (SE)*
- Retractable low voltage, high contrast solid-state backscatter electron detector (DBS)*
- Retractable STEM detector with BF/DF/ HAADF segments*
- Integrated beam current measurement

ELECTRON BEAM RESOLUTION @ OPTIMUM WD

	CX	UC
30 kV (STEM*)	0.7 nm	0.6 nm
15 kV	0.8 nm	
1 kV	1.4 nm	0.7 nm
500 V (ICD)		1.0 nm

STAGE		
	CX	UC
Stage type	Flexible 5-axis motorized	High precision 5-axis motorized, with XYR axis piezo driven
XY	110 mm	150 mm
Z	65 mm	10 mm
R	n x 360° (endless)	
T	- 15° to +90°	-10° to +60°
T precision		0.1° (between 50° and 54°)
XY repeatability	3µm	1 µm
Max sample height	Clearance 85 mm to eucentric point	Clearance 55 mm to eucentric point
Max sample weight @ 0° tilt	2 kg	500 g (including sample holder)
Max sample size	150 mm with full rotation (larger samples possible with limited rotation)	
Eucentricity	Compucentric rotation and tilt	

Vacuum system

- 1 × 210 l/s TMP
- 1 × PVP (dry pump)
- 4 × IGP (total for electron column and ion column)
- Chamber vacuum: 2.6×10^{-6} mbar (after 24 h pumping)

Chamber

- E- and I-beam coincidence point at analytical WD (4 mm SEM)
- Angle between electron and ion columns: 52°
- 21 ports
- Left to right: 379 mm

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 0.025 to 25,000 µs/pixel
- Up to 6144 × 4096 pixels
- File type: TIFF (8, 16, 24-bit), BMP or JPEG standard
- Single frame or 4-quad image display
- SmartSCAN™ (256 frame average or integration, line integration and averaging, interlaced scanning) and 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
- 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*

Supporting software

- 'Beam per view' graphical user interface concept, with up to 4 simultaneously active quads
- FEI SPI™, iSPI™, iRTM™ 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
- Image registration
- Directly imported BMP file or stream file for 3D milling and deposition
- Material file support for 'minimum loop time', beam tuning and independent overlaps

Common accessories*

- GIS (Gas Injection System) – Solutions:
 - Single GIS: up to 5 independent units for enhanced etching or deposition
 - 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
 - Enhanced Etch™ (iodine, patented)
 - Insulator enhanced etch (XeF₂)
 - Delineation Etch™ (patented)
 - Selective carbon mill (patented)
 - Empty crucibles for FEI approved user supplied materials
 - More beam chemistries available upon request

- **Manipulators:**
 - EasyLift™ + Hitachi *In Situ* Lift-Out License for thin sample preparation*
 - Other manipulators available upon request
 - **FIB Charge Neutralizer***
 - **Analysis:** EDS, EBSD, WDS, Cathodoluminescence Imaging and Spectroscopy*
 - **QuickLoader™:** loadlock for fast sample transfer*
 - **Electron beam lithography:** kits from Raith, Nability or other vendors
 - **Cryo solution for DualBeam**
 - Exclusive FEI CryoMAT for material science cryo applications*
 - Solutions from external vendors
 - **FEI acoustic enclosure***
 - **Integrated plasma cleaner***
 - **FEI CryoCleaner***
- Software options***
- **AutoFIB™** package for macro and script based DualBeam automation
 - **iFast** for advanced DualBeam automation
 - **MAPS™** for automatic acquisition of large images
 - **AutoTEM™** wizard automated sample preparation with section wizard
 - **NanoBuilder™** – advanced FEI proprietary CAD based (GDSII) solutions for FIB and beam deposition optimized nanoprototyping of complex structures
- **AutoSlice and View™** – automated sequential mill and view to collect series of slice images for 3D reconstruction
 - **EBS3™** – automated sequential mill and EBSD map acquisition to collect series of texture or orientation maps for 3D reconstruction
 - **EDS3™** – automated sequential mill and EDS map acquisition to collect series of chemical maps for 3D reconstruction
 - 3D reconstruction software
 - Knights Technology CAD navigation
 - Web enabled data archive software
 - Image analysis software
- Consumables (partial list)**
- Replacement Ga-ion source
 - Replacement Schottky electron source module
 - Aperture strips for electron and ion columns
 - GIS refill kit
- Warranty and training**
- 1 year warranty
 - Choice of service maintenance contracts
 - Choice of operation/application training contracts
- Installation requirements**
(refer to preinstall guide for detailed data)
- Power:
 - voltage 100–240 V AC,
 - frequency 50 or 60 Hz (± 1%)
 - Power consumption: < 3.0 kVA for basic microscope
- Earth resistance: < 0.1 Ω
 - Environment:
 - temperature 20°C ± 3 °C
 - relative humidity below 80 % RH, 20°C
 - stray AC magnetic fields: < 200 nT a-synchronous, < 600 nT synchronous for line times > 20 ms (50 Hz mains) or > 17 ms (60 Hz mains)
 - Minimum door width × height: 0.9 m × 2.0 m
 - Weight: column console 950 kg
 - Dry nitrogen
 - Compressed air 4 to 6 bars; clean, dry and oil-free
 - System chiller
 - Acoustics guidelines: site survey required as acoustic spectrum relevant. System acoustic enclosure available as option.
 - Vibration isolation table available as option
- Documentation and support**
- On-line help
 - Prepared for RAPID™ (remote diagnostic support)
 - Free membership in the FEI FIB UserClub

Specifications are subject to change.

* Optional

** Some Beam Chemistries may be available

only on the MultiChem or on the Single GIS

(i) Available on Helios NanoLab G3 UC only

(ii) Standard on Helios NanoLab G3 UC,

optional on Helios NanoLab G3 CX

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