Introducing Scios 3 DualBeam

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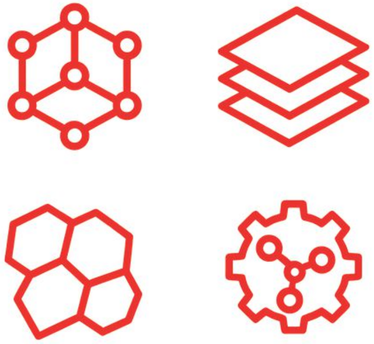
Product Specialist
DualBeam

The world leader in serving science

Challenge: Meeting the Demands of Materials Science

SEM/FIB labs face increasing pressure – more, fast, easier

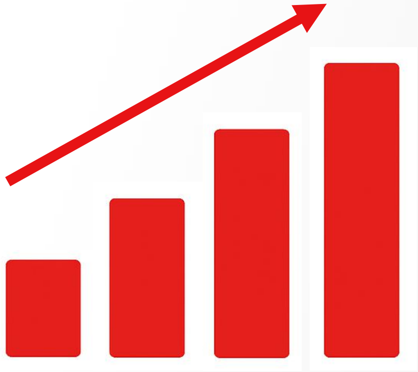
Sample complexity



Rising need of **novel** materials for advanced technology

Sustainability & green energy

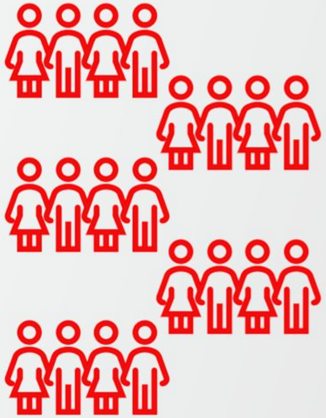
Throughput requirements



Users demand more data, delivered faster – more than just one picture

Statistically relevant results

Number of users

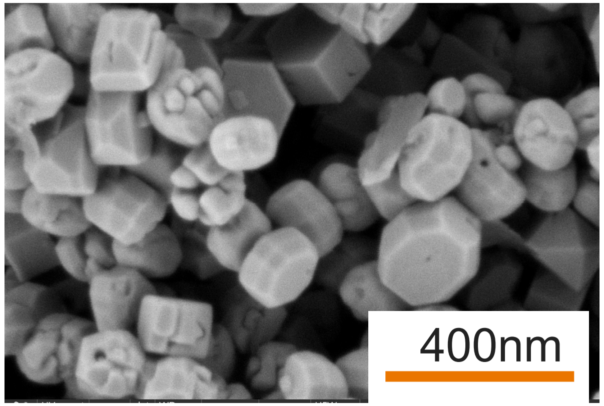


The number of users is constantly increasing, driving the need for easier to use analytical equipment

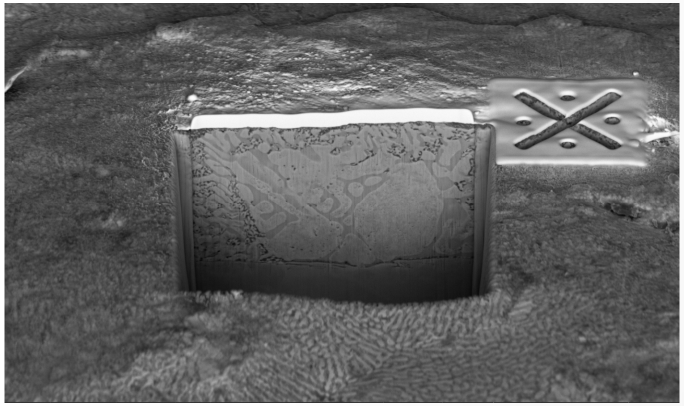
FIB Milling

Scios 3 for Complete Application Versatility

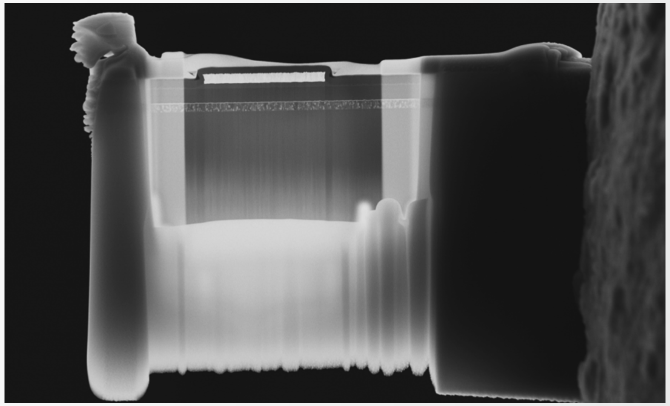
Ultra High-Resolution Imaging

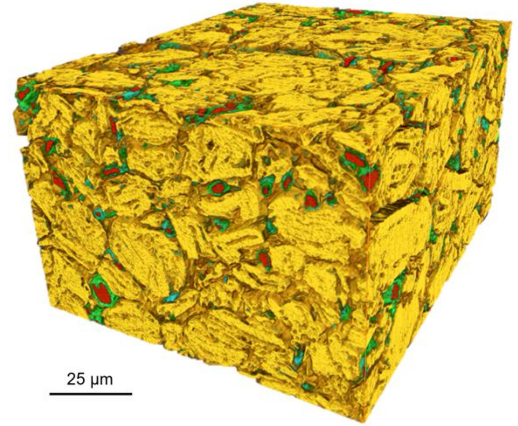


Cross-Sectioning

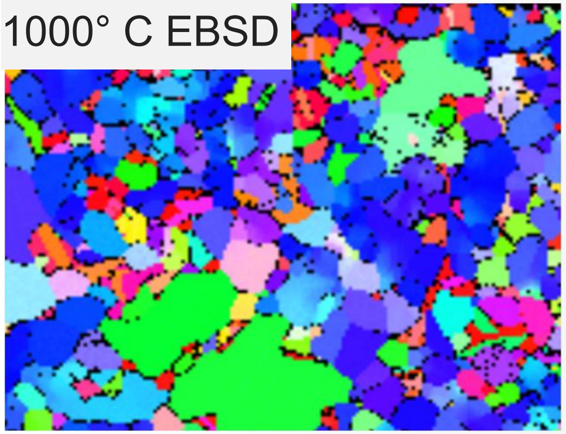


TEM sample Preparation

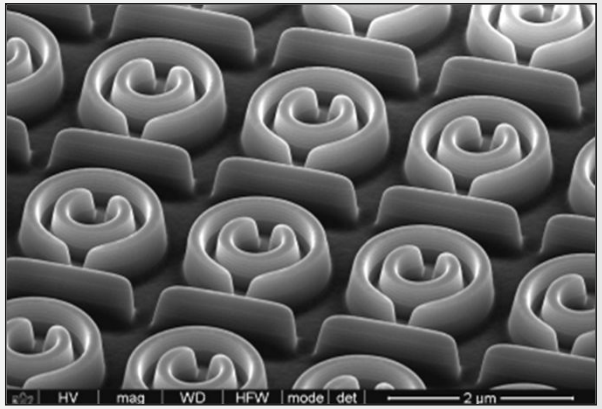




3D Characterization



In Situ Characterization



Nanopatterning

DualBeam Family

Scios 3 DualBeam

Versatile high performance

- TEM sample prep
- 3D characterization

Helios 5 DualBeam

High performance

- Demanding sample prep
- Nano-prototyping
- Low Voltage capabilities

Helios 5 PFIB DualBeam

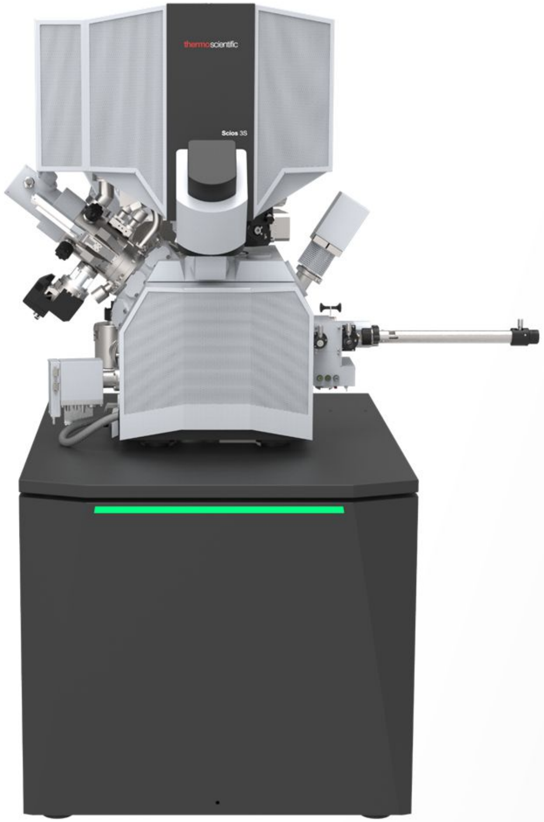
- High quality large volume 3D characterization
- Ga-free TEM sample prep

Helios 5 Hydra DualBeam

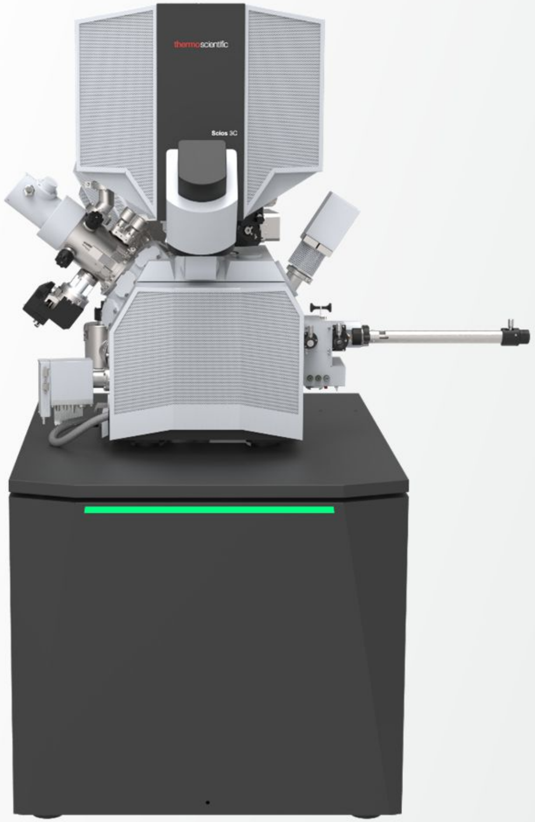
- Different ion sources → cover wide number of applications in different materials system

All platforms enable automated, high-quality TEM sample preparation.

Scios 3 DualBeam systems

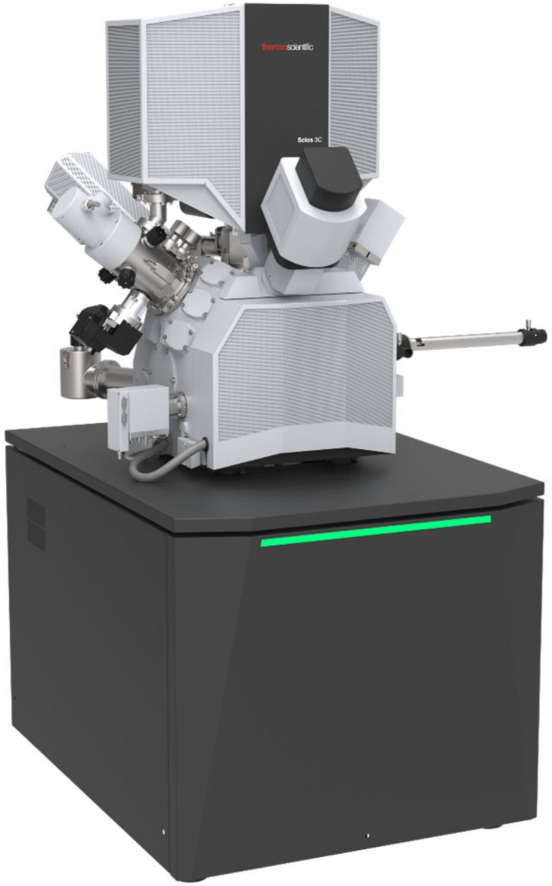


Scios 3S



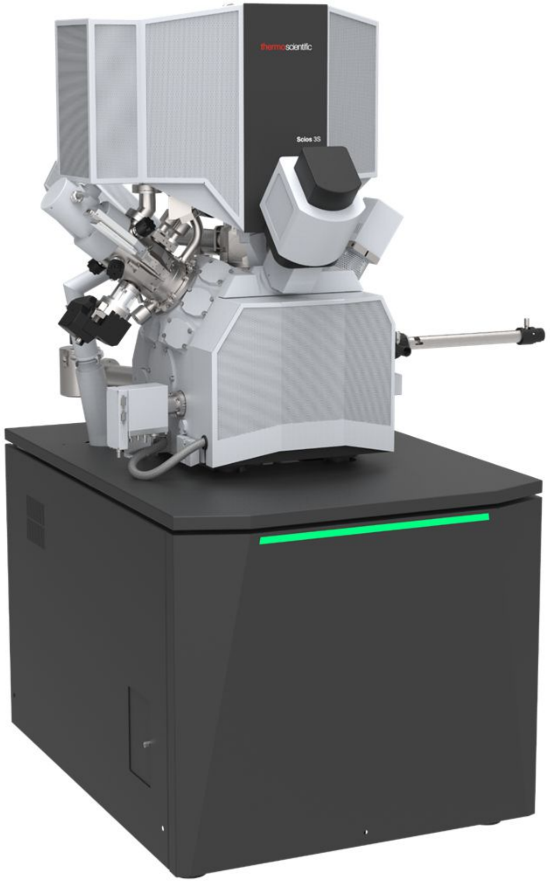
Scios 3C

Scios 3C - Maximizing Productivity Through Workflow Automation



- **Fully featured FIB-SEM for all applications:**
  - **Streamlined subsurface characterization** with new **Auto Cross-Section Software**
  - **Superior contrast in UHR SEM imaging** with the unique Trinity detection scheme
  - **Routine TEM Lamella sample preparation** with **Sidewinder™ HT** FIB, Easylift™ & AutoTEM 5
  - **3D characterization** with Auto Slice & View 5 Software, Spin Mill function
- **Heavily focused on operator productivity** with customized User Guidance for all user modes

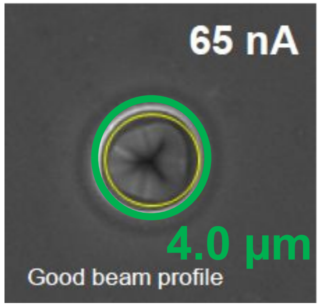
Scios 3S - Maximum Performance with Application Versatility



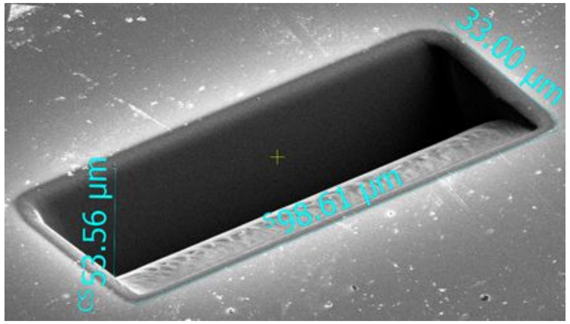
- **Highest quality S/TEM sample preparation** with **Tomahawk™ HT** FIB, Easylift™ & **AutoTEM 5 with Automation Science Software**
- **Access to high quality** automated cross sectioning and 3D characterization
- **Superior contrast UHR imaging** with the unique Trinity detection scheme
- **Fully configurable to address any materials challenge:** LoVac mode, MultiChem gas injection system, cryo workflow and more
- **Complete analytical platform** with full suite of analytical detectors: EDS, EBSD, ToF SIMS, CL, STEM

Scios 3 provides excellent beam profile

Scios 3C

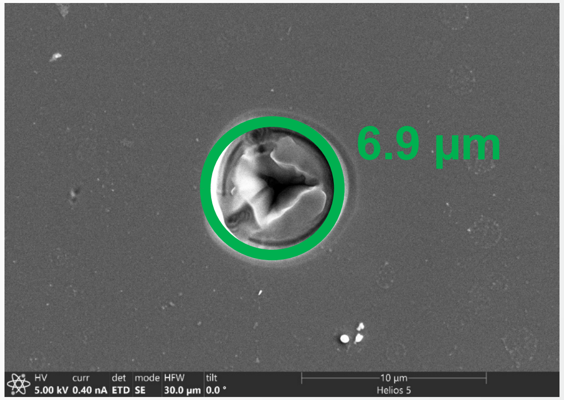


Sidewinder HT FIB:
1s spot burn
65nA within
4.0 µm

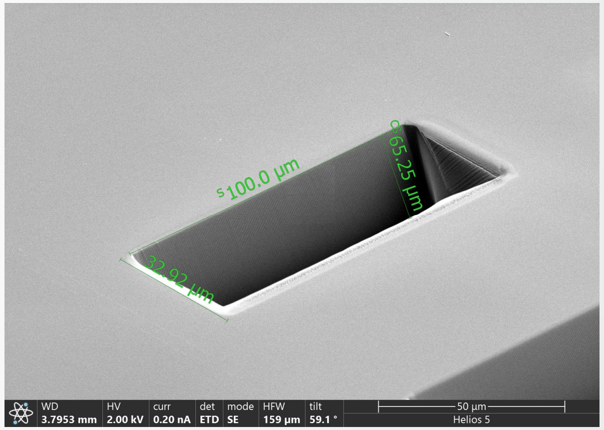


65 nA:
10 minute cross-section
100 X 33 X 53 µm^3

Scios 3S

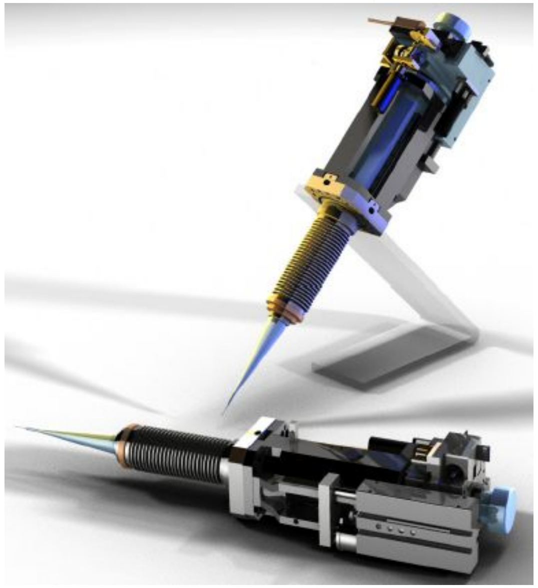


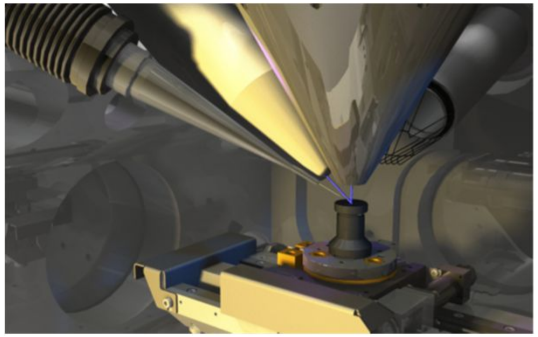
Tomahawk HT FIB:
1s spot burn
100nA within 6.9 µm

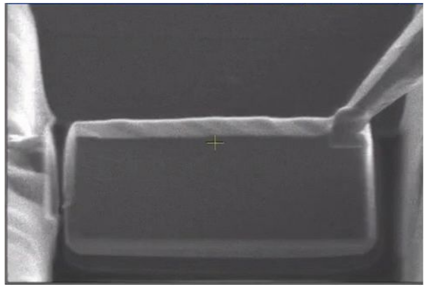


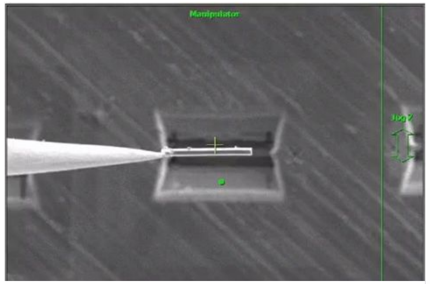
100 nA:
10 minute cross-section
100 X 33 X 65 µm^3

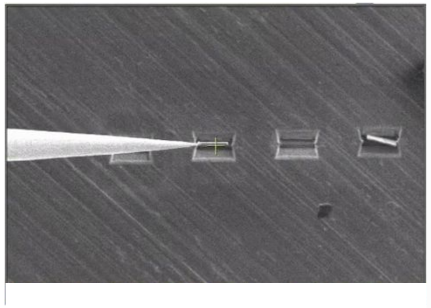
EasyLift – fully integrated nanomanipulator



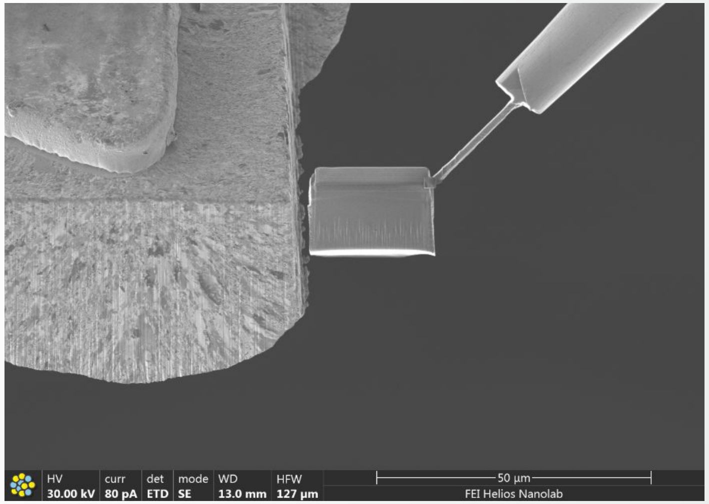


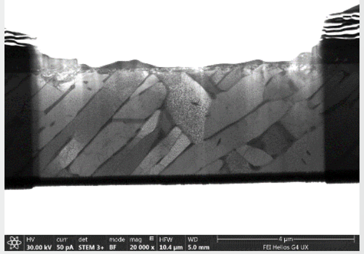


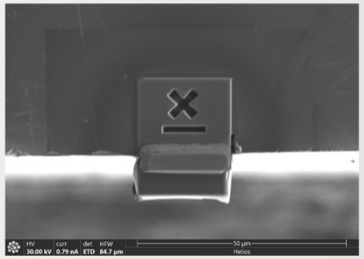




- Motorized XYZ, compucentric rotation
- Precise, reliable movement
- Controls built into the microscope UI
- Simple needle exchange and alignment
- Automation – Control incorporated into AutoTEM, iFast, and AutoScript







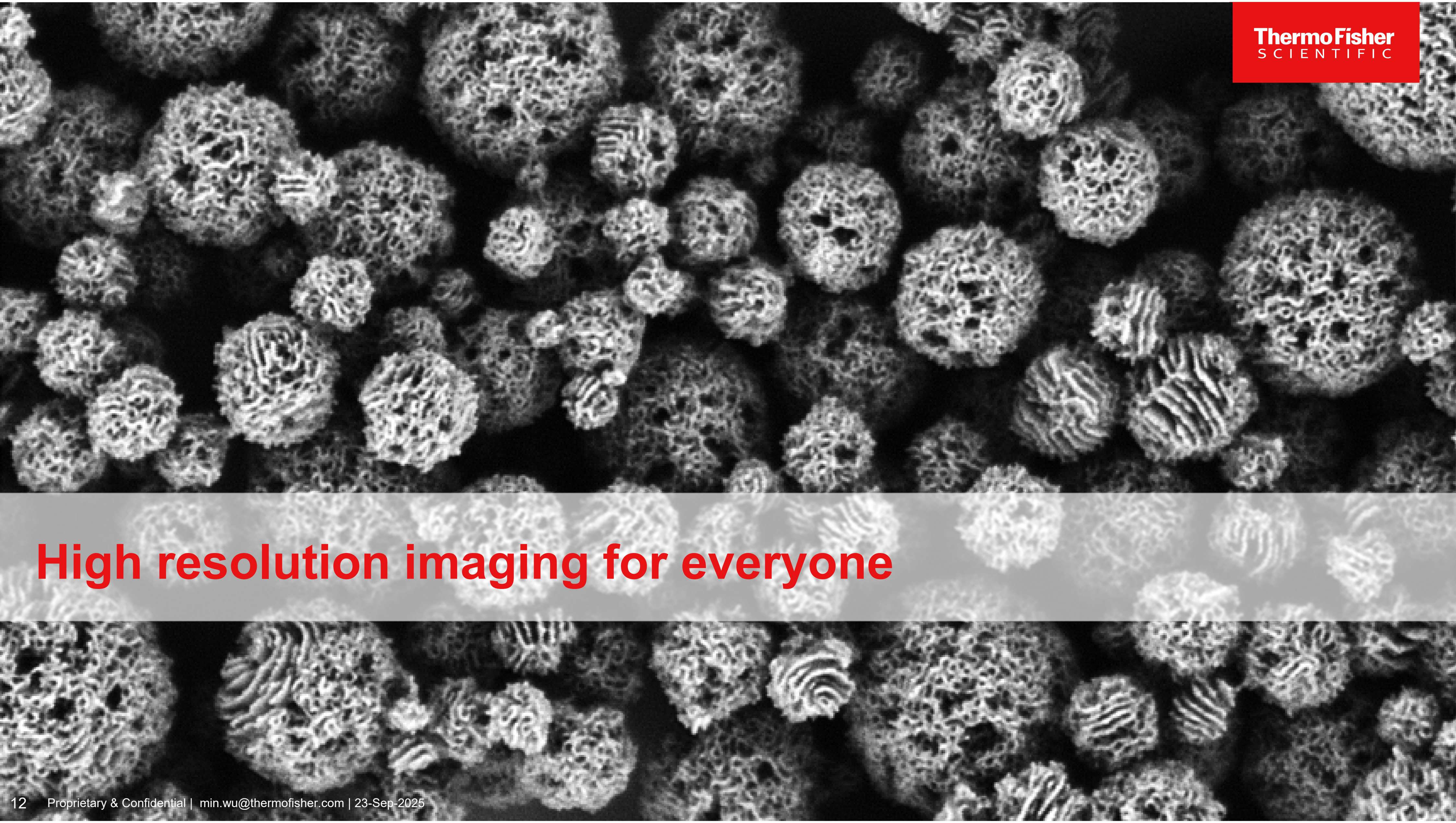
Scios 3 features

Sidewinder HT 65 nA
NICol
HighVac
110 mm Stage ★
Scios 3C

Tomahawk HT 100 nA ★
NICol
LoVac
HighVac
110 mm Stage ★
Scios 3S

Core	CCD	Nav-Cam	ETD, T1, T2	Win 11 ★	32” 4k monitor ★	Multi Purpose Holder
Options	EasyLift	Single GIS	T3	CleanConnect	360° Cryo Stage ★	UltraDry EDS
Scios 3S only →				MultiChem ★	ToF SIMS C2 ★	Retractable CL
				µPolisher	µHeater	High Vacuum Heating Stage
SW	Auto Cross-Section ★	AutoTEM 5	AS&V 5	Analytical Package Spin Mill ★	AutoScript 4	Maps 3

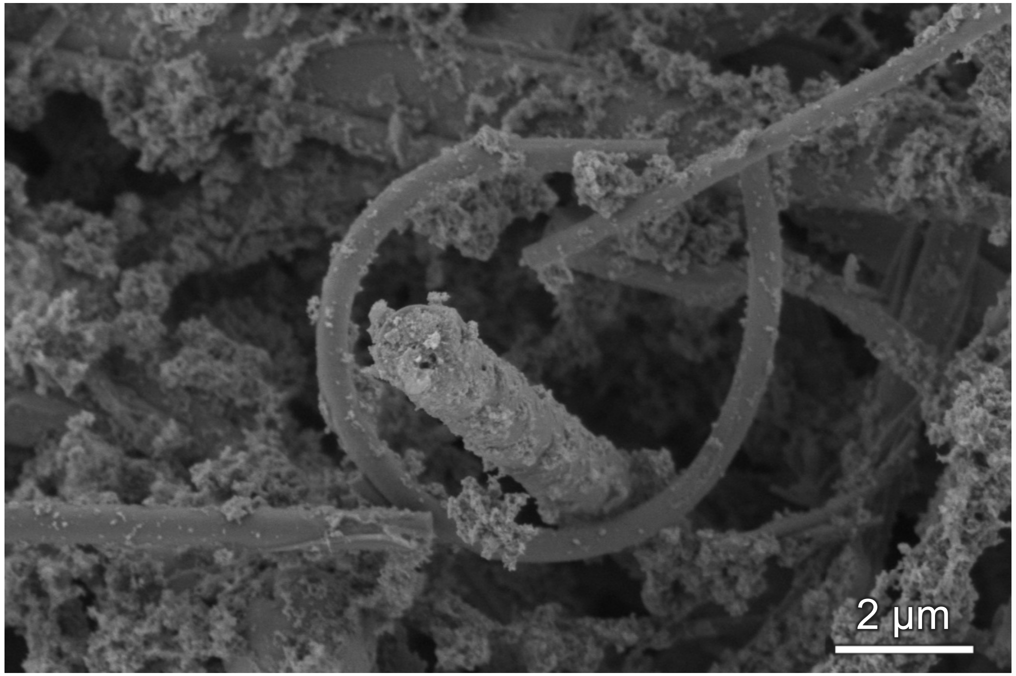
Fully automated lamella prep ★ **AutoTEM 5 Science**



High resolution imaging for everyone

Scios 3 - Highest flexibility for wide variety of samples

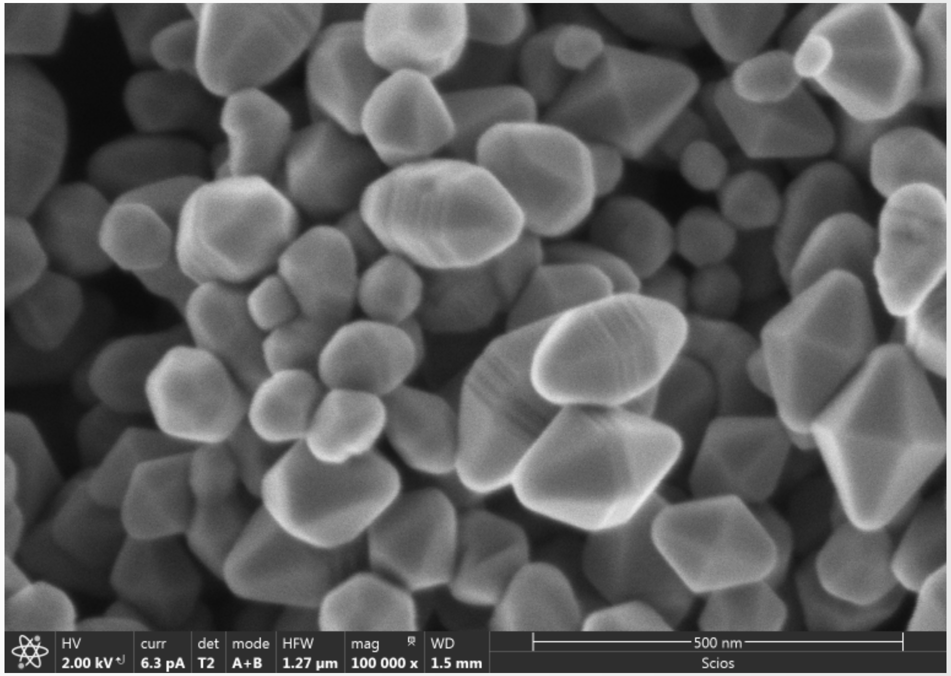
Low vacuum capability



Insulating filter material @ 2kV in LoVac mode

- Low vacuum option to 500 Pa
- On request up to 800 Pa

Full support of magnetic samples

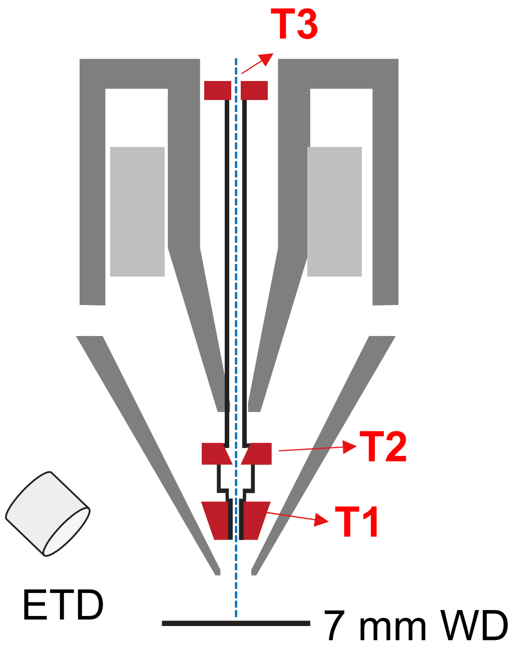


Magnetic nanoparticles (Fe_3O_4)

High resolution on any samples, including magnetic and non-conductive

Data acquired: Petr Wandrol and Haifeng Gao, Thermo Fisher

Trinity Detection for Streamlined Data Collection

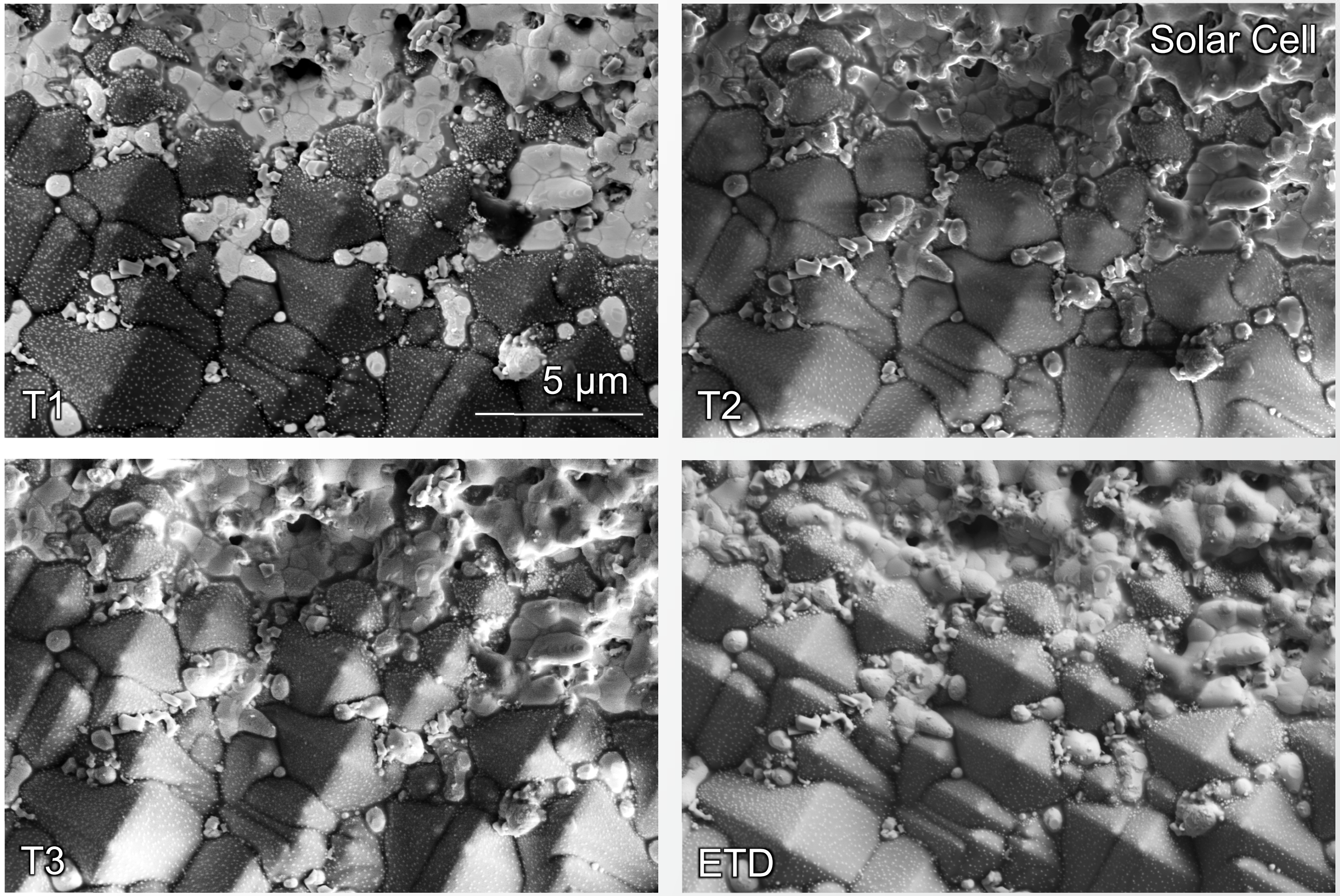


ETD: morphology and topography (SE)

T1: sample composition (BSE)

T2: composition and topography

T3: Highest surface sensitivity



Trinity Detection System: Provides richer contrast and more diverse sample information, enhancing data insights.

Tomahawk HT ion column on Scios 3S

New

Scios 3C

Sidewinder HT
Gallium, 65 nA

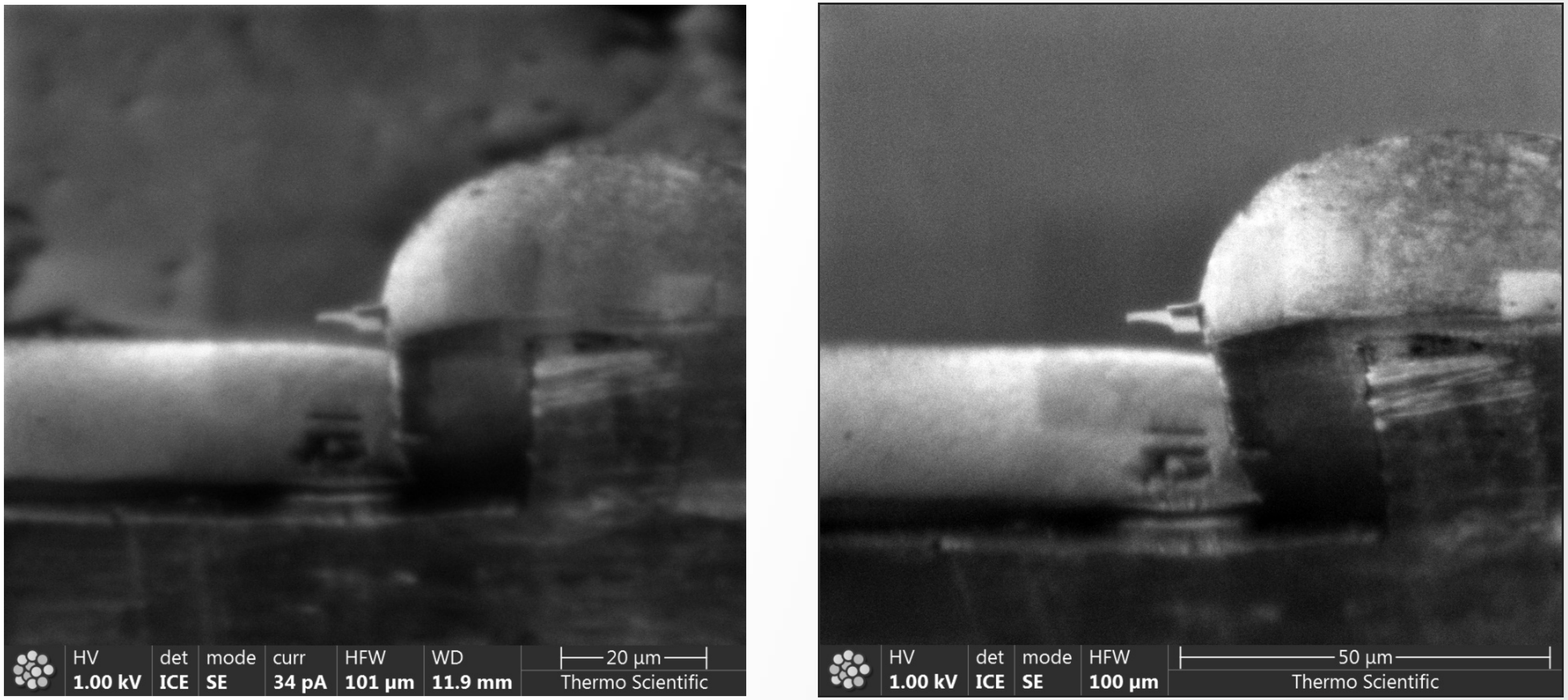
Scios 3S

Tomahawk HT
Gallium, 100 nA

Tomahawk HT column:

- Increased max beam current (100nA)
- Improved resolution and low kV performance
- New fast beam blanker & Faraday cup
  - FBB: deflect the beam to faraday cup
  - Faraday cup: measure beam current
- **Time of flight correction**
- IGP4 with Differential Pumping
  - Better vacuum for GIS
  - Fast sample evacuation

Low kV Optics Improved Further



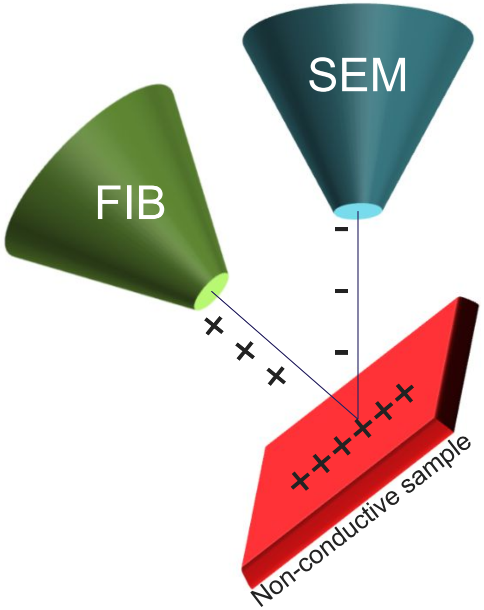
Sidewinder – Available
on Scios 2 and **Scios 3C**

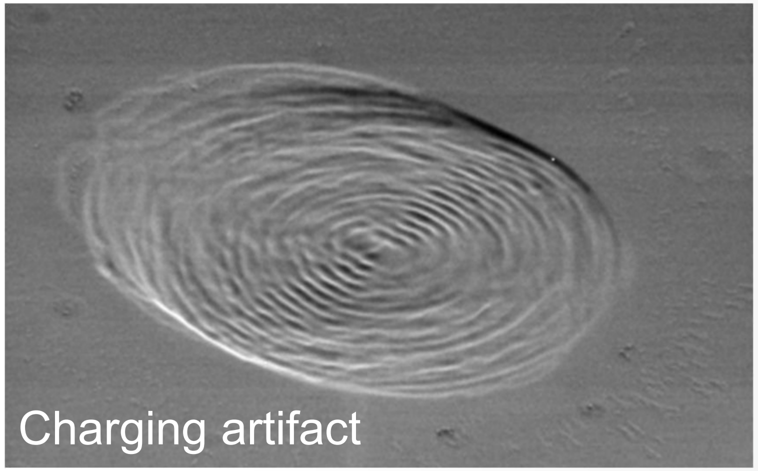
Tomahawk – Available on Helios 5
CX and UC and **Scios 3S**

1 kV FIB Images

Easily Process Non-Conductive Material

Unique Drift Suppression mode for milling polymers, glass, and ceramics





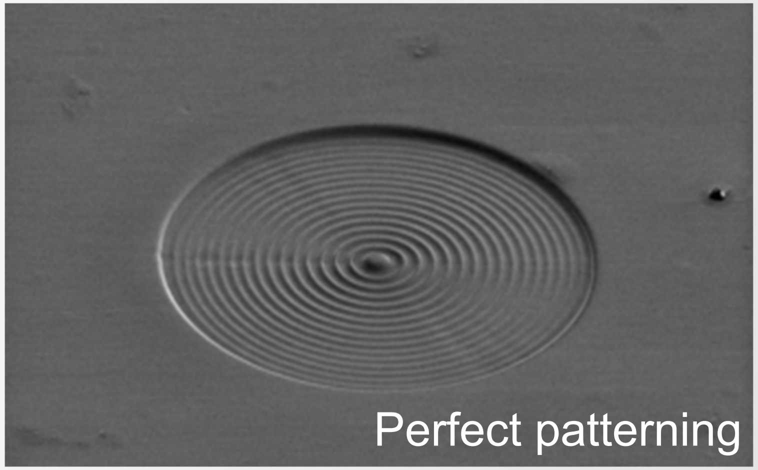
Without Drift Supression

Concentric ring pattern milled on un-coated glass using a FIB current of 13 nA – positive surface charging causes milling pattern drift

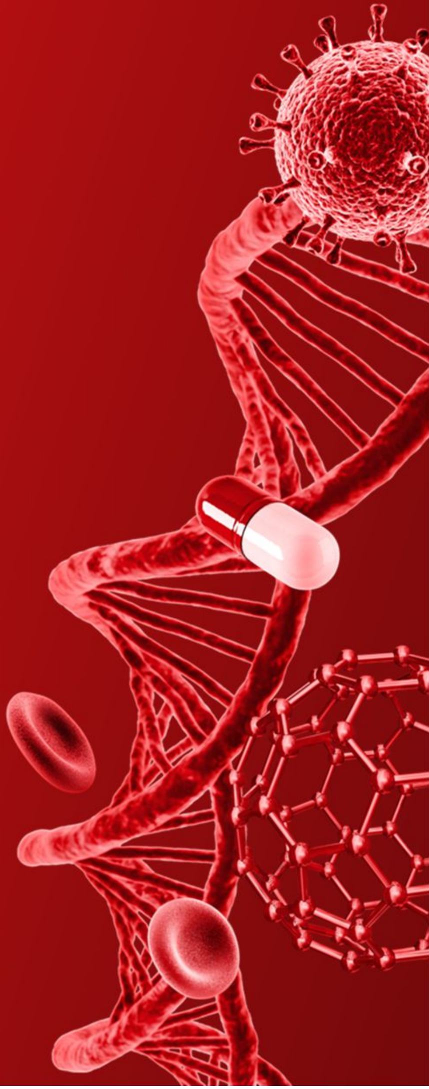
Scios 3 provides up to 400 nA of electron beam current to easily neutralize ion beam surface charging

Drift Suppression On

Flooding with high current from the electron beam mitigates the drift



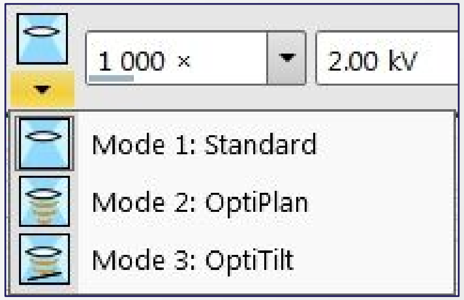
Thank you



Scios 3 - Unique OptiTilt imaging mode

Standard

- Basic operation, navigation, preparation of TEM samples and cross sections, EDX, EBSD



1 000 ×

2.00 kV

Mode 1: Standard

Mode 2: OptiPlan

Mode 3: OptiTilt

OptiPlan

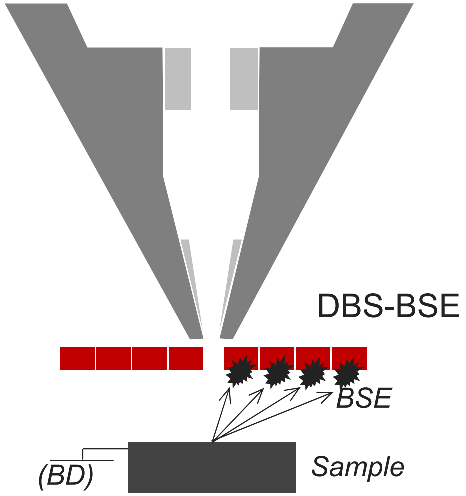
- High resolution imaging at short WD (≤5mm)

OptiTilt

- High resolution imaging of tilted samples and cross-sections at eucentric WD (≤7mm)

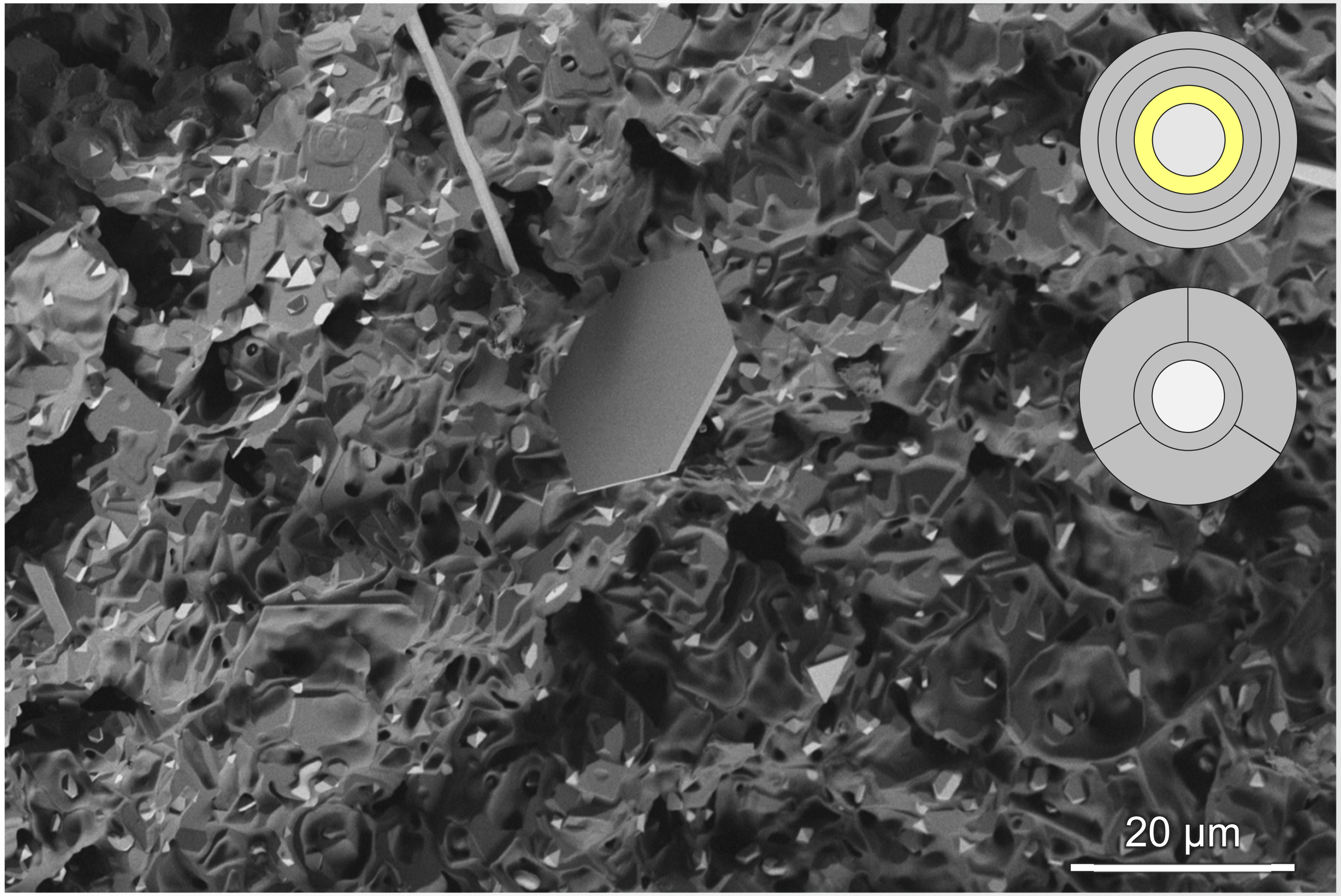
Directional Backscattered Detector (DBS): Unique detector versatility

- Tunable materials / topographic contrast
- Simultaneous collection
- High sensitivity even at very low keV
- Retractable
- 8 segments



✓ Angular segmentation

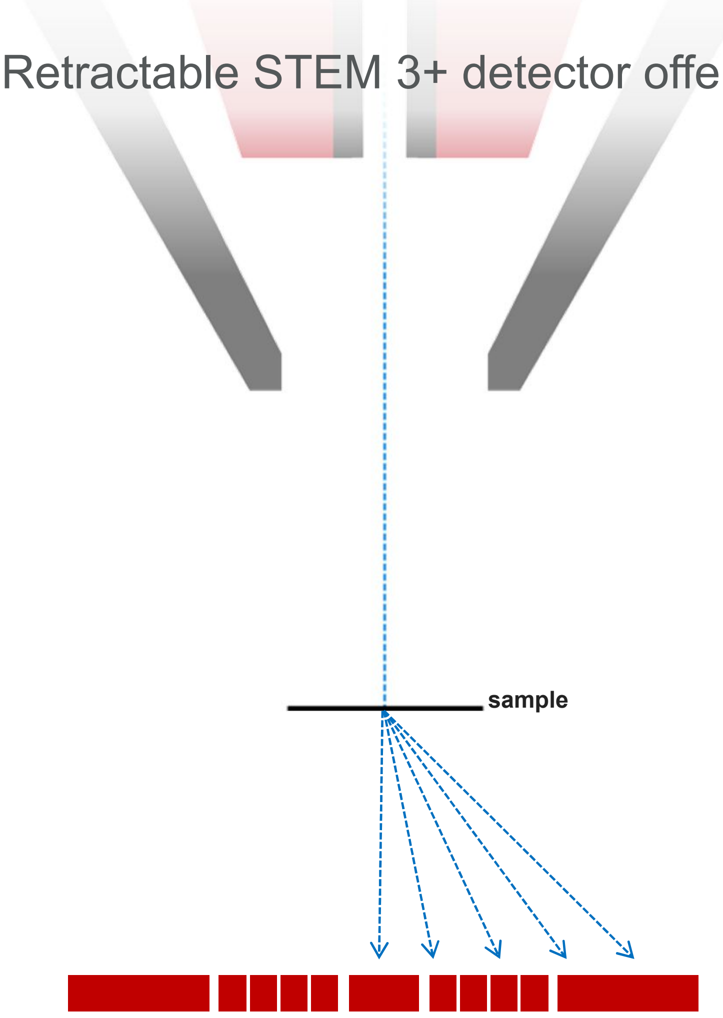
✓ Annular segmentation

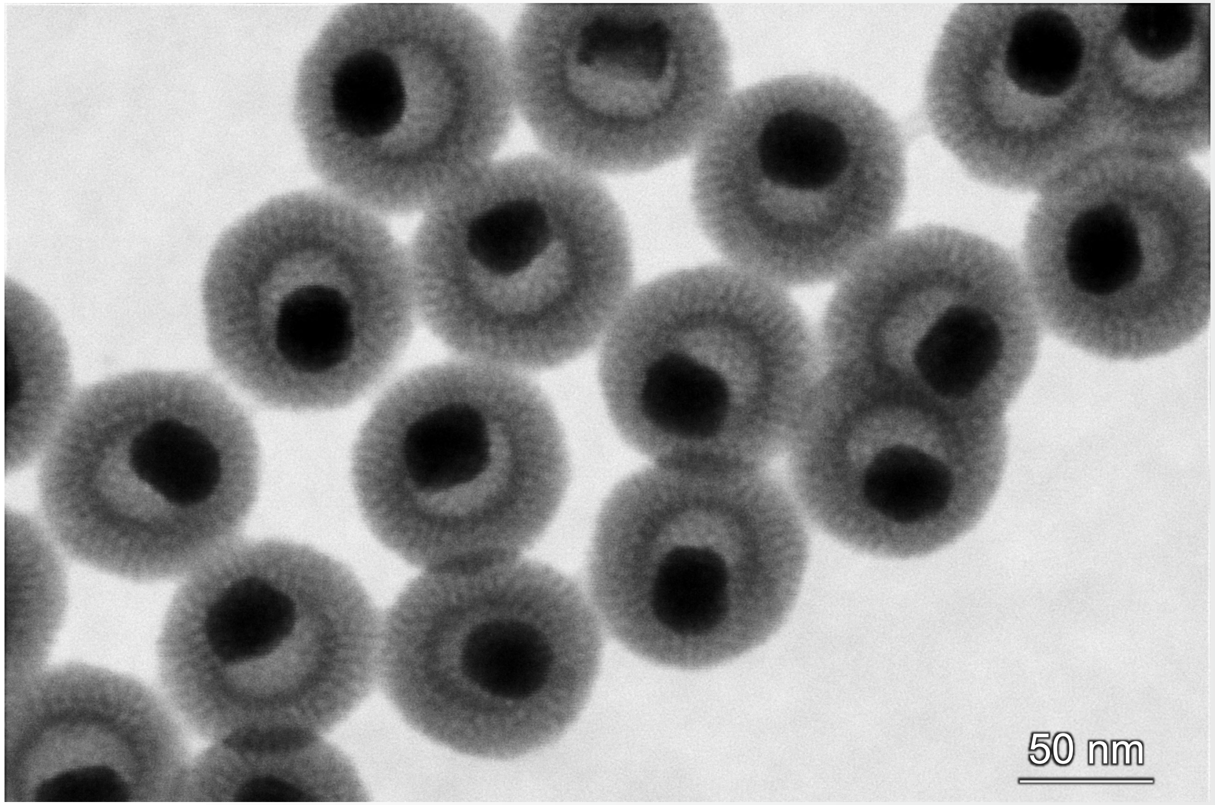


Sample: Ceramic with Pt particles
Images: Adrian Sandu

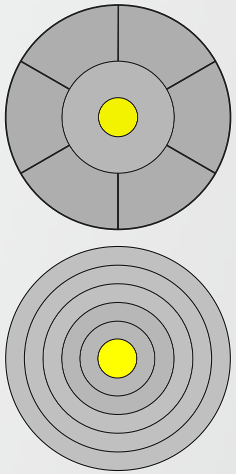
STEM 3/3+: Unique detector versatility

Retractable STEM 3+ detector offers 11 individually addressable segments





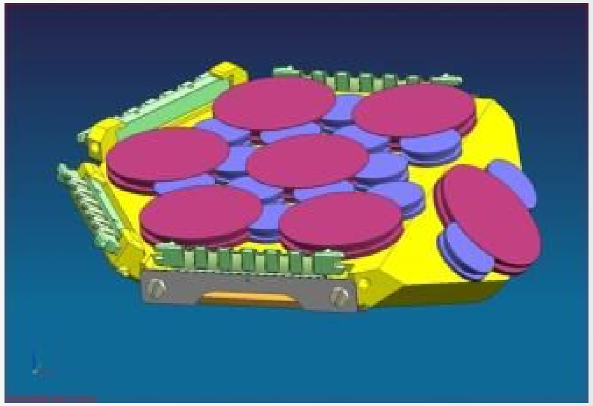
30 kV, BF

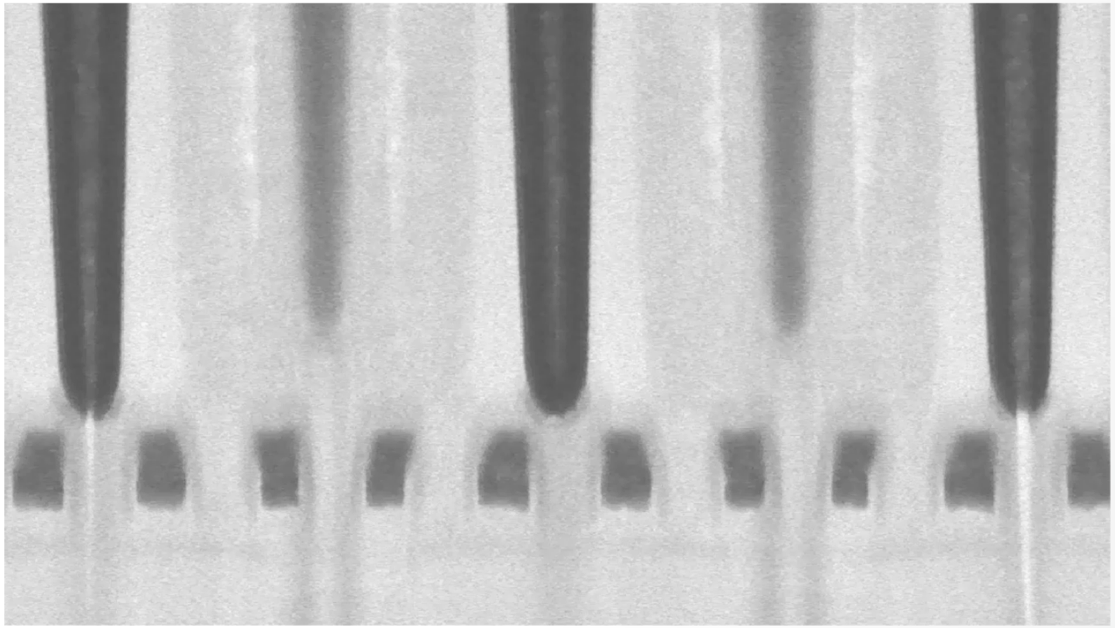


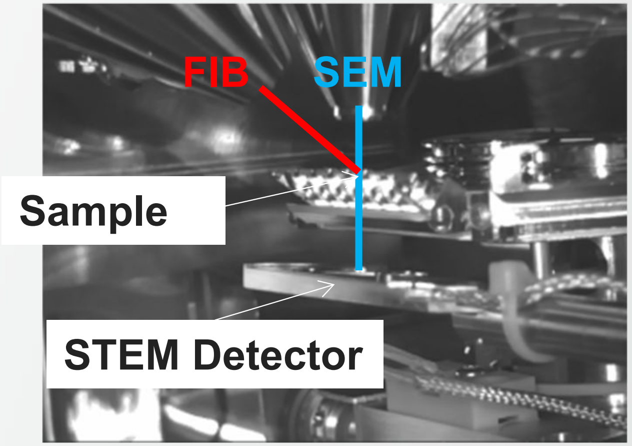
Live STEM imaging while thinning

Perform **live SEM and STEM imaging**, while thinning the sample

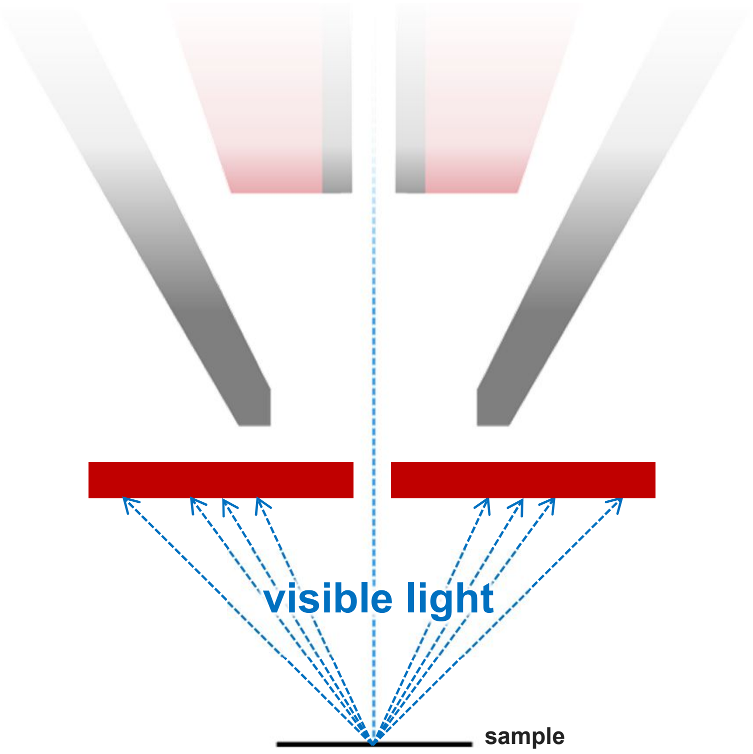
- Unique multi-purpose holder supporting up to 18 (1/2 inch) bulk samples, and 24 TEM sample grids
- Vertical and pre-tilted grid positions
- Lift-out the lamella and attach to the grid without breaking vacuum
- Insert the STEM detector directly underneath







RGB Cathodoluminescence Detector – Shortest time to real color imaging



Sensitivity: λ=350-900 nm

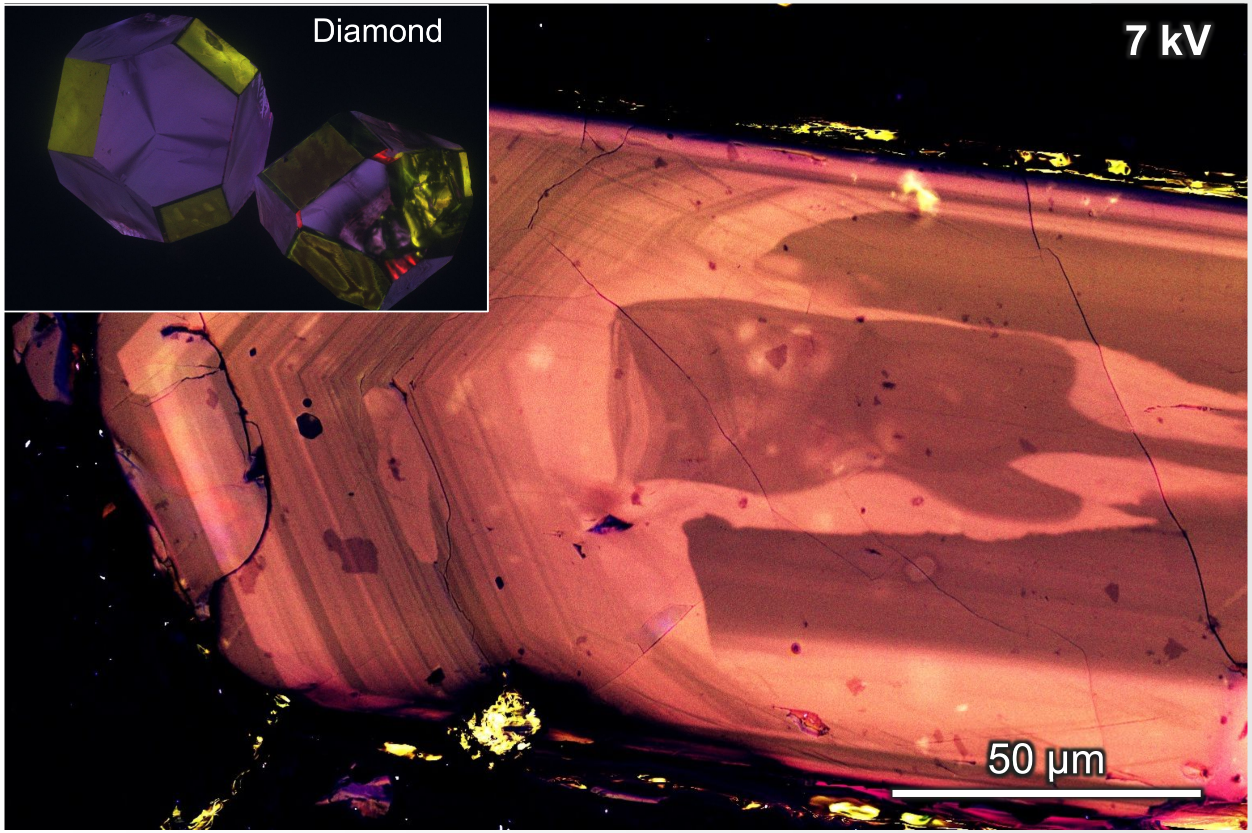


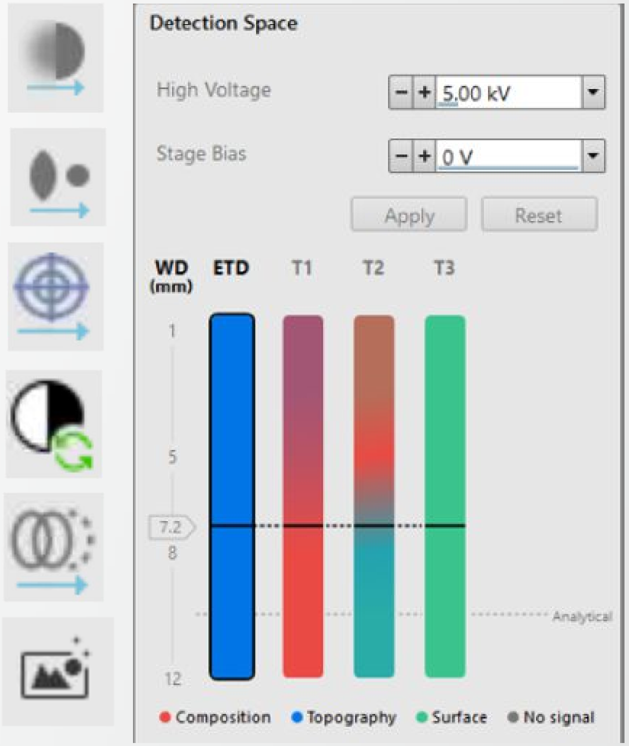
Image courtesy: UC Santa Cruz

New Software Focused on Ease of Use

New

- Auto-functions from Apreo SEM
  - AutoFocus
  - AutoStigmator
  - AutoLens Alignment
- Dynamic Contrast & Brightness
- AutoFlow (queuing auto-functions)
- **Adaptive Image Enhancement**
- **Smart Frame Integration**

- **Detection Space**
- **Rocking Mill**
- **Spin Mill**
- Auto Eucentric



Detection Space

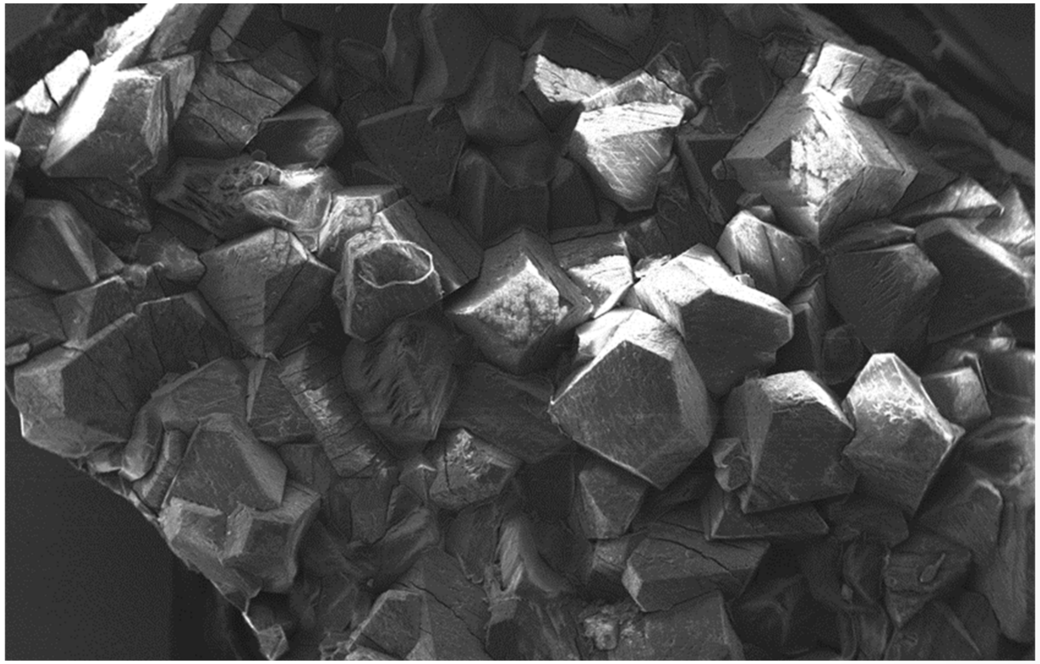
High Voltage: 5.00 kV

Stage Bias: 0 V

Smart Frame Integration

New

- Brand new imaging mode – Smart Frame Integration
  - Enhances image quality in real time by dynamically adjusting detector settings, using a High Dynamic Range algorithm for superior contrast and low noise, ensuring high-quality images with minimal effort.



SFI off

SFI on

Smart Frame Integration

New

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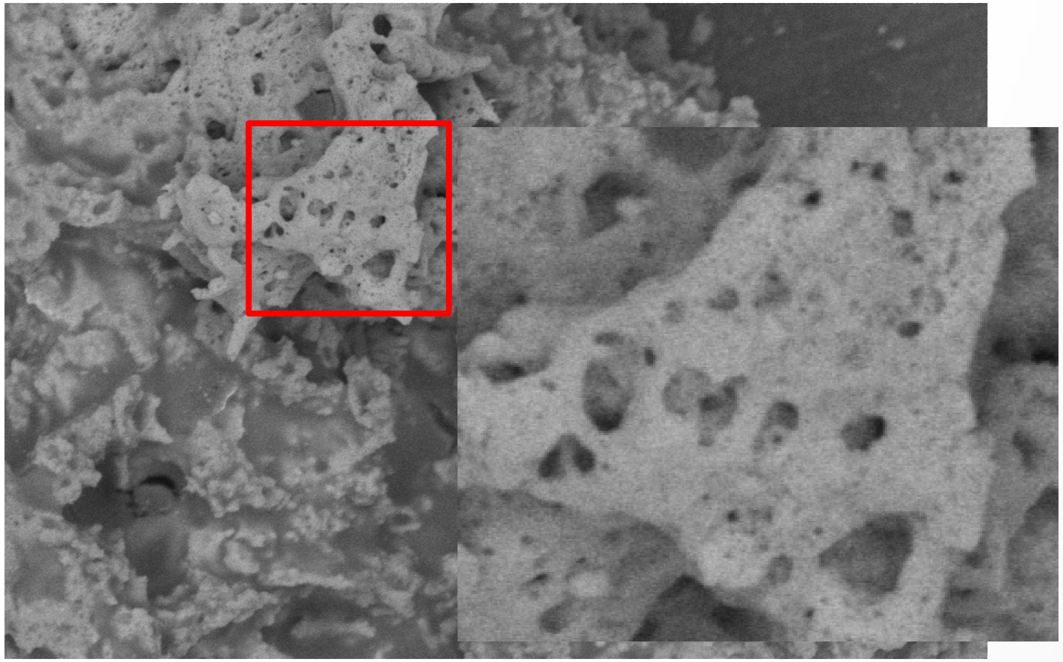
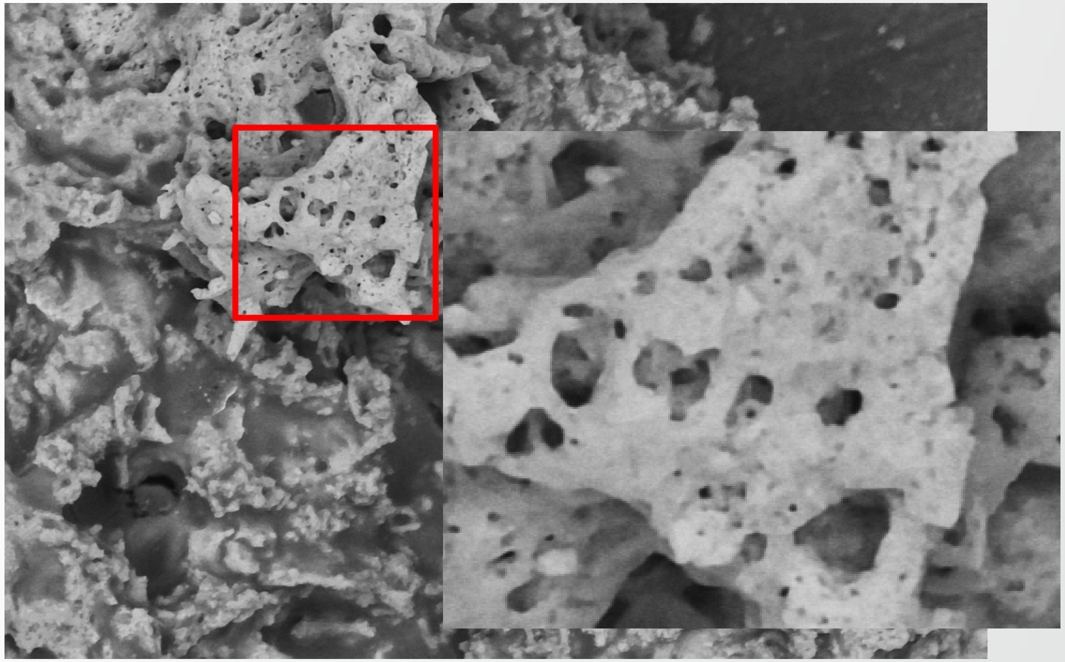
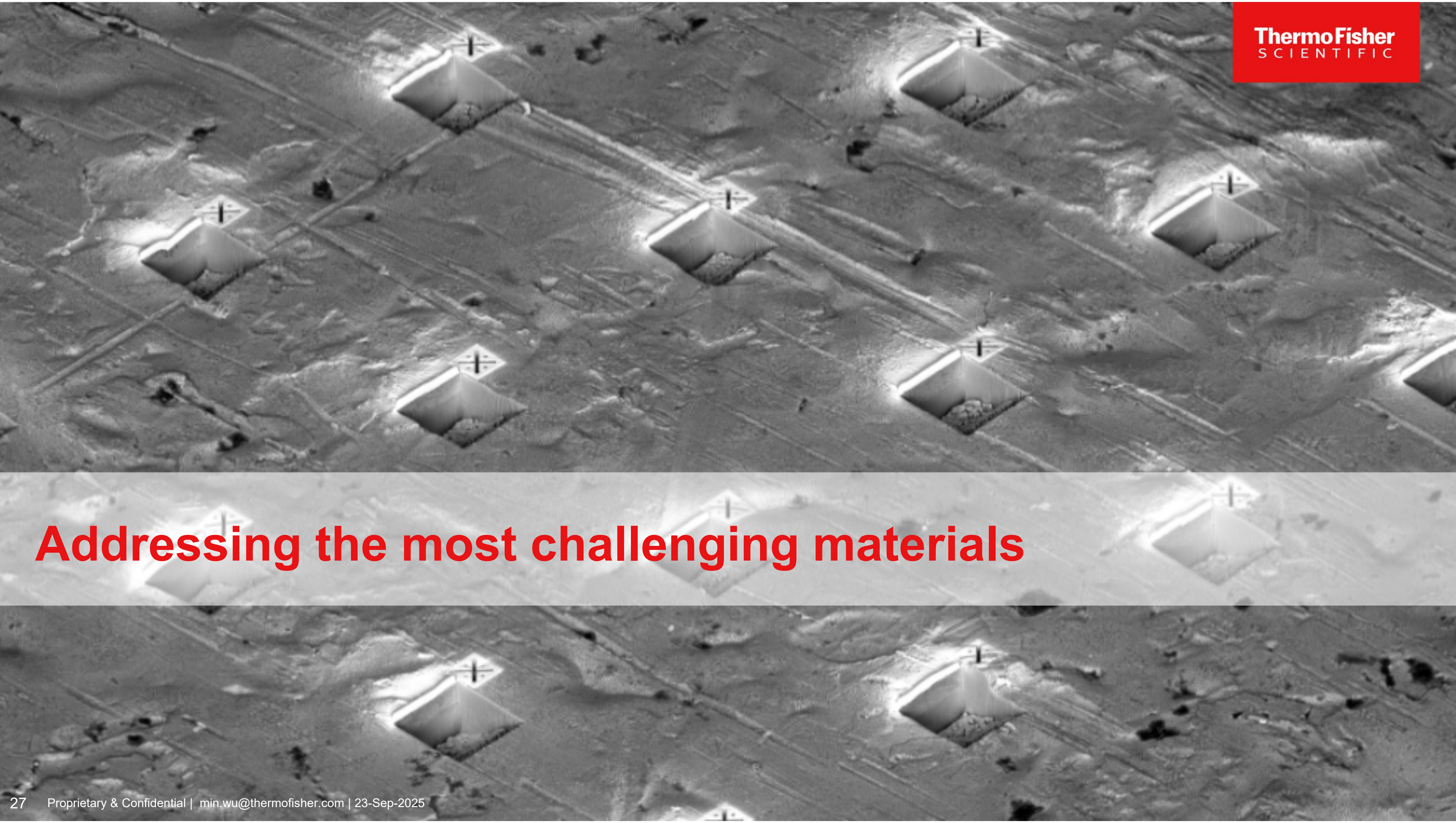


SFI off



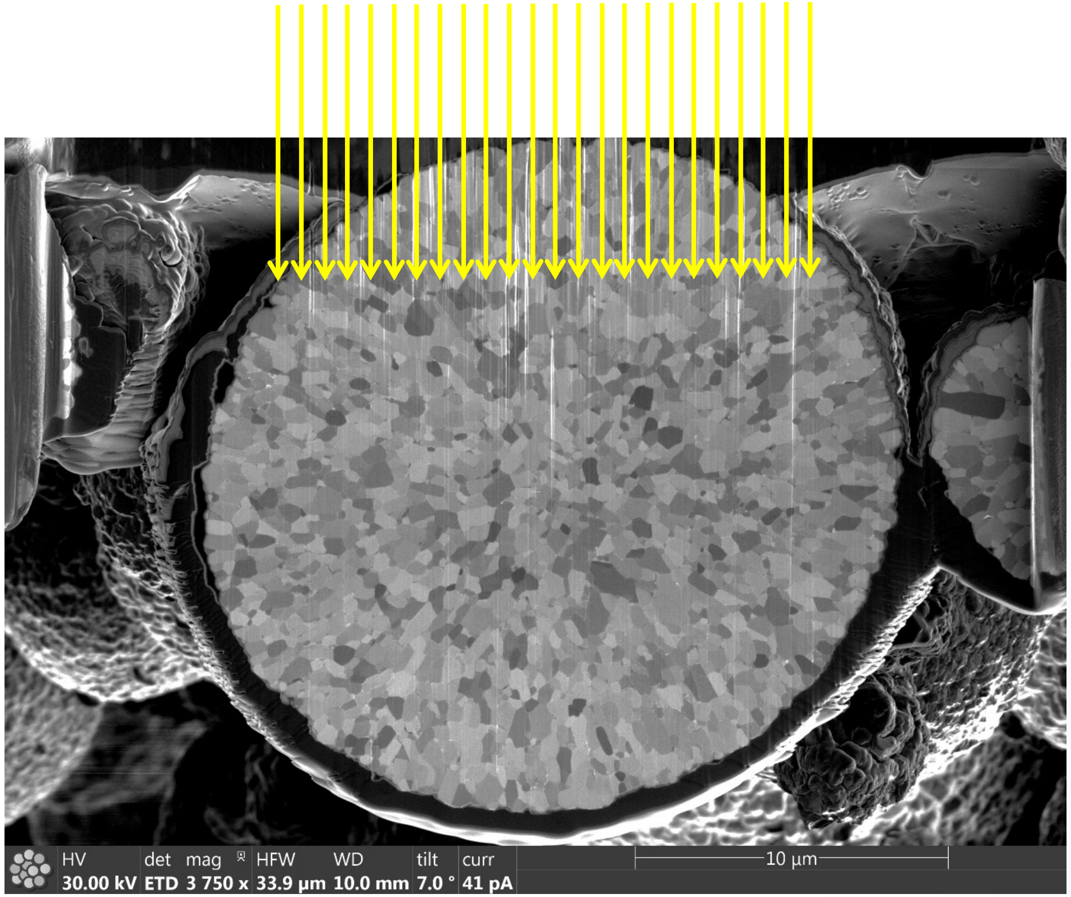
SFI on



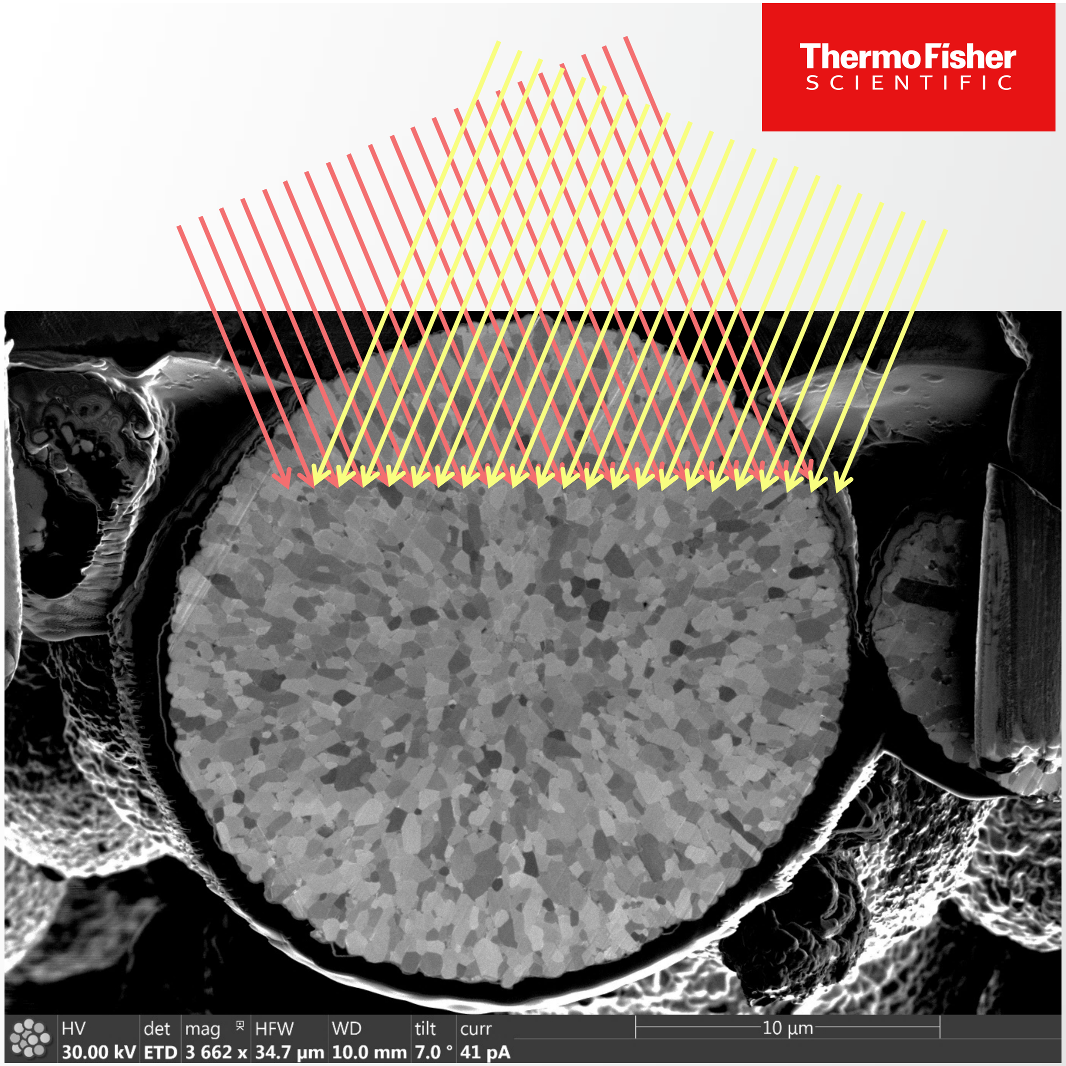
Addressing the most challenging materials

ThermoFisher
SCIENTIFIC

Rocking Mill Integrated in xT UI



Traditional Perpendicular Polishing



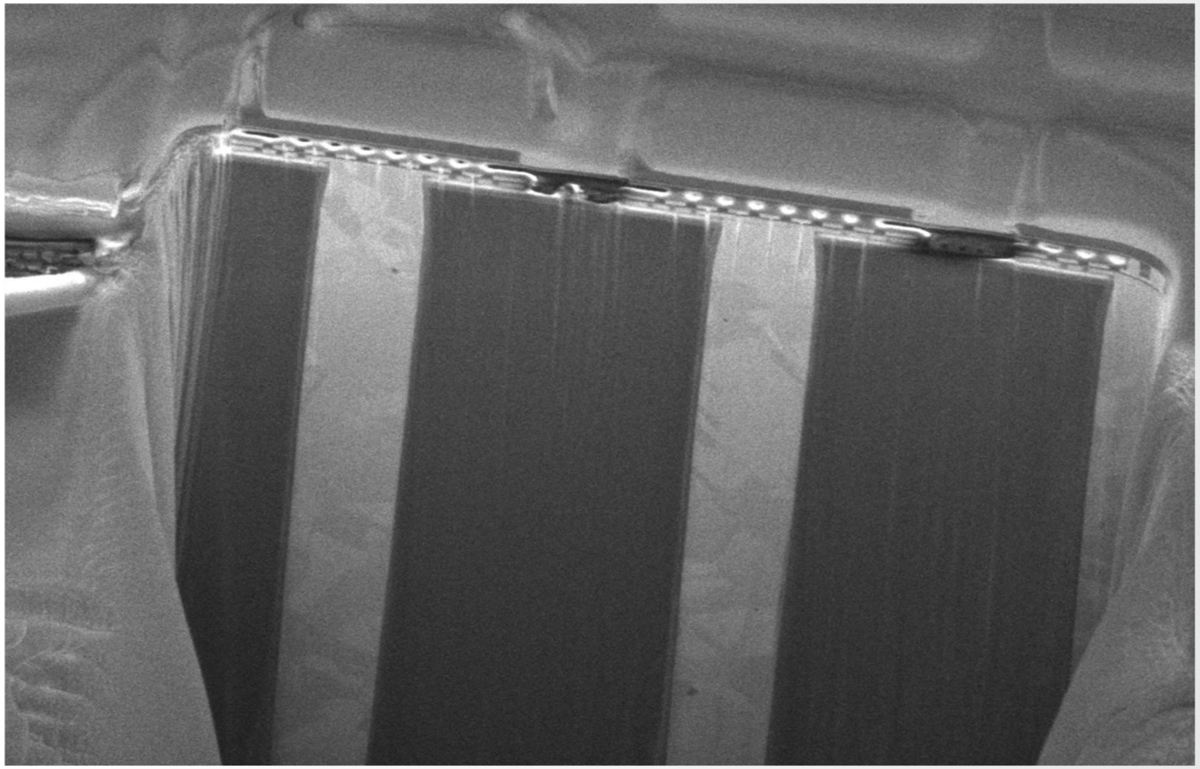
Rocking Mill Polishing

Courtesy: Devin Wu, Thermo Fisher

Rocking Mill Integrated in xT UI

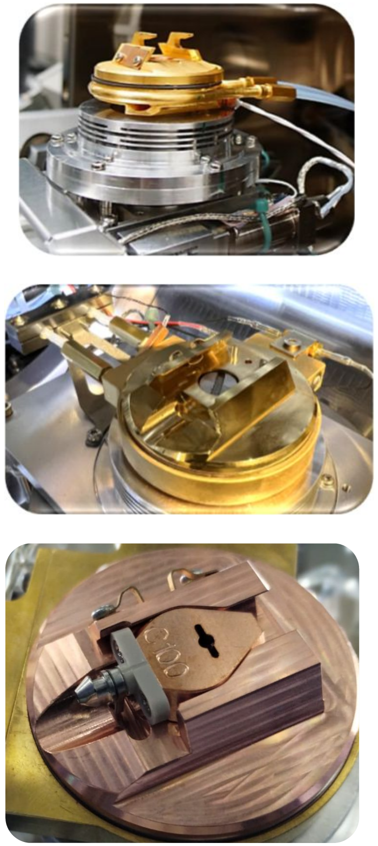
New

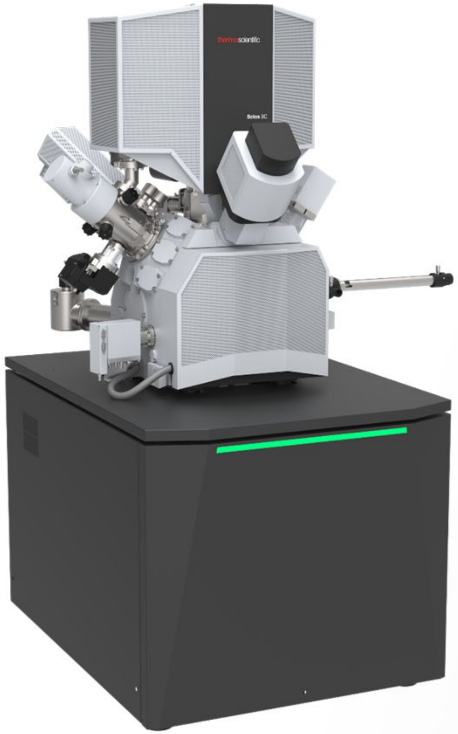
- Part of Scios 3 base platform
- No 3rd party HW add-ons or options needed
- Fully automated



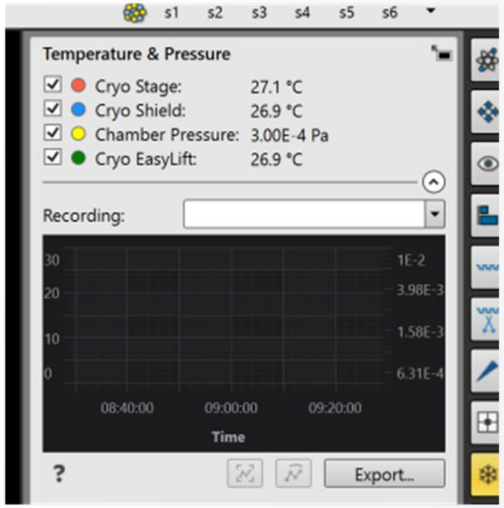
Integrated Aquilos cryo stage: New opportunity for cryogenic application for MS samples

Aquilos Cryo-Stage





Cryo tab in xT UI

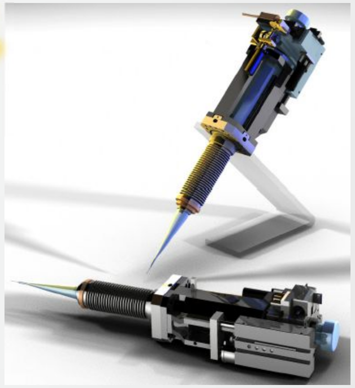


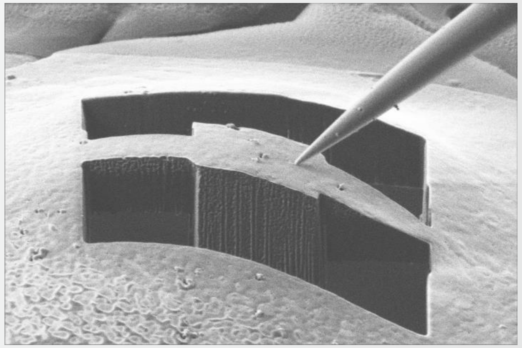
Temperature & Pressure

☑ Cryo Stage: 27.1 °C
☑ Cryo Shield: 26.9 °C
☑ Chamber Pressure: 3.00E-4 Pa
☑ Cryo EasyLift: 26.9 °C

Recording:

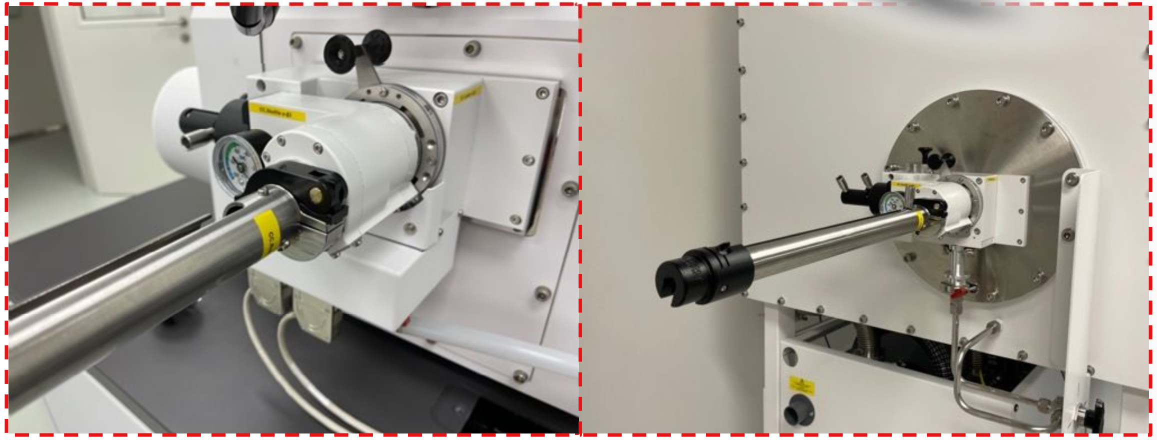
New





Exploring new paths for cryo-applications (lamella preparation, AS&V, Cryo EasyLift)

Integrated CleanConnect™ for air sensitive sample transfer



Microscope side

Glovebox side

Key Benefits

Sample integrity is preserved by the use of inert gas sample transfer

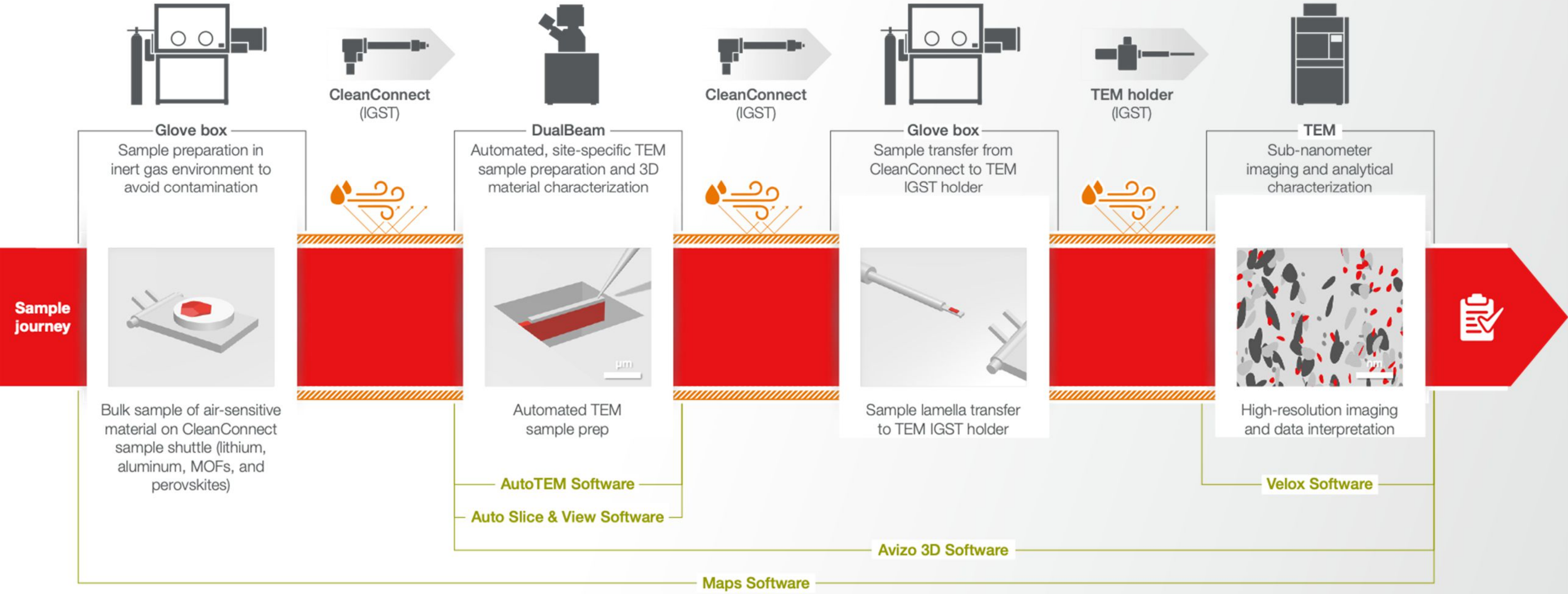
Seamless, automatic integration to a variety of Thermo Scientific SEM/DualBeams

Compatible with Cryo-stage with no any changes in system or microscope

Ergonomic and modular design enables uncomplicated sample handling

Compatible with most glove box systems and available with optional direct glove box connectivity

Thermo Scientific Inert Gas Sample Transfer workflow



Sample journey

Glove box
Sample preparation in inert gas environment to avoid contamination

Bulk sample of air-sensitive material on CleanConnect sample shuttle (lithium, aluminum, MOFs, and perovskites)

CleanConnect
(IGST)

DualBeam
Automated, site-specific TEM sample preparation and 3D material characterization

Automated TEM sample prep

CleanConnect
(IGST)

Glove box
Sample transfer from CleanConnect to TEM IGST holder

Sample lamella transfer to TEM IGST holder

TEM holder
(IGST)

TEM
Sub-nanometer imaging and analytical characterization

High-resolution imaging and data interpretation

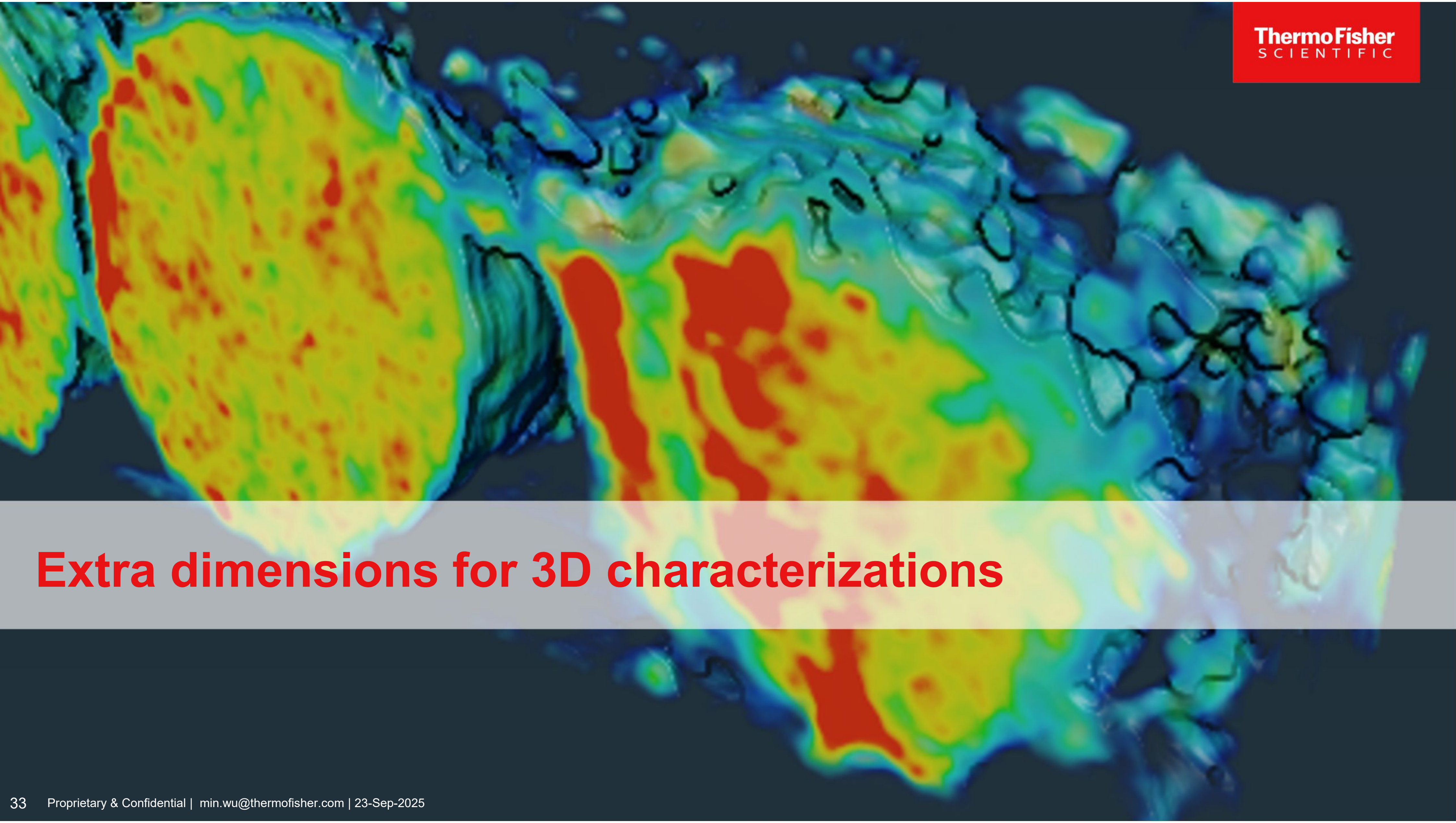
AutoTEM Software

Auto Slice & View Software

Velox Software

Avizo 3D Software

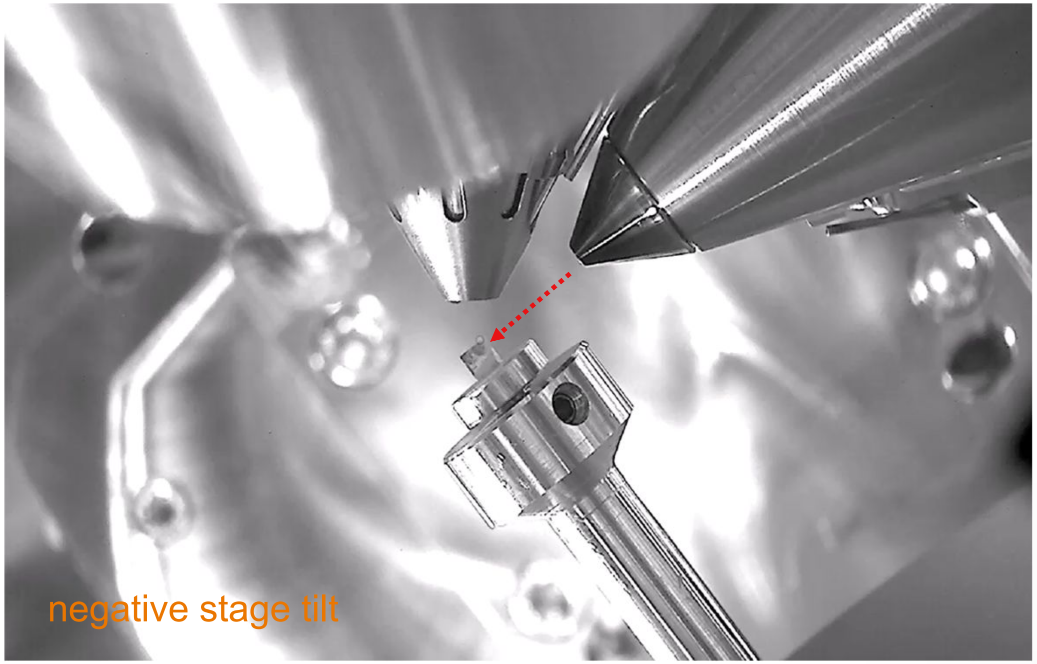
Maps Software

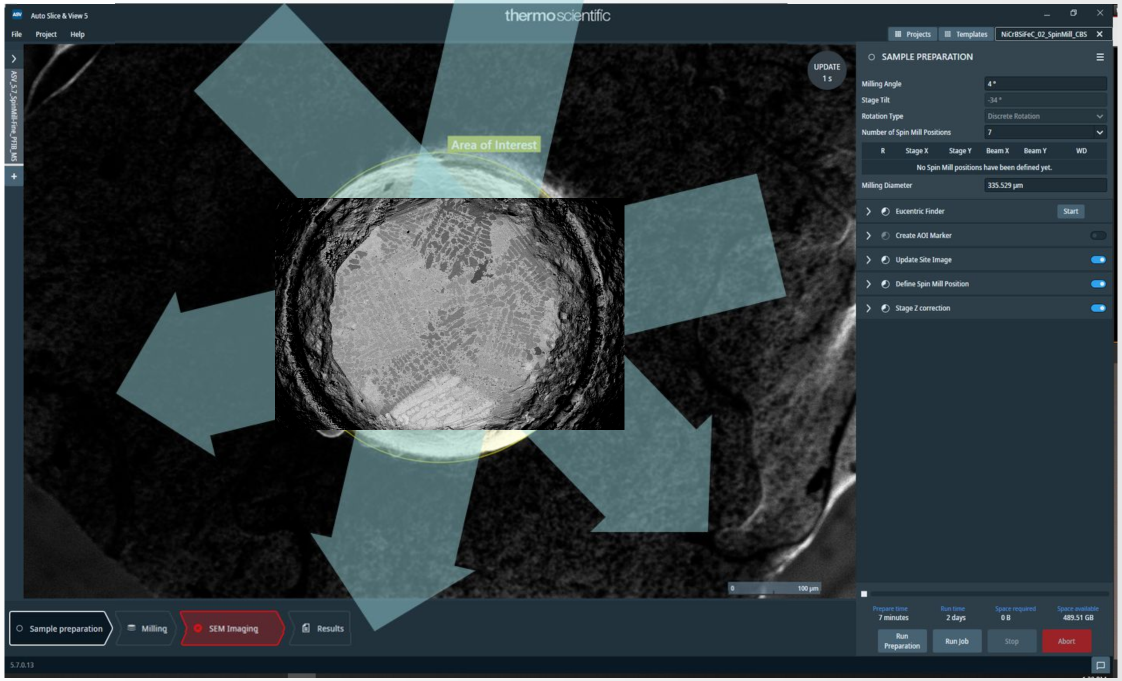


Extra dimensions for 3D characterizations

Spin Mill on Scios 3

New





SAMPLE PREPARATION

Milling Angle: 4 °
Stage Tilt: -34 °
Rotation Type: Discrete Rotation
Number of Spin Mill Positions: 7

R	Stage X	Stage Y	Beam X	Beam Y	WD
No Spin Mill positions have been defined yet.					

Milling Diameter: 335.529 µm

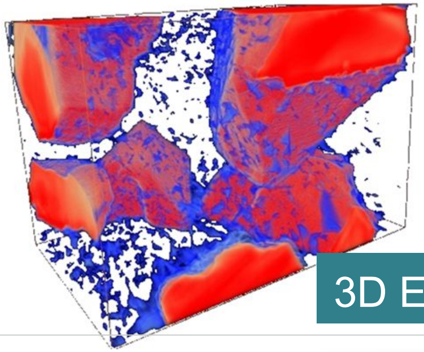
- Eucentric Finder — Start
- Create AOI Marker
- Update Site Image
- Define Spin Mill Position
- Stage Z correction

Prepare time	Run time	Space required	Space available
7 minutes	2 days	0 B	489.51 GB

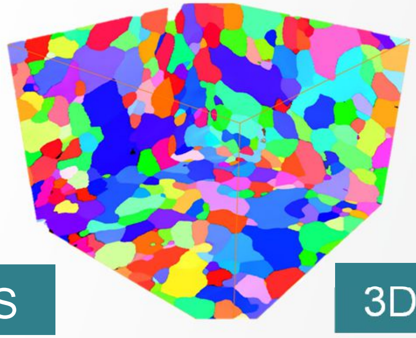
- Method for accessing very large regions in horizontal plane – for surface polishing or 3D characterization
- Negative stage tilt is a must – very low angle milling
- Spin Mill – ion milling at glancing angles is enabled on Scios 3 thanks to **the extended negative 38° tilt range**

AS&V 5 + SIMS enables large volume 3D SIMS analysis

Enables 3D analytics

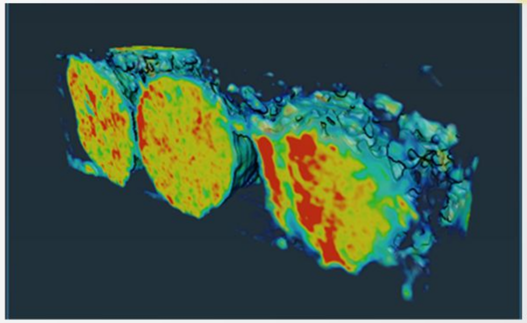


3D EDS

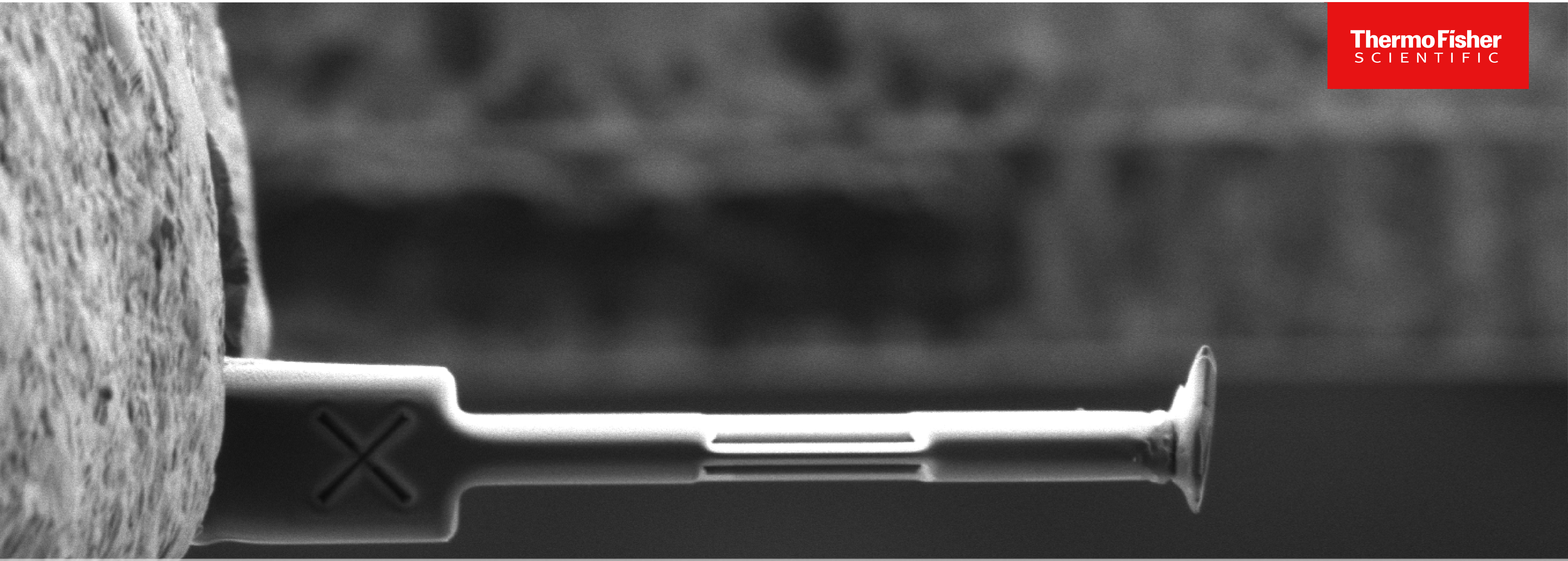


3D EBSD

New



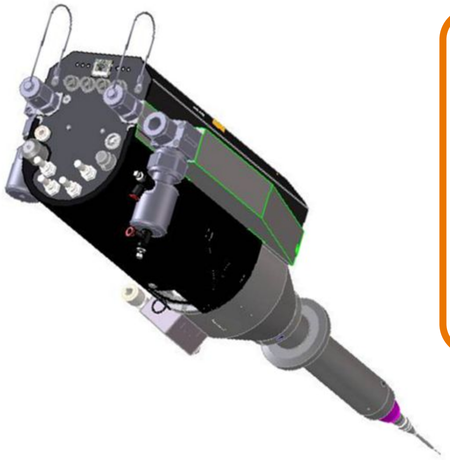
True 3D SIMS with extended volumes



Automated TEM sample lamella preparation with AutoTEM 5

MultiChem for Scios 3S

New



- Up to 6 gas chemistry
- Gas mixing capability
- Piezo drive movement of nozzle fully integrated in the UI

Enhanced Etch
EE

Insulator Enhanced Etch
IEE

Copper Etch
SCM

Si Trenching
IEE

Delayering/Cu-Etch
Dx

Insulator Deposition
IDEP II

Delineation Etch
DE/Low-k Dielectric Etch

¶ Platinum
Pt

Standard GIS. Tiny grain structure - good for focusing. Softer than C. Good for probe pads ~500u-ohm-cm. Conductor deposition for circuit edit (CE).

¶ Carbon
C

Good for TEM prep. No visible grain structure and good contrast next to low atomic number material. Typically, not used for CE. A PFA Cap layer which can also be used for welding.

¶ Tungsten
W

Good contrast next to high atomic number materials. Conductor deposition for CE with lower resistivity than Pt. For via deposition, connections of nets and vias. ~200u-Ohm-cm. Requires high beam currents for deposition.

And much more……

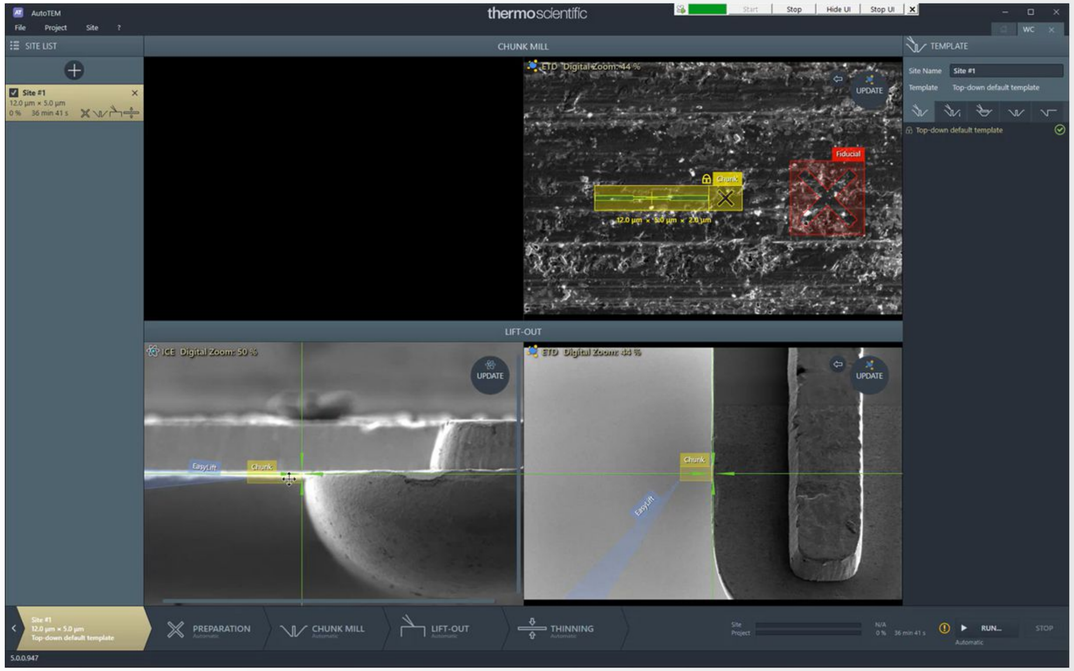
Replacing difficult manual procedure with 3 simple steps

Traditional Procedure

1. Switch to e-beam deposition 2 kV, high current
2. Find the ROI
3. Select Pt e-dep application
4. Place pattern rectangle with right dimensions
5. Start e-beam deposition
6. Tilt towards ion beam
7. Switch back to SEM imaging conditions
8. Set FIB parameters for deposition
9. Place pattern rectangle with right dimensions
10. Select Pt i-dep application
11. Start i-beam deposition
12. Locate area of interest
13. Bulk milling of trenches
14. Undercut chunk
15. Bulk cleanup
16. Mounting manipulators to the stage
17. Move manipulator needle to chunk for extraction from bulk
18. Insert GIS
19. Set FIB parameters for deposition
20. Define deposition pattern and attach needle to chunk
21. Set FIB parameters for milling
22. Define milling pattern and release chunk from bulk
23. Retract GIS
24. Retract needle
25. Find grid
26. Move needle to grid for attachment to grid
27. Weld chunk to grid
28. Release chunk from needle
29. Retract probe
30. Switch to 1nA
31. Tilt to 53.5 degrees and remove re-deposited material from lift-out, clean up front
32. Tilt to 50.5 degrees and clean up back until sample is ~0.5µm thick
33. Reduce current to 300pA and tilt to 53.2 degrees.
34. Clean front until 0.25µm thick
35. Change tilt to 50.8 degrees and clean back until 0.15µm thick
36. Reduce current to 100pA and change tilt to 52.8 degrees. Thin sample until ~0.12µm
37. Change tilt to 51.2 degrees and thin sample until ~0.1µm thick or until Pt capping layers starts to be removed
38. Watch for bending or non-uniform thinning during entire process
39. Change beam currents and tilts for any new material
40. Switch FIB energy to 5 kV
41. Change tilt to 57 degrees
42. Quickly take an image of the lamella to avoid adding re-deposition on the lamella surface
43. Identify the thin part of the lamella only
44. Define and place pattern over thin part only
45. Change tilt to 47 degrees and repeat pattern
46. Switch FIB energy to 2 kV and repeat
47. Switch FIB energy to 1 kV or lower and repeat

~50 manual steps

AutoTEM 5 → Fast, simple and intuitive



Site Name: Site #1
Template: Top-down default template

1. Select template
2. Define position on the bulk
3. Define grid position

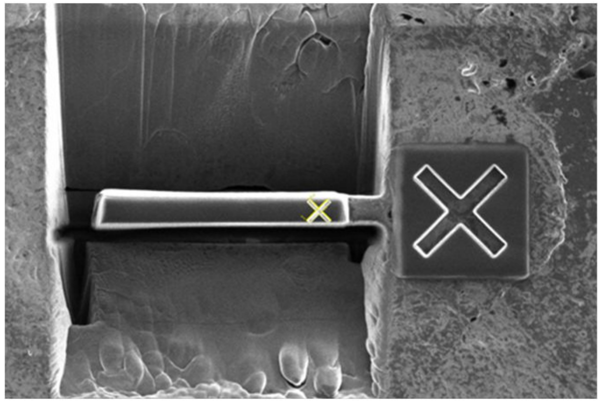
▶ RUN

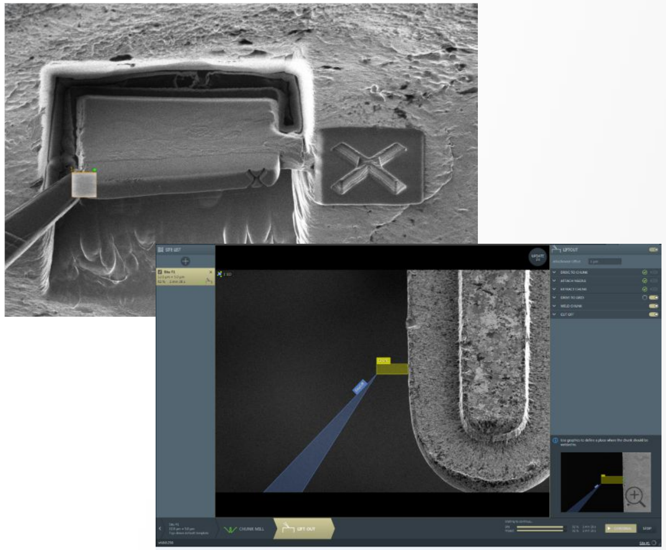
AutoTEM 5 – Fully automated *in-situ* Lift-out Workflow

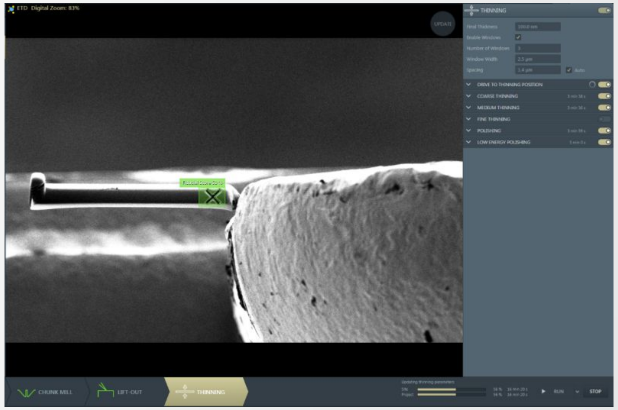
CHUNK MILL

LIFT-OUT

THINNING

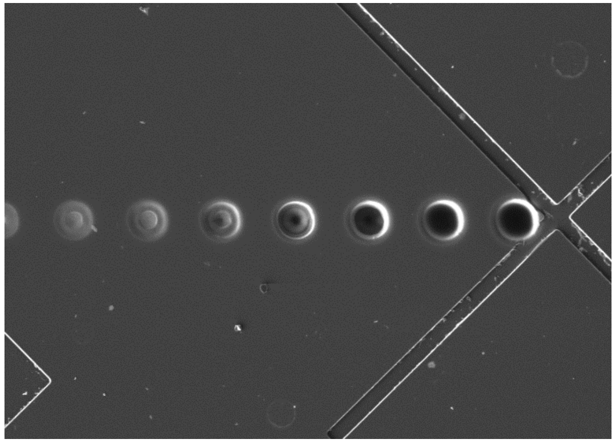




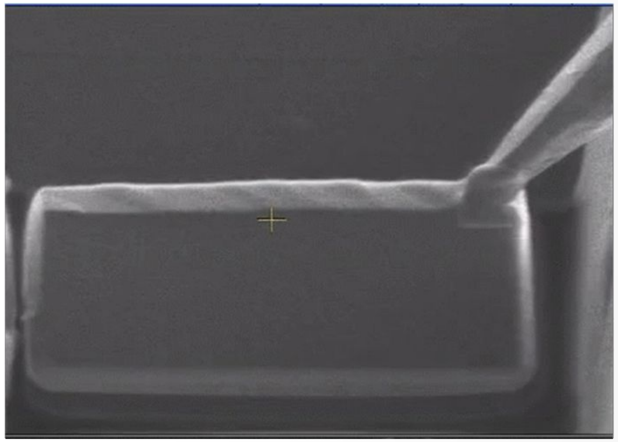


Fully automated, highest quality in-situ sample preparation

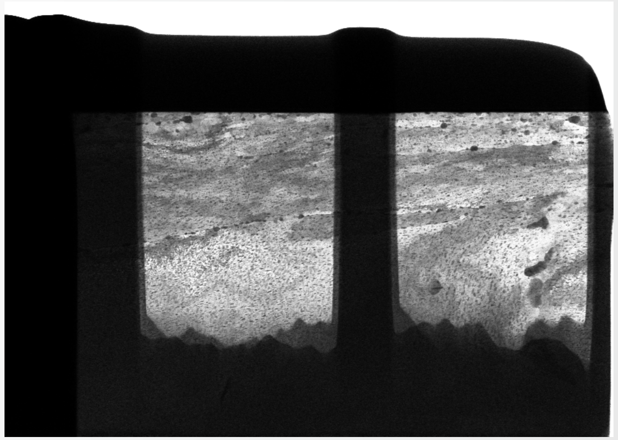
Scios 3 - Setting Up Modern Labs for Success



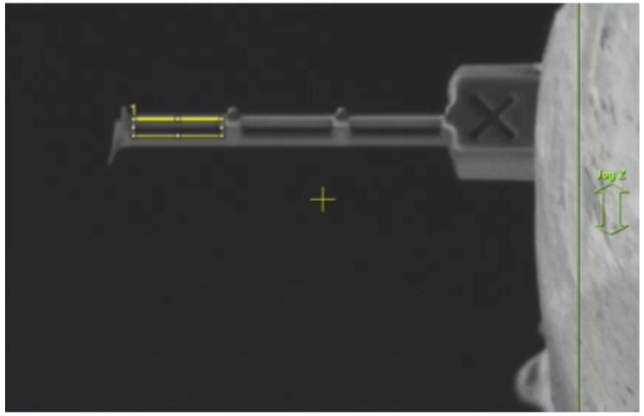
Excellent beam profiles at 65nA and 100 nA for fast and precise chunking



EasyLift nanomanipulator for seamless and reliable lift-out



Simultaneous FIB thinning and live monitoring with STEM 3+ for lamella quality check



Tomahawk HT low kV performance that makes a difference, allowing **full automation** on Scios 3S.

New

Top down, plan view, inverted lamella

AT Automated 5 kV and 2 kV final polishing with AutoTEM 5 software

Cross-sectioning… Applying the Power of Automation

New Auto Cross-Section Software

Automated milling and imaging

Full End-to-End Workflow

New

Targeted multi-site multi- sample FIB cross-sectioning

Automated SEM Imaging

Results evaluation

Software that anyone can use…

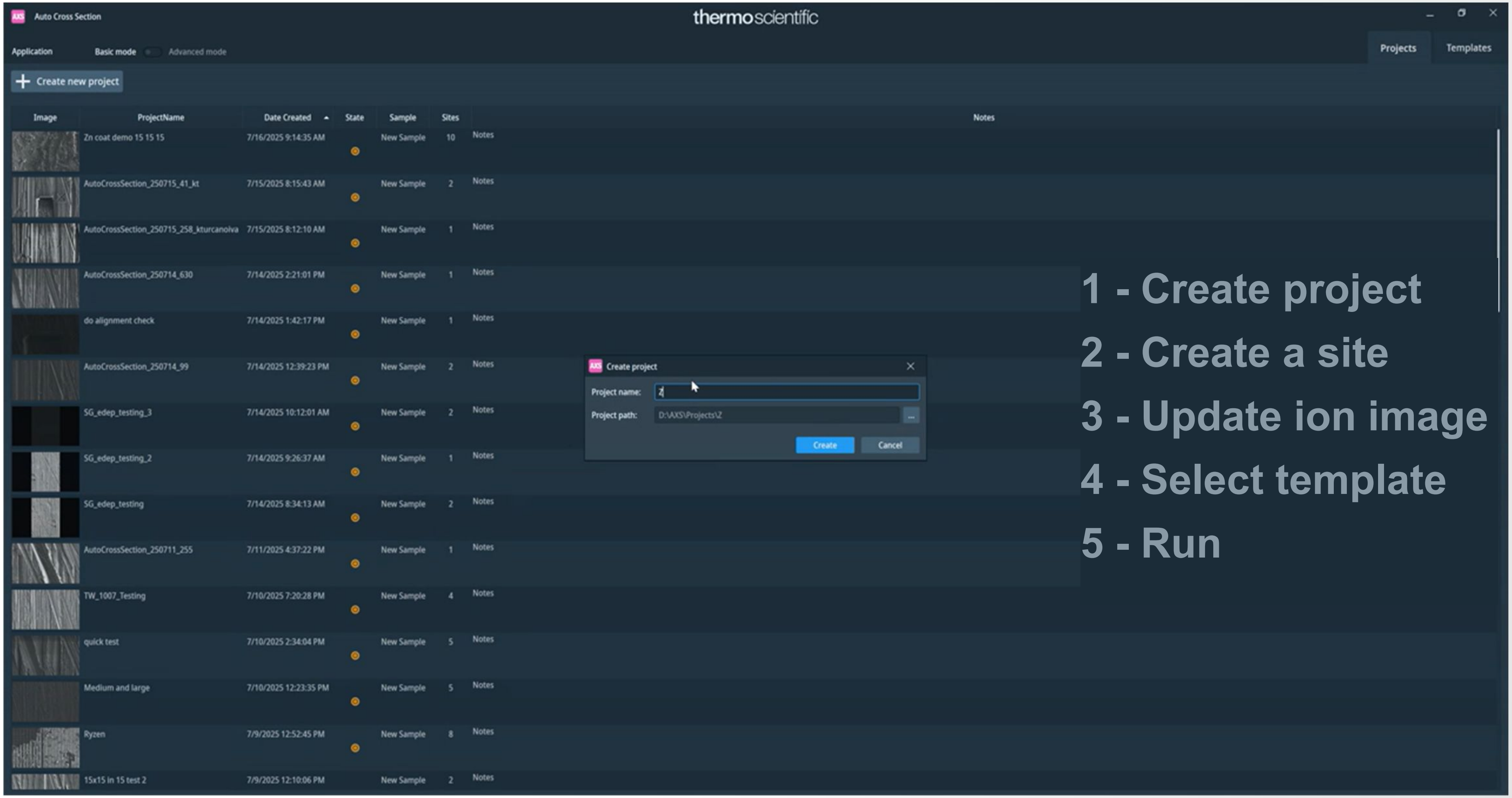


Image	ProjectName	Date Created	State	Sample	Sites	Notes
	Zn coat demo 15 15 15	7/16/2025 9:14:35 AM	●	New Sample	10	Notes
	AutoCrossSection_250715_41_kt	7/15/2025 8:15:43 AM	●	New Sample	2	Notes
	AutoCrossSection_250715_258_kturcanoiva	7/15/2025 8:12:10 AM	●	New Sample	1	Notes
	AutoCrossSection_250714_630	7/14/2025 2:21:01 PM	●	New Sample	1	Notes
	do alignment check	7/14/2025 1:42:17 PM	●	New Sample	1	Notes
	AutoCrossSection_250714_99	7/14/2025 12:39:23 PM	●	New Sample	2	Notes
	SG_edep_testing_3	7/14/2025 10:12:01 AM	●	New Sample	2	Notes
	SG_edep_testing_2	7/14/2025 9:26:37 AM	●	New Sample	1	Notes
	SG_edep_testing	7/14/2025 8:34:13 AM	●	New Sample	2	Notes
	AutoCrossSection_250711_255	7/11/2025 4:37:22 PM	●	New Sample	1	Notes
	TW_1007_Testing	7/10/2025 7:20:28 PM	●	New Sample	4	Notes
	quick test	7/10/2025 2:34:04 PM	●	New Sample	5	Notes
	Medium and large	7/10/2025 12:23:35 PM	●	New Sample	5	Notes
	Ryzen	7/9/2025 12:52:45 PM	●	New Sample	8	Notes
	15x15 in 15 test 2	7/9/2025 12:10:06 PM		New Sample	2	Notes

Project name: Z

Project path: D:\AXS\Projects\Z

1 - Create project

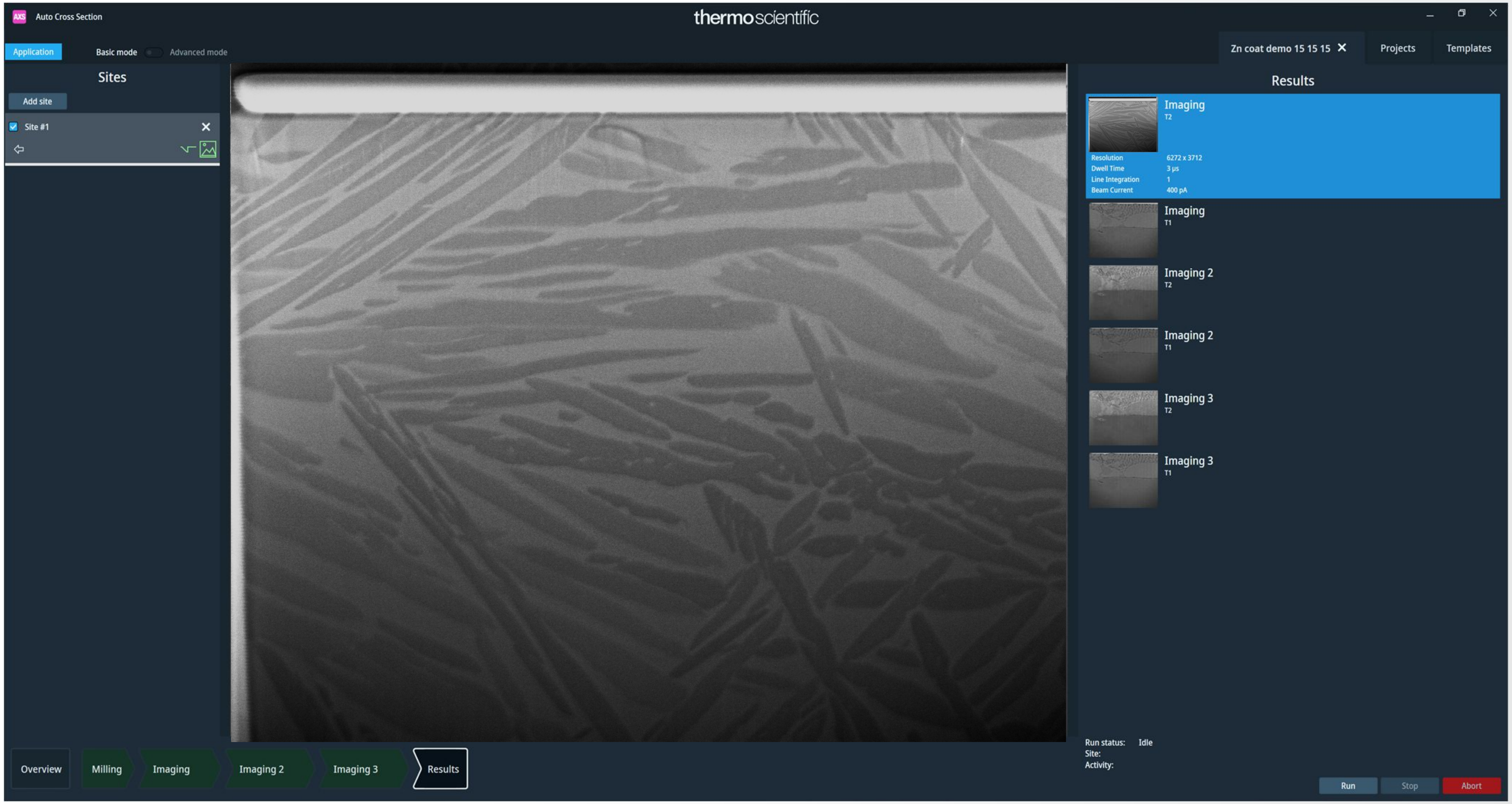
2 - Create a site

3 - Update ion image

4 - Select template

5 - Run

Immediate Access to Results



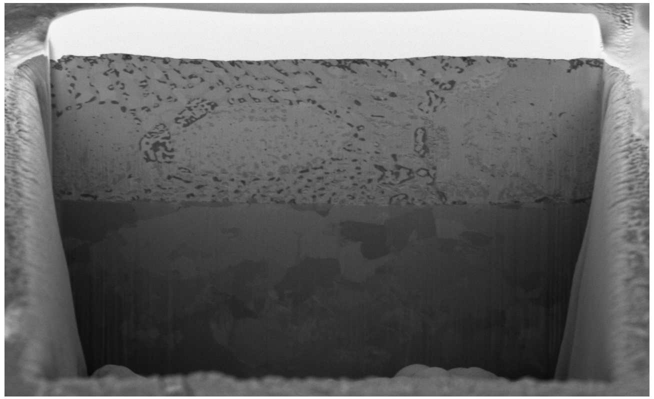
Resolution 6272 x 3712
Dwell Time 3 µs
Line Integration 1
Beam Current 400 pA

Run status: Idle
Site:
Activity:

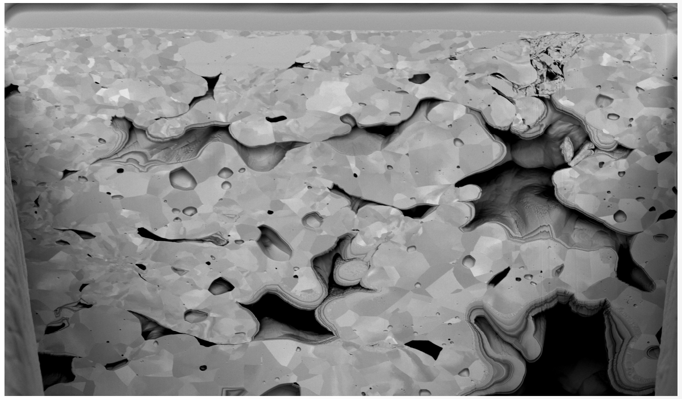
Acquired data are at your fingertips for the review

Tuned to Work for Materials Science Samples

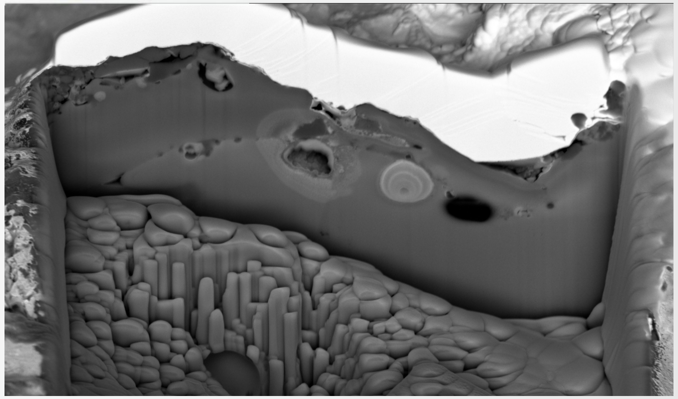
New



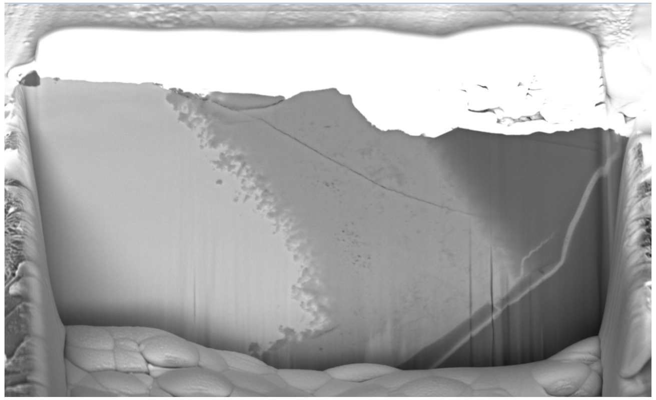
Zn-based automotive coating



Ceramic crucible



PEO coating on Al



Gibeon meteorite

Smart software controls enable accurate milling and imaging on the wide variety of materials

Courtesy: Bart Winiarski, Stepan Gamanov, Thomas Weston, Thermo Fisher

Delivering Statistical Relevance with Multi-Site Acquisition

Configure arrays and multi-sample projects for experimental consistency and precision while optimizing microscope use