

# Helios 5 EXL DualBeam

## High-precision, reproducible, ultra-thin TEM lamella preparation for next-generation logic and memory

Today's most advanced chipmakers are seeking to push the limits of physics and chemistry with their nanoscale features, novel materials, and increasingly complex 3D structures.

With each new chip design, failure analysis and yield learning demands increase, requiring new levels of precision control at the atomic scale and faster TEM sample preparation capabilities. The Thermo Scientific™ Helios 5 EXL DualBeam is the latest full-wafer focused ion beam scanning electron microscope (FIB-SEM) from Thermo Fisher Scientific, designed to address the challenges of TEM sample preparation for the 5 nm technology node and beyond. This system is capable of precisely extracting lamella samples that are less than 10 nm thick, capturing point defects and isolating pre-defined structures and regions of interest (ROI) for TEM analysis.

### Precision FIB milling for the most advanced sample preparation

The Helios 5 EXL DualBeam includes the Thermo Scientific Phoenix Ion Column, which provides revolutionary low-kV performance and leading-edge TEM sample preparation.

### Automated alignments, high resolution, consistent results

The high-performance Thermo Scientific Elstar™ Electron Column features our unique UC monochromatic technology, offering improved resolution and TEM sample end-pointing. New SEM auto-alignments ensure consistent results across multiple tools and operators.

### Automated TEM sample preparation software

The Helios 5 EXL DualBeam combines wafer and defect navigation with Thermo Scientific AutoTEM™ 5 Software recipe definition and execution, ensuring efficiency and consistency

### Key features

Fast, accurate, ultra-thin TEM lamella preparation supporting 5 nm process nodes and beyond

Precise thickness and cut placement control using machine learning end-pointing for top-down samples

Automated and repeatable results with AutoTEM 5 Software for top-down, inverted, and plan-view TEM sample preparation

Advanced electron- and ion-beam-induced deposition and etching with the MultiChem Gas Delivery System

Acceleration of new processes and learning with the optional Automated FOUNDRY Loader (AFL) and factory-automation integration

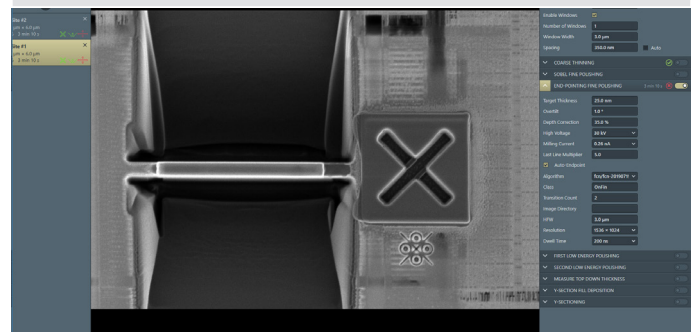


Figure 1. AutoTEM 5 Software performing multi-site top-down TEM sample preparation.

among operators with varying levels of expertise. AutoTEM Software simplifies TEM sample preparation, allowing you to easily schedule multi-site jobs for inverted, plan-view, and top-down TEM sample preparation workflows.

AutoTEM 5 Software also introduces machine learning for precision end-pointing, enabling fully automated *ex situ* TEM sample preparation workflows with unparalleled thickness control and precise lamella placement.

### Fab-compatible Automated FOUNDED Loader (AFL) option

The optional Automated FOUNDED Loader (AFL) supports placing the Helios 5 EXL DualBeam inside the semiconductor wafer fab. With AFL, the instrument is closer to the wafer process line (near-line) to deliver critical information up to three times faster than laboratory-based analysis of cleaved wafer pieces, accelerating the development of new processes and the yield ramp to high-volume production.

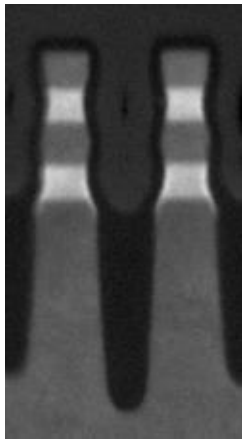


Figure 2. TEM image of a Si/SiGe gate-all-around (GAA) fin.

### Automated sample manipulation and lift out

The Thermo Scientific EasyLift Nanomanipulator offers low-drift, high-precision movements for the simple and consistent creation of traditional or ultra-thin TEM lamella. The EasyLift Nanomanipulator provides an intuitive method for lift-out and transfer of TEM samples to a grid. Highly accurate, easy-to-use, and fast motorized rotation makes it ideally suited for high-speed inverted or plan-view sample preparation.

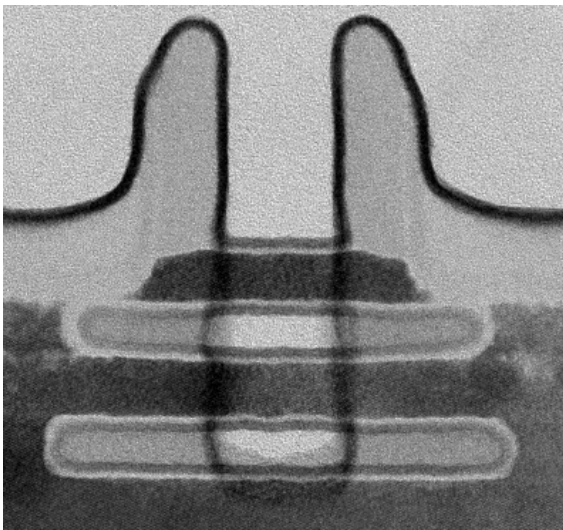


Figure 3. TEM imaging along the nanowire of a GAA structure.

### Specifications

#### Phoenix Ga+ FIB Ion Column

- Up to 65 nA maximum beam current
- Low-voltage (500 V) performance for high sample preparation quality
- Ion beam resolution @ coincident point:
  - 550 nm @ 500 V using preferred statistical method
  - 4.0 nm @ 30 kV using preferred statistical method
- Ion source: 1,000 hours guaranteed

#### Elstar UHR Immersion Lens FESEM Column

- Elstar electron gun with ultra-stable Schottky field emitter gun and UC+ monochromator technology
- Electron beam resolution:
  - 1.0 nm @ 15 kV
  - 0.9 nm @ 1 kV
- Electron source lifetime: 12 months

#### Gas delivery

- MultiChem Integrated Gas Delivery System
  - Slots for up to 6 individual chemistries
- Single gas injection system
  - Ports for up to 3 independent GIS units

#### Sample handling

- Automated handling of 300 mm FOUNDED with EFEM (GEM300 compliant)
- Manual loading of 300 mm, 200 mm, and 150 mm wafers

#### Additional options

- Optical microscope with 920  $\mu\text{m}$  field of view
- 30 kV STEM detector with BF/DF/HAADF segments
- Oxford EDS
- CAD navigation compatibility (NEXS and Synopsys Camelot)
- Thermo Scientific iFast Software semiconductor wafer navigation (optional)
- Integrated defect navigation based on KLARF 1.2 and 1.8 standards
- User-defined wafer maps and site plans

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