

# Helios 5 FX DualBeam

## Enabling breakthrough failure analysis for advanced technology nodes

The Helios 5 Dual Beam platform continues to serve the imaging, analysis, and S/TEM sample preparation applications in the most advanced semiconductor failure analysis, process development and process control laboratories.

The Thermo Scientific™ Helios 5 FX™ DualBeam continues the Helios legacy to the fifth generation combining the innovative Elstar™ with UC+ technology electron column for high-resolution and high materials contrast imaging, in-lens S/TEM 4 for 3Å *in-situ* low kV S/TEM imaging and the superior low kV performing Phoenix™ ion column for fast, precise and sub-nm damage sample preparation. In addition to the industry leading SEM and FIB columns, the Helios 5 FX incorporates a suite of state-of-the-art technologies which enable simple and consistent sample preparation (for high resolution S/TEM imaging and/or Atom Probe microscopy) on even the most challenging samples.

### High quality imaging at all landing energies

The ultra-high brightness electron source on the Helios 5 FX System is equipped with 2nd generation UC technology (UC+) to reduce the beam energy spread below 0.2 eV for beam currents up to 100 pA. This enables sub-nanometer resolution and high surface sensitivity at low landing energies. The highly efficient Mirror Detector and In-Column Detector in the Helios 5 FX System 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.

### Shorten time to useable data

The Helios 5 FX System is the world's first DualBeam to incorporate a TEM-like CompuStage for TEM lamella sample preparation and combine it with an all new In-lens STEM 4 detector to drastically reduce the time to high quality useable data. The integrated CompuStage is independent of the bulk stage and comes with separate X, Y, Z, eucentric 180° alpha tilt and 200° beta tilt axes enabling SEM endpointing on both sides of S/TEM lamella. The accompanying S/TEM rod is compatible with standard 3 mm TEM grids and enables fast grid exchange without breaking vacuum. In addition, the system is equipped

### Key benefits

**High-performance** Elstar electron column with UC+ monochromator technology for sub-nanometer SEM and S/TEM image resolution

**Exceptional low kV** Phoenix ion beam performance enables sub-nm TEM sample preparation damage

**Sharp, refined, and charge-free** contrast obtained from up to 5 integrated in-column and below-the-lens detectors

**MultiChem Gas Delivery System** provides the most advanced capabilities for electron and ion beam induced deposition and etching on DualBeams

**EasyLift EX Nanomanipulator** enables precise, site-specific preparation of ultra-thin TEM lamellae all while promoting high user confidence and yield

**STEM 4 detector provides** outstanding resolution and contrast on thin TEM samples

**Backed by the Thermo Fisher Scientific** world class knowledge and expertise in advanced failure analysis for DualBeam applications

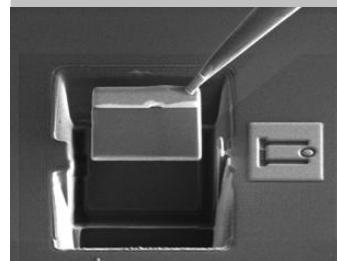


Figure 1. TEM sample preparation using the Thermo Scientific iFAST automation software package and extracted using the EasyLift Nanomanipulator.

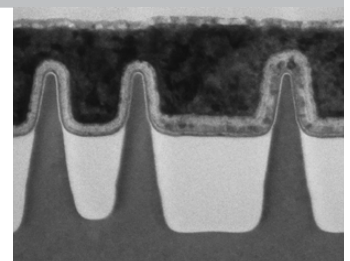


Figure 2. HRSTEM Bright Field image of a 14 nm SRAM Inverter thinned to 15 nm showing both nFET and pFET structures connected with a metal gate.

with a retractable, annular STEM 4 detector which can be used either in standard mode for real-time STEM endpointing (6Å resolution) or in the new In-lens mode for ultimate imaging performance (3Å resolution). Both modes support improved materials contrast through the use of Bright Field, Dark Field annular and HAADF segments collecting transmitted electrons simultaneously. A new STEM detector enables diffraction imaging and zone axis alignment (automated or manual), enabling highest resolution and contrast on STEM samples. Extreme high resolution, high contrast imaging of ultra-thin lamella is now possible using 30 kV electrons. Having the ability to complete failure analysis work in the DualBeam without exposing the finished sample to ambient air shortens the time to data and reduces the need for standalone S/TEM systems.

## High quality ultra-thin TEM sample preparation

Preparing high quality, ultra-thin TEM samples requires polishing the sample with very low kV ions to minimize damage to the sample. The Thermo Scientific most advanced Phoenix Focused Ion Beam (FIB) column not only delivers high resolution imaging and milling at 30 kV but now expands unmatched FIB performance down to accelerating voltages as low as 500 V enabling the creation of 7 nm TEM lamella with sub-nm damage layers.

## Enabling flexibility

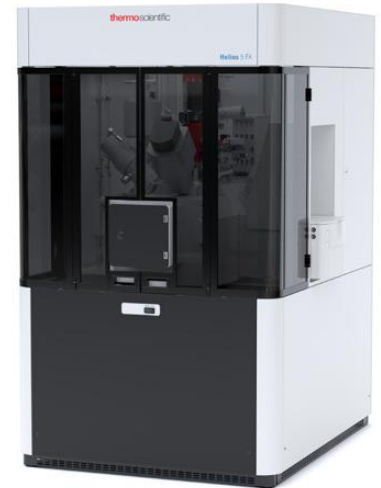
Smart Alignments actively maintain the system for optimum performance, ready to deliver the highest performance for all users. Patterning improvements ensure the highest quality depositions at any condition, and an extensive automation suite make the Helios 5 the most advanced DualBeam ever assembled—all backed by the Thermo Fisher expert application and service support.

## 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
- STEM resolution
  - 6Å Standard mode
  - 3Å In-len mode
- SEM resolution
  - Optimal WD
    - 0.6 nm @ 2–15 kV
    - 0.7 nm @ 1 kV
    - 1.0 nm @ 500 V with beam deceleration
  - Coincident WD
    - 0.8 nm @ 15 kV
    - 1.2 nm @ 1 kV
- Ion beam resolution at coincident point
  - 4.0 nm @ 30 kV using preferred statistical method
  - 2.5 nm @ 30 kV using selective edge method
- 500 nm @ 500 V using preferred statistical method
- EDS resolution
  - < 30 nm on thinned samples
- Gas Delivery
  - Integrated MultiChem Gas Delivery System
  - Up to 6 chemistries can be installed
  - Up to 2 external gasses can be installed
- *In situ* TEM sample liftout
  - EasyLift EX Nanomanipulator
- Stage
  - 5 axis CompuStage with S/TEM holder, equipped with automated insert/retract mechanism and air lock for fast TEM grid exchange without breaking system vacuum
  - 5 axis all piezo motorized bulk stage with automated Loadlock
- Sample types
  - Wafer pieces, packaged parts, grids
- Maximum sample size
  - 70 mm diameter with full travel
- Application software
  - iFAST Developers Kit Professional automation software
- User interface
  - Windows® 10 GUI with integrated SEM, FIB, GIS, simultaneous patterning and imaging mode
  - Local language support: *Check with your local Thermo Fisher sales representatives for available language packs*
  - Two 24-inch widescreen LCD monitors

## Key options

- MultiChem gas chemistries
  - Range of deposition and etch chemistries
- Software
  - Auto Slice & View™ software, Magma CAD Navigation
- Hardware
  - EDS and WDS



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