The Helios FIB-SEM instrument for your workflows

A practical guide to balancing precision, throughput, and flexibility

thermo scientific

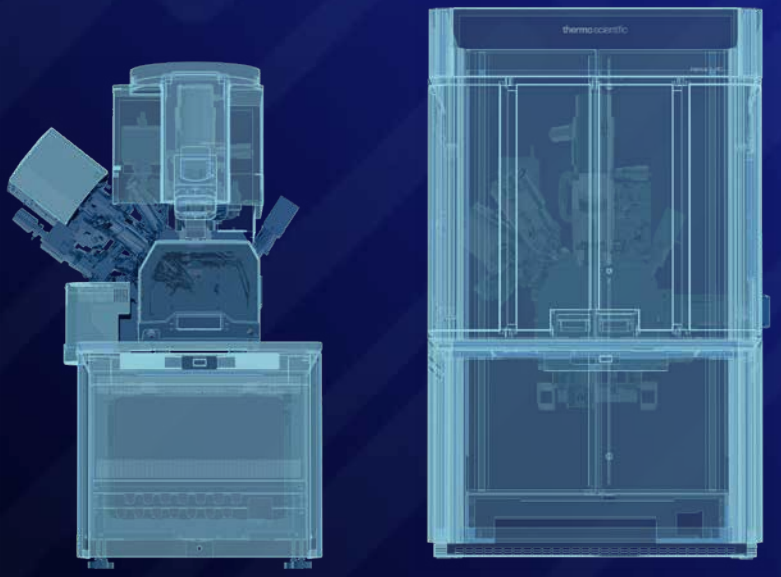
Choosing an instrument for your workflow

Semiconductor analysis often starts with the same question: How do you get the insight you need without compromising your devices, your time, or your results?

As device architectures evolve, so do the challenges in failure analysis, materials characterization, and metrology. Smaller features, more complex material stacks, and increasing data demands mean that no single approach fits every workflow.

Thermo Scientific™ DualBeam™ technology–enabled FIB-SEMs play a central role by enabling:

- Site-specific cross-sectioning
- High-quality TEM sample preparation
- 3D structural analysis
- Precise layer-by-layer deprocessing



But not all FIB-SEMs are optimized in the same way and choosing the right instrument isn't about capability alone. It's about how that capability is applied to your workflow.

Decision process

But not all FIB-SEMs are optimized in the same way and choosing the right instrument isn't about capability alone. It's about how that capability is applied to your workflow.

Choosing the right FIB-SEM can be complex, as applications, materials, and throughput requirements continue to evolve. A structured approach can help you focus on what matters most: your application, your workflow, and the capabilities that support your goals.

Selecting the right instrument starts with understanding your application and priorities.

What are you working on?

Your technology segment defines the structures, materials, and constraints you face.

What do you need to do?

Your primary use case determines the type of preparation or analysis required.

What matters most?

Key instrument capabilities enable precision, throughput, or flexibility.

What fits best?

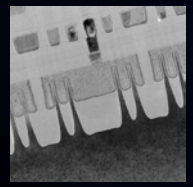
Different Thermo Scientific Helios™ FIB-SEMs are optimized for different operating regimes.

All Helios FIB-SEMs are designed to deliver high-quality results.
What differs is how they are optimized for your specific workflow.

Step 1: Segment
What are you working on?

Application area is one of the most important factors in selecting a FIB-SEM, as it defines the constraints, structures, and priorities that shape your workflow.

Different application areas introduce different constraints and priorities.



Logic
- Advanced nodes with extremely small features
- Tight tolerances for site-specific preparation
- Increasing need for repeatability and automation

Packaging
- Heterogeneous integration and large structures
- Wide cross-sections and multi-material interfaces
- Emphasis on throughput and versatility

Memory
- Complex 3D structures (e.g., NAND)
- Deep features requiring large-volume access
- Combination of precision and scale

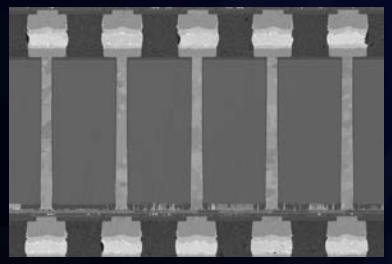
Power
- Thick materials and multi-layered devices
- Large-area cross-sectioning
- Robust sample preparation across material type

Understanding your technology helps define what “good” looks like for your workflow.

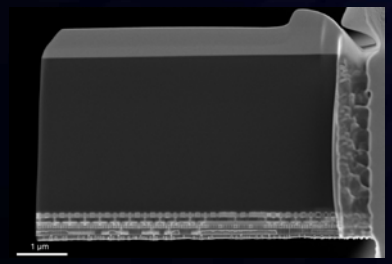
Step 2: Use cases
What do you need to do?

Your primary workflow defines the capabilities required, from precision and control to throughput and scale.

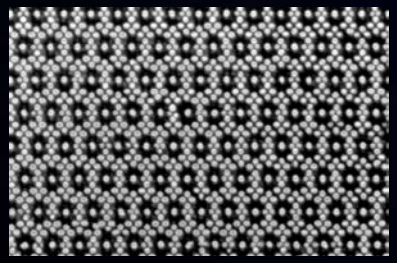
Most FIB-SEM workflows fall into three primary categories:



Cross-sectioning and 3D analysis
- Reveal internal structures and interfaces
- Enable large-area or volumetric investigation
- Requires balance between quality and speed



TEM lamella preparation
- Extract thin, site-specific samples
- Demands control at the lowest beam currents
- Requires repeatability and consistency



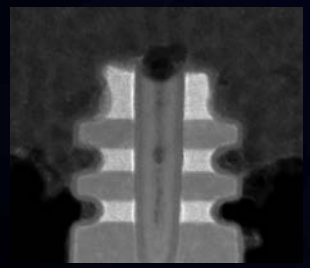
Delayering
- Sequentially remove layers to expose underlying structures
- Requires uniform material removal across large areas
- Often tied to throughput and workflow efficiency

Each use case places different demands on the instrument, and those demands shape which platform is best suited.

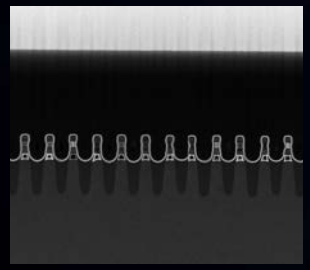
Step 3: Capabilities
What matters most in your workflow?

The capabilities you prioritize have the greatest impact on how effectively your workflow performs.

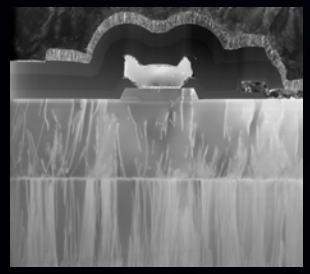
The key to selecting the right instrument is understanding which capabilities matter most.



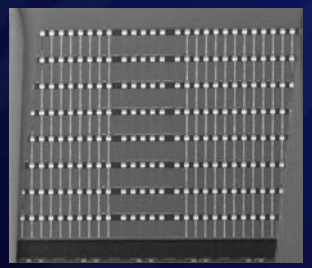
Precision at the smallest scale
- Required for ultra-thin lamella and site-specific work
- Depends on performance at the lowest beam current



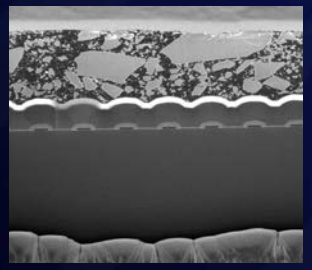
Throughput and automation
- Critical for high-volume or repetitive workflows
- Enables consistency and reduced operator variability



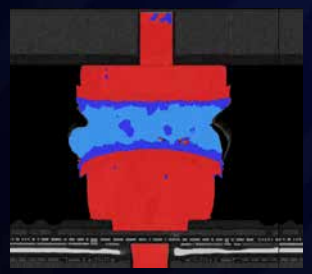
Gallium-free processing
- Important for specific materials or workflows sensitive to implantation



Large cross-section capability
- Needed when working with features greater than ~50 µm
- Common in packaging, power, and memory applications



Multi-material performance
- Important when working across diverse material stacks
- Requires consistent cut quality across interfaces

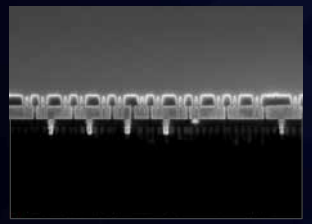


Integrated analysis
- EDS, EBSD, and other analytical techniques
- Supports deeper insight without transferring samples

Most workflows require a combination of capabilities, but typically one or two dominate.

Step 4: Instrument overview
Which one fits best?

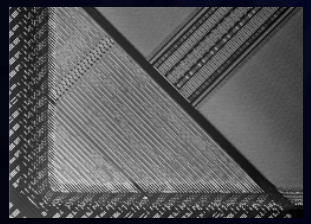
Built on three core platform approaches, each Helios FIB-SEM is optimized for a different operating regime, making alignment with your workflow critical.



Gallium FIB

Optimized for the lowest current regimes, enabling:

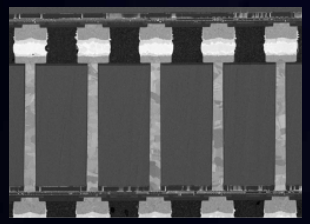
- Finest features and thinnest lamella
- Highly site-specific sample preparation
- Mature automation for repeatable workflows



Xenon plasma FIB

Optimized for higher current regimes, enabling:

- Rapid material removal
- Large cross-sections
- Efficient delayering and 3D workflows



Multi-ion plasma FIB

Optimized for flexibility across operating regimes, enabling:

- Adaptation to different materials using multiple ion species
- Tunable balance between precision and throughput
- Workflow consolidation across diverse applications

All platforms deliver high-quality results.
The difference lies in how they are optimized for your priorities.

Compare what matters most

Comparing platforms based on the capabilities that matter most to your workflow helps simplify selection and focus your decision.

Use the tool below to evaluate capabilities across platforms:

- Understand how each platform aligns with your priorities
- Identify which capabilities matter most in your workflow
- Narrow your selection before exploring specific instruments

	Helios 5 CX	Helios 5 UC	Helios 5 UX	Helios 5 FX	Helios 6 HD	Helios 6 HX	Helios PFIB	Helios Hydra
TEM Prep								
***In situ* STEM**	STEM in SEM	STEM in SEM	STEM in SEM	3A STEM			STEM in SEM	STEM in SEM
High-volume automation					Pre-Thinning	Thinning		
Tech node capability optimization	> 28nm	> 14nm	> 5nm	> 5nm	≤ 5nm	≤ 5nm	Ga-free	Ga-free
Gallium-free processing							Xe+	Xe+ and Ar+
3D and Cross-section								
Integrated analysis (EBSD, EDS)	Yes	Yes	Yes				Yes	Yes
Routine cross-section width	< 75µm	< 75µm	< 50µm	< 50µm	< 50µm	< 50µm	> 50µm	> 100µm
Multi-material cut quality	Good	Good	Good	Good	Good	Good	Better	Best
Delayering								
Gas-assisted deprocessing							Yes	Yes

From technology platform to targeted solution

Once you've identified the right platform, consider compatible software solutions that will enhance your productivity and results.

Compare what matters most

Software can be a critical component to any semiconductor workflow, from preparation to 3D visualization.

Use this tool to understand compatible levels of automation and enhanced capabilities:

- Lamella preparation options range from guided workflows for beginning operators to optimized user-free productivity
- Visualization software is compatible with all DualBeam technologies and offers ultimate insights to increasingly multi-dimensional devices

Software	Capability	5 CX	5 UC	5 UX	6 HD	6 HX	PFIB	Hydra
AutoTEM 5	User guided lift-out, automated blind thinning	●	●	●			●	●
AutoTEM 5 Automation Science	Automated lift-out and blind thinning (up to 5 sites)		●	●			●	●
AutoTEM 6 Essential	High-volume, automated lift-out and blind thinning				●			
AutoTEM 6 Enhanced	High-volume, automated lift-out and ML-based fiducial end-pointing				●			
AutoTEM 6 Professional	High-volume, automated lift-out and AI-based device end-pointing					●		
Auto Slice & View	Automated acquisition for 3D reconstruction	●	●	●			●	●
Avizo 3D	Flexible 3D data visualization and AI-based segmentation	●	●	●	●	●	●	●

From technology platform to targeted solution

The next step is selecting the instrument that matches your workflow scale and complexity.

Refining your choices

The following sections provide a closer look at each instrument family to help you refine your decision.

Helios 5 DualBeam Family

Helios 5 CX DualBeam

Reliable performance for routine workflows

The Helios 5 CX DualBeam is designed for:

- Routine cross-sectioning and sample preparation
- Labs requiring dependable, accessible FIB-SEM capability
- Workflows where ease of use and consistency are key

Typical applications:

- Standard cross-section automation
- Basic TEM sample preparation
- General-purpose failure analysis

Positioning:

- Entry point into Helios FIB-SEM precision workflows
- Balanced capability for everyday needs

Helios 5 UC DualBeam

Flexible performance for expanding workflows

The Helios 5 UC DualBeam is designed for:

- Greater flexibility across a range of use cases
- Reliable performance for labs moving beyond routine workflows

Typical applications:

- Mixed cross-sectioning and TEM workflows
- Labs expanding capability and throughput without requiring advanced automation
- Large sample or wafer handling and navigation

Positioning:

- Flexible, capability-building instrument for growing workflows

Refining your choices

Helios 5 UX DualBeam

Advanced flexibility with increased precision

The Helios 5 UX DualBeam offers:

- Increased workflow automation and efficiency
- Support for more complex and demanding applications
- Sample handling and navigation for large samples and full wafers

Typical applications:

- FA workflows balancing precision and throughput
- More advanced technology TEM preparation
- Labs balancing flexibility with productivity demands

Positioning:

- Multi-use instrument that bridges flexibility and automation

Helios 5 FX DualBeam

Automation for specialized workflows

The Helios 5 FX DualBeam is designed for:

- High-volume, repeatable TEM preparation
- Advanced automation in atom probe prep

Typical applications:

- Automated TEM lamella on fine features
- Advanced techniques requiring *in situ* STEM or diffraction-based capabilities, like 4D-STEM and ECCI

Positioning:

- Automation-focused platform for scaling precision workflows

Refining your choices

Helios 6 FIB-SEM Family

Helios 6 HD and Helios 6 HX FIB-SEMs

Advanced automation and next-generation TEM preparation workflows

Both extend gallium performance with:

- Advanced automation capabilities
- Support for high-volume and complex workflows
- Enhanced instrument intelligence and workflow optimization

Typical applications:

- Advanced node failure analysis
- High-throughput environments
- Labs pushing both precision and volume

Positioning:

- Highest level of automation and performance in gallium instruments

Refining your choices

Helios Plasma FIB DualBeam Family

Helios 5 PFIB DualBeam

Delayering precision without compromising throughput

The Helios 5 PFIB DualBeam is optimized for:

- Large-area cross-sections
- Efficient delayering

Typical applications:

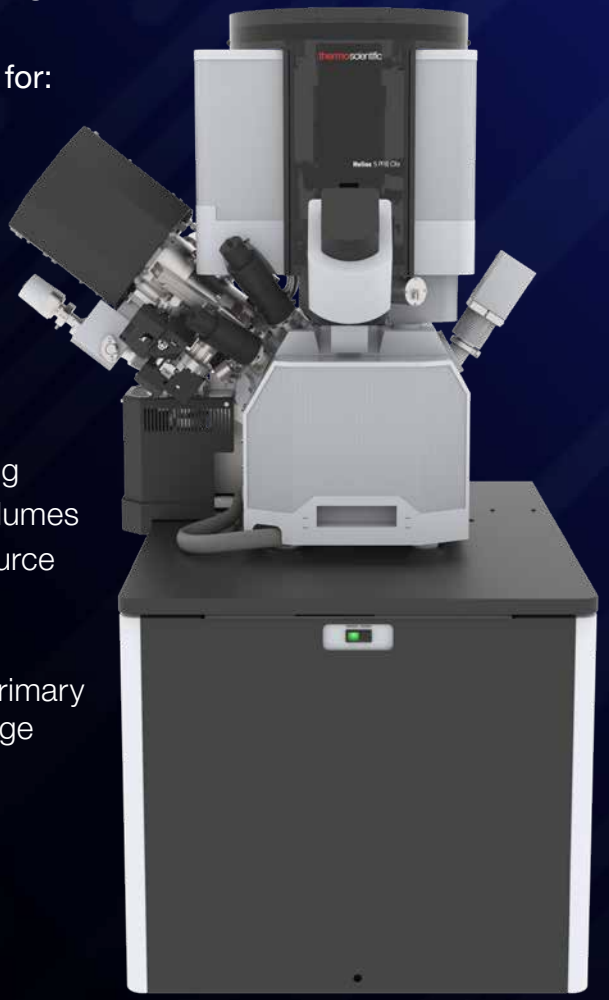
- Large volume packaging analysis
- Memory and logic device delayering

Key strengths:

- High current operation for fast processing
- Consistent performance across large volumes
- Ga-free preparation with Xe+ plasma source

Positioning:

- Ideal when delayering applications are primary driver, with throughput as a priority in large volume applications



Helios Hydra™ Multi-Ion PFIB-SEM

Flexibility and speed across materials and workflows

Helios Hydra PFIB-SEMs introduce multiple ion species, enabling:

- Tunable interaction between beam and samples
- Improved performance across complex stacks

Typical applications:

- Multi-material, large volume analysis
- Compound semiconductor sample preparation

Key strengths:

- Flexibility across use cases
- Future-ready platform for evolving workflows
- Scalable workflows across technologies
- Ga-free sample preparation with multi-ion species workflows

Positioning:

- Best suited when flexibility and adaptability are critical across applications, where quality and throughput are critical performance metrics

Choosing your best fit

Selecting the right platform starts with aligning your top priorities to the strengths of each FIB-SEM system.

If your priority is:

- ***Finest features and ultra-thin lamella***
  Gallium instruments
- ***Large cross-sections and delayering precision***
  Xenon PFIB-SEM
- ***Flexibility across materials and evolving workflows***
  Helios Hydra PFIB-SEM

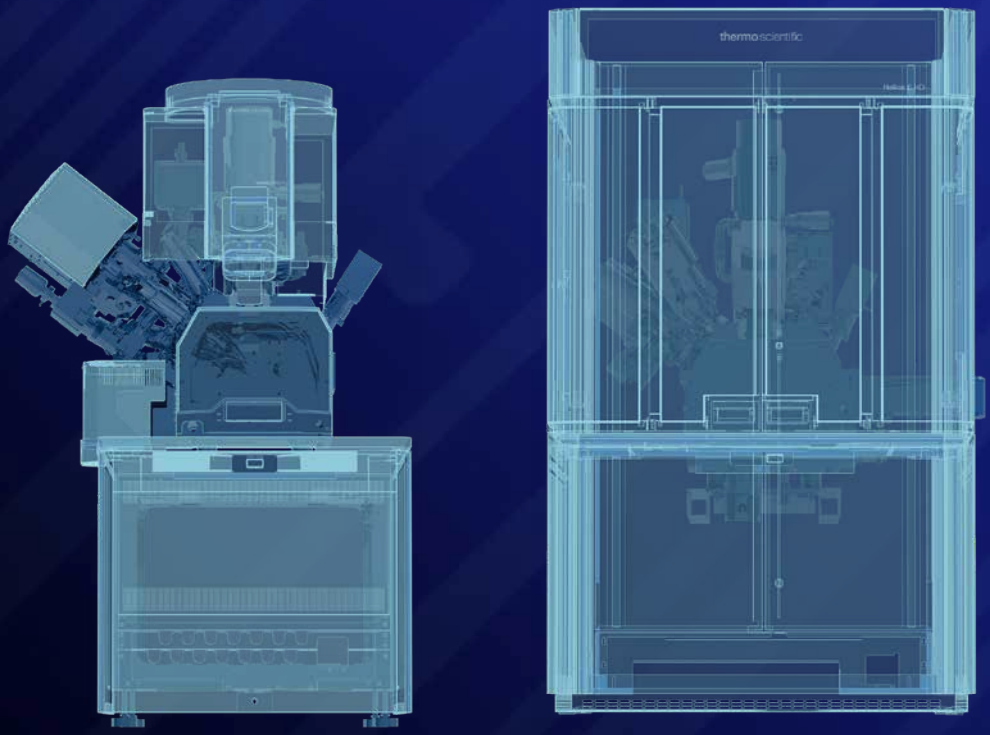
Your optimal solution may depend on how your needs evolve over time.

Still deciding?

Every workflow is different. The right solution often depends on details that go beyond specifications:

- Scaling throughput
- Improving precision
- Expanding into new materials or applications

A deeper discussion can help clarify your best path forward.



Talk to one of our expert to explore your workflow, evaluate options, and determine the right Helios FIB-SEM for your needs.

Contact us today

About Thermo Fisher Scientific

Thermo Fisher Scientific is the leading provider of failure analysis, metrology and characterization solutions for nanoscale imaging and analysis of semiconductor devices. With more than four decades of experience working with the semiconductor industry, and with the broadest portfolio of localization, preparation, and analysis tools, Thermo Fisher provides the data semiconductor manufacturers need to accelerate development, inform process improvements, and maximize yields.

Our Mission

To enable our customers to make the world healthier, cleaner and safer.

Global support

A strong worldwide infrastructure is the foundation of our support delivery

- EM technical experts
- Field application engineers
- International warehouse network
- Extensive parts inventory
- Global Nanoports & training centers

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