FEI™

Helios NanoLab 460HP

Advanced DualBeam for high productivity, high quality TEM sample preparation

The Helios NanoLab™ series is the world's most advanced DualBeam™ platform for imaging, analysis, and TEM sample preparation in semiconductor failure analysis, process development and process control laboratories.

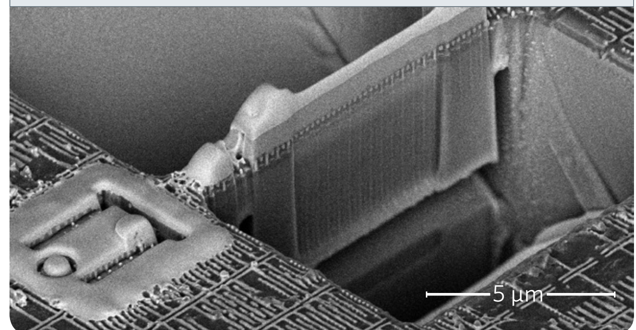
All Helios NanoLab 460 series systems combine the innovative Elstar™ with UC technology electron column for high-resolution and high materials contrast imaging with the high-performance Tomahawk ion column for fast, precise sample preparation. The columns and flexible chamber have been optimized to provide the best combined performance available in any DualBeam (FIB/SEM) system.

The Helios NanoLab 460HP is ideally suited for high throughput, high quality, ultra-thin TEM lamella preparation. The Helios 460HP comes with the EasyLift EX Nanomanipulator for *in situ* sample lift-out. The EasyLift system allows operators to extract and attach lamella to a TEM grid all within the DualBeam chamber. When used in conjunction with FEI's iFast Starter Recipes designed for either *ex situ* or *in situ* inverted sample preparation, even novice operators are able to create high-quality, ultra-thin lamella with tremendous confidence. The addition of the QuickFlip shuttle facilitates inverted sample thinning to eliminate curtaining in the region of interest. iFast brings automation and consistency to the TEM sample preparation process without losing the flexibility to adapt to new processes and Failure Analysis methodologies. The combination of these unique features results in a >40% improvement in TEM lamella throughput over the Helios NanoLab 450.

Elstar electron column

The innovative Elstar electron column with UC monochromator technology, previously introduced in the Verios™ XHR SEM, provides the foundation of the systems' unprecedented high-resolution imaging capability. This translates to uncompromised SEM resolution of 0.6nm at both DualBeam coincidence and optimum working distances. Double magnetic shielding increases the systems' immunity to environmental fields. Constant power lens technology eliminates thermal instabilities caused by routine changes in lens power.

KEY BENEFITS
High-performance Elstar™ electron column with UC monochromator technology for sub-nanometer SEM image resolution and accurate endpoint detection.
Tomahawk ion column for highspeed, high-resolution milling and cross sectioning.
Low kV ion beam clean-up minimizes TEM sample damage.
Sensitive ICE detector for improved low kV ion imaging.
Five-axis piezo-driven stage with loadlock provides full coverage of 100 mm sample.
FEI's EasyLift EX Nanomanipulator enables precise, site-specific preparation of ultra-thin TEM lamellae all while promoting high user confidence and yield.
iFast Developer's Tool Kit Pro for customizable process automation and improved operator ease-of-use.
Cell Navigator for fast defect localization.
QuickFlip shuttle for simplified inverted TEM sample preparation.



↑ TLD image of a thinned TEM lamella prior to *in situ* liftout. Wide fields of view can be precisely thinned using standard iFast recipes.

Tomahawk ion column

The Tomahawk ion column combines high resolution with exceptional low voltage imaging performance. Not only does this enable excellent ion image resolution but it also provides the most precise ion milling to ensure that valuable defect information is preserved in the cross-section or TEM lamella.

A full range of beam chemistry options supports accelerated milling, selective milling, deposition and enhanced imaging with both ion and electron beams. The Tomahawk ion column's ability to maintain small beam diameter at less than 1 kV enables low-energy, grazing-incidence final clean-up to remove surface damage induced by higher-energy milling. Extensive automation permits unattended preparation of multiple site-specific S/TEM samples in a single session at a cost-per-sample competitive with conventional SEM bulk sample preparations. Optional X-ray (EDS or WDS) spectrometers offer compositional analysis in thin samples with resolution down to 30 nm.

Automated slice and view capability can acquire a sequence of cross-sectional images for reconstruction into a three-dimensional model of the cross-sectioned volume that can be viewed and virtually resectioned in any direction.

Best Overall Image

The highly efficient Mirror Detector and In-Column Detector in the Helios NanoLab 460HP come with the ability to simultaneously acquire and mix TLD-SE, MD-BSE and ICD-BSE signals to produce the best overall ultra-high resolution images. Low-loss MD-BSE provides excellent materials contrast with an improvement of up to 1.5x in Contrast-to-Noise ratio, while No-loss ICD-BSE provides materials contrast with maximum surface sensitivity.

Specifications

- Electron source
  - Schottky thermal field emitter, over 1 year lifetime
- Ion source
  - Gallium liquid metal, 1000 hours
- Landing voltage
  - 20 V – 30 kV SEM
  - 500 V – 30 kV FIB
- SEM resolution
  - Optimal WD
    0.6 nm @ 2–15 kV
    0.7 nm @ 1 kV
    1.5 nm @ 200 V with beam decleration
  - Coincident WD
    0.8 nm @ 15 kV
    1.2 nm @ 1 kV
- FIB resolution coincident WD
  - 4.0 nm @ 30 kV using preferred statistical method
  - 2.5 nm @ 30 kV using selective edge method
- EDS resolution
  - < 30 nm on thinned samples
- *In situ* TEM sample liftout
  - EasyLift EX Nanomanipulator
- Stage
  - 5 axis all piezo motorized
  - 100 mm XY motion
  - QuickFlip shuttle
  - Automated loadlock
- Sample types
  - Wafer pieces, packaged parts, TEM
  - Grids, whole wafers up to 100 mm
- Max. sample size
  - 100 mm diameter with full travel
- User interface
  - Windows® 7 GUI with integrated SEM, FIB, GIS, simultaneous patterning and imaging mode
  - Two 24-inch widescreen LCD monitors

Key Options

- Beam chemistry
  - Standard Gas Injection Systems
  - MultiChem Gas Delivery System
- Software
  - Auto Slice & View™, Knights Camelot CAD Navigation, FEI Navigator™
  - MAPS
- Hardware
  - EDS, WDS, EBSD analysis

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