

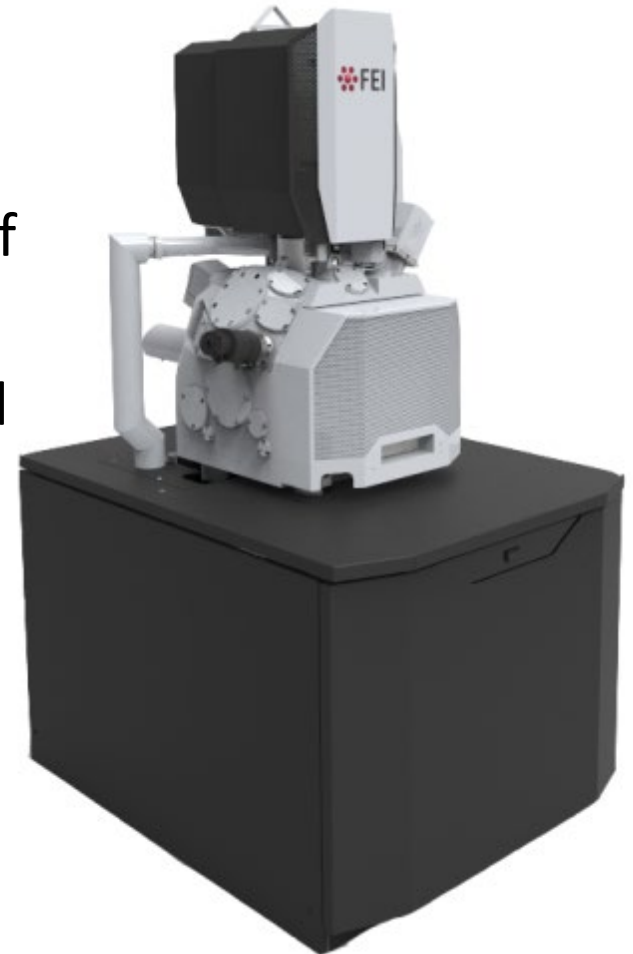


Teneo SEM



Teneo

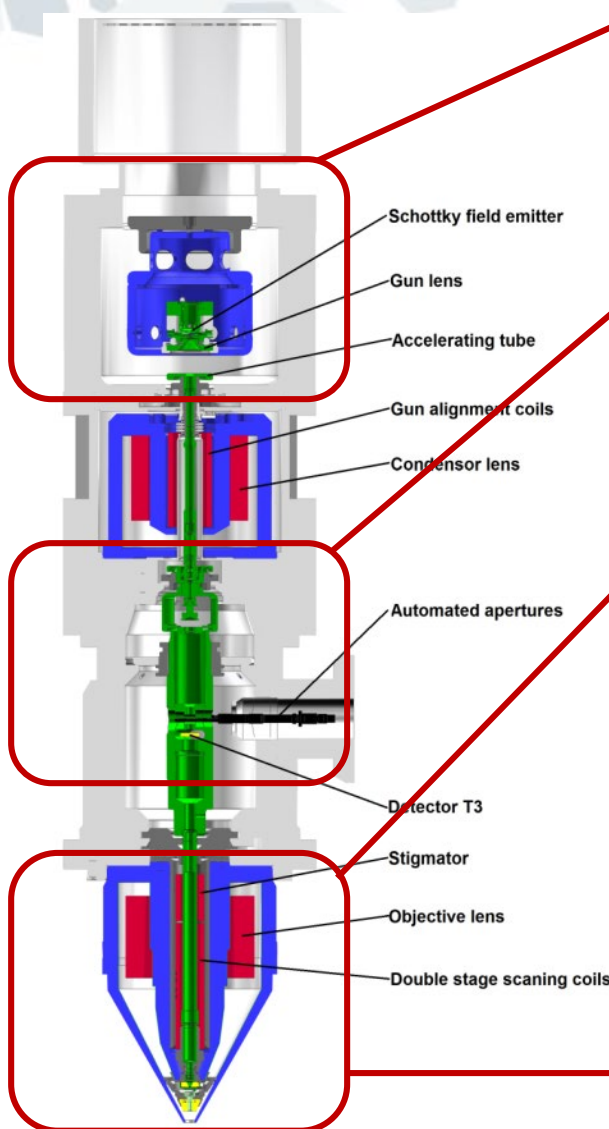
- A revolution in detection – the unique Trinity™ detection scheme delivers highest contrast on the widest range of samples
- Fastest and most accurate imaging and analysis of non-conductive materials
- Redefining SEM Workflows to deliver ease of use: User Guidance and NG User Interface ensures high performance for all users
- Smallest footprint, fastest installation and reduced cost-of-ownership with ‘ship-as-one’ concept



Outline

- Introduction
- NICol benefits
- Configurations
- Flexibility
- Analytical Performance
- Ease of use
- Additional information

NICol SEM Column

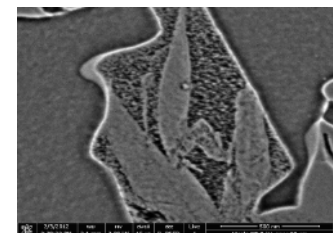
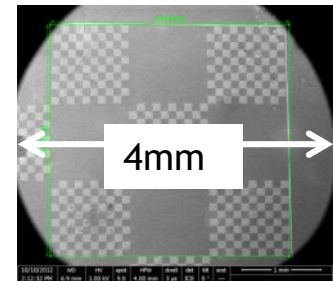
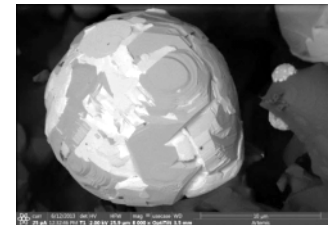


Faster and easier maintenance with auto bake-out, auto-start and fully automated alignments

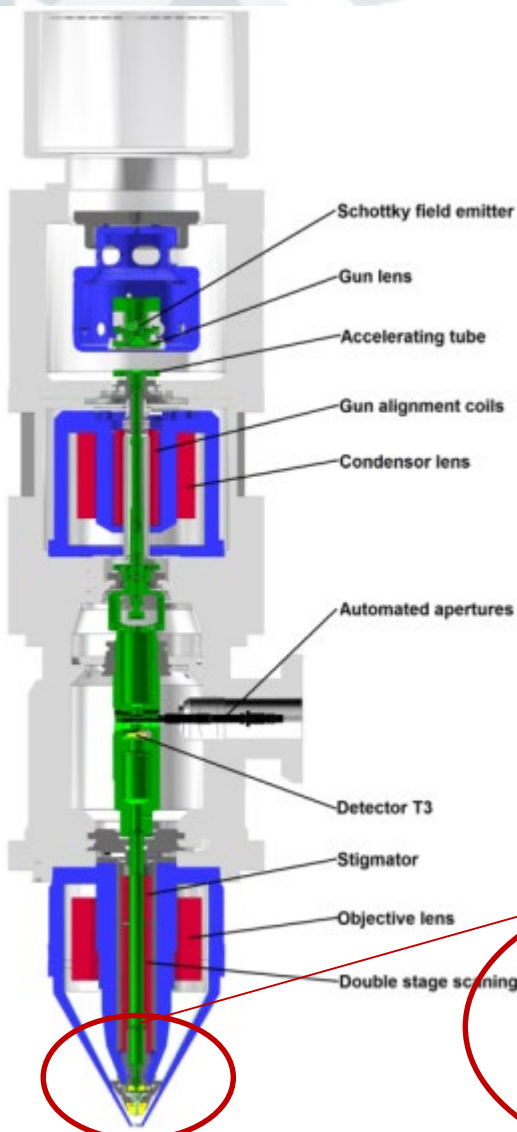
Optimum conditions at any beam current with automated, heated apertures

Accurate wide field of view imaging with double stage scanning coils

Ultra high resolution imaging of all samples, including magnetic materials with Dual objective lens

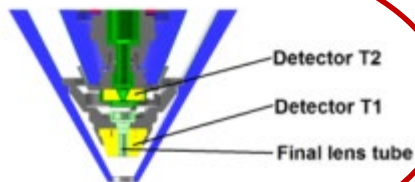


NICol Benefits

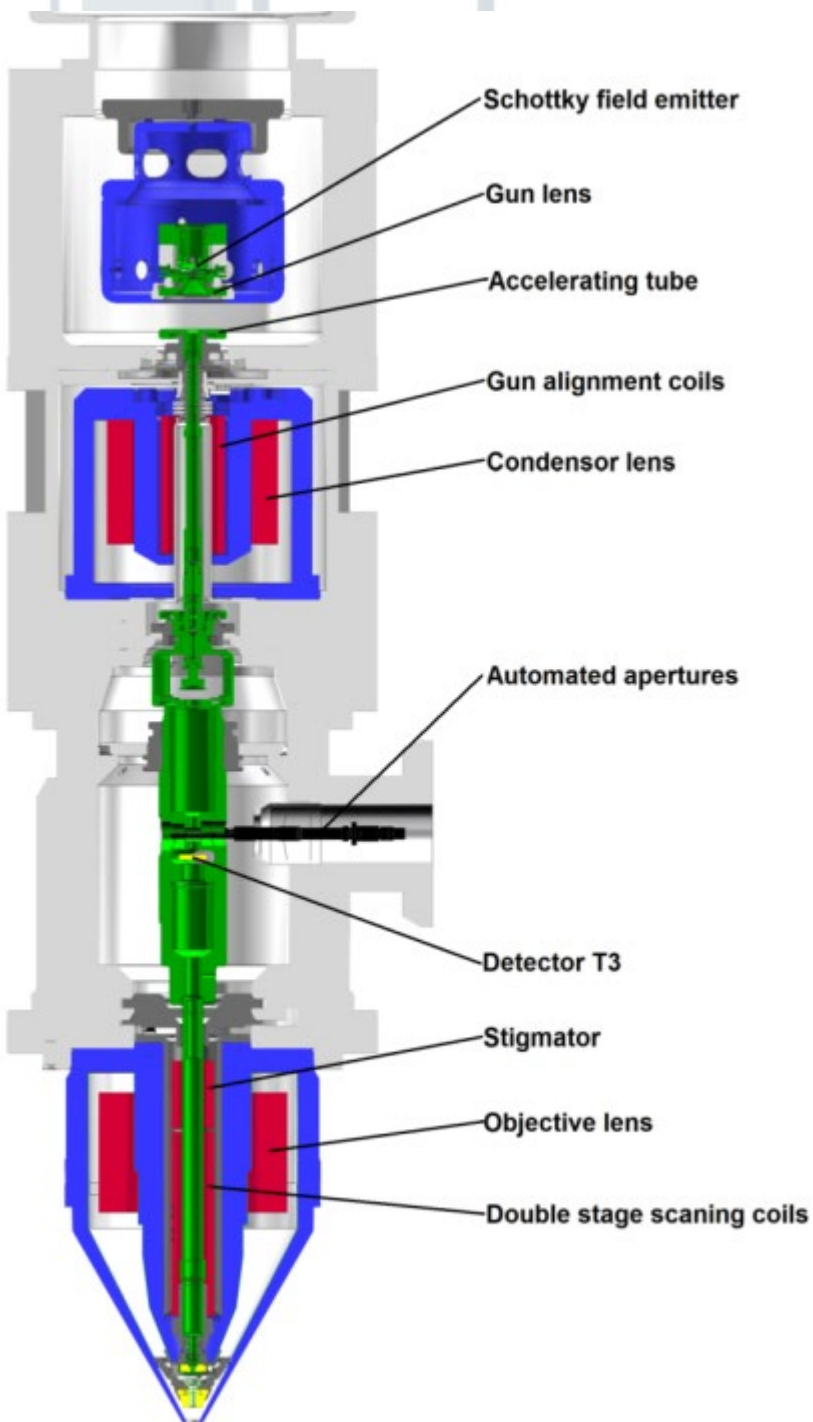


Simultaneous detection of all information with the in-lens Trinity Detection system and NICol SEM column

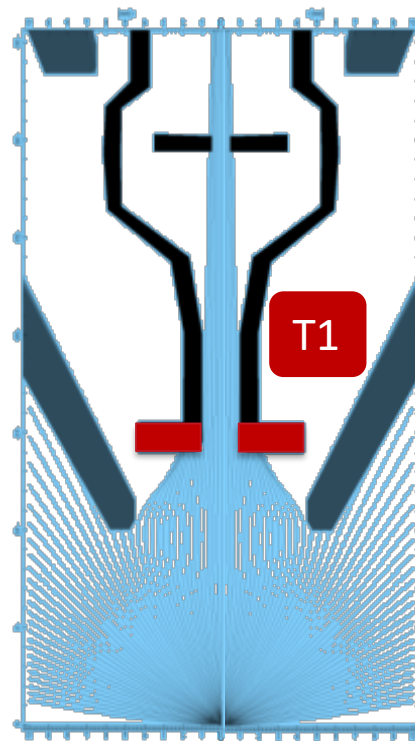
- Gather both material and topographic contrast with the unique segmented in-lens BSE detector (T1)
- Collect excellent edge contrast with the upper in-lens detector (T2).
- Extreme surface sensitivity is enabled through low energy secondary electron signal collection with the in-column detector (T3).
- Dual mode final lens for optimum results on all materials – including magnetic samples



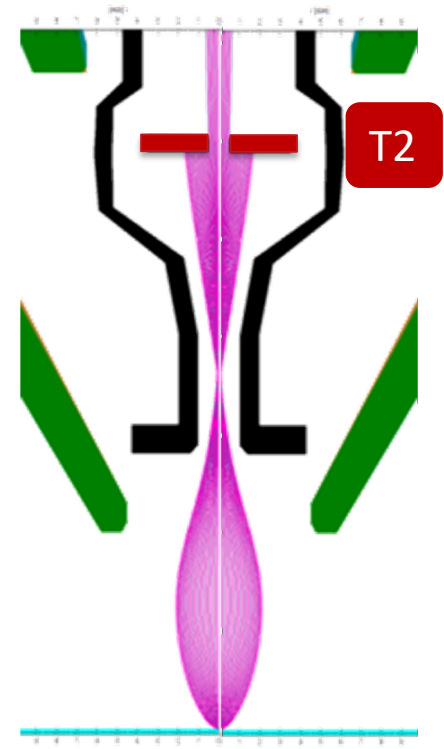
Detection Concept



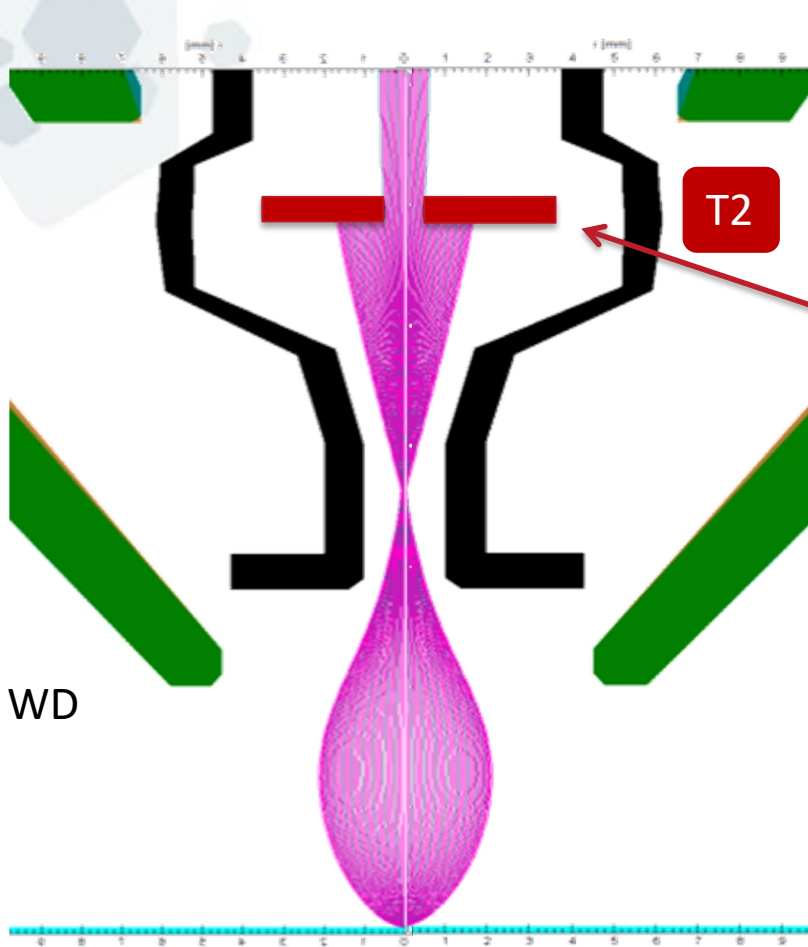
BSE Detection



SE Detection



Secondary Electron Detection



T3

- Collects slow SE's, high-angle (Charging, surface sensitivity)

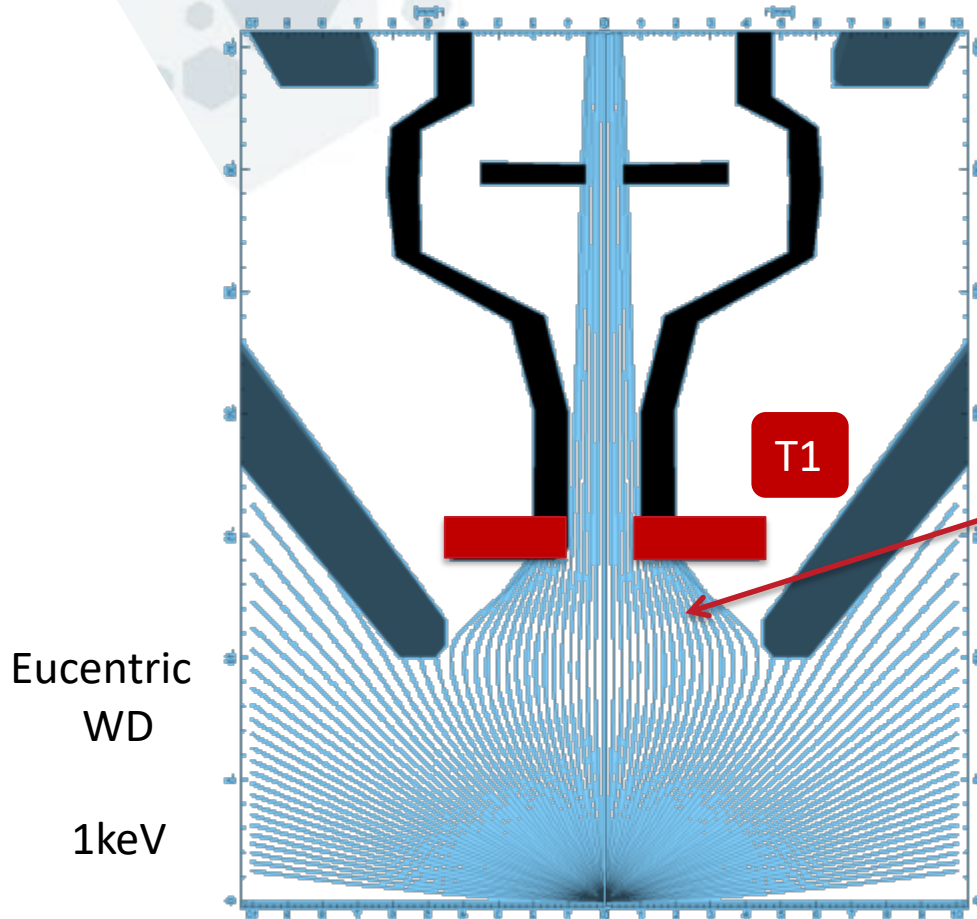
T2

- Detects more energetic low-angle SE's (not sensitive to charging)

Eucentric WD

1keV

Backscattered Electron Detection

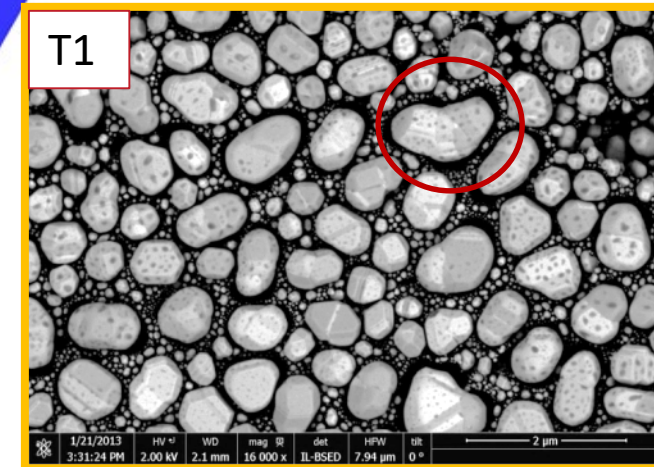
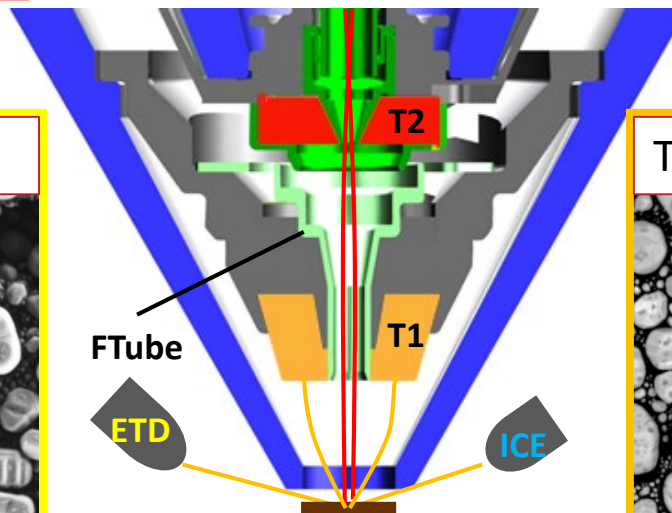
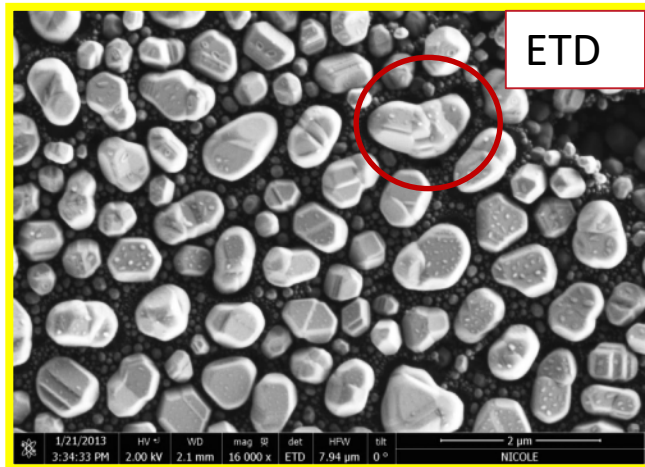
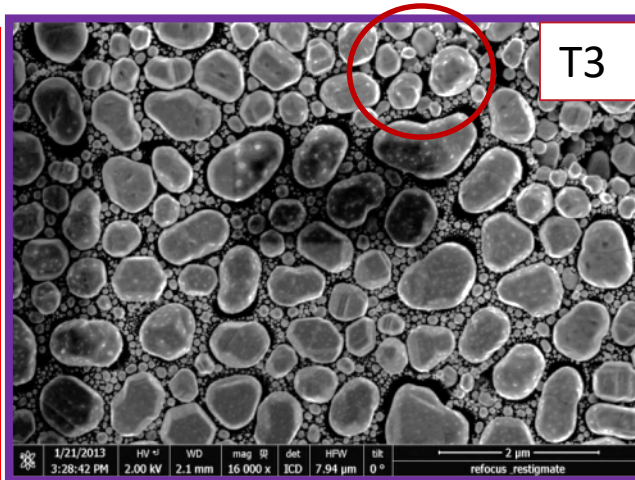
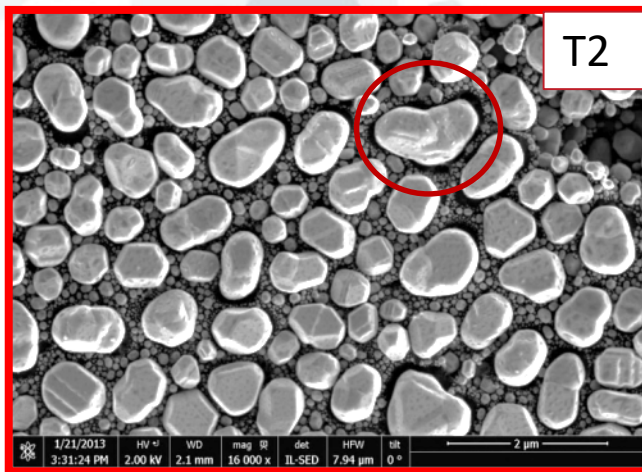


➤ T1 - IL-BSED

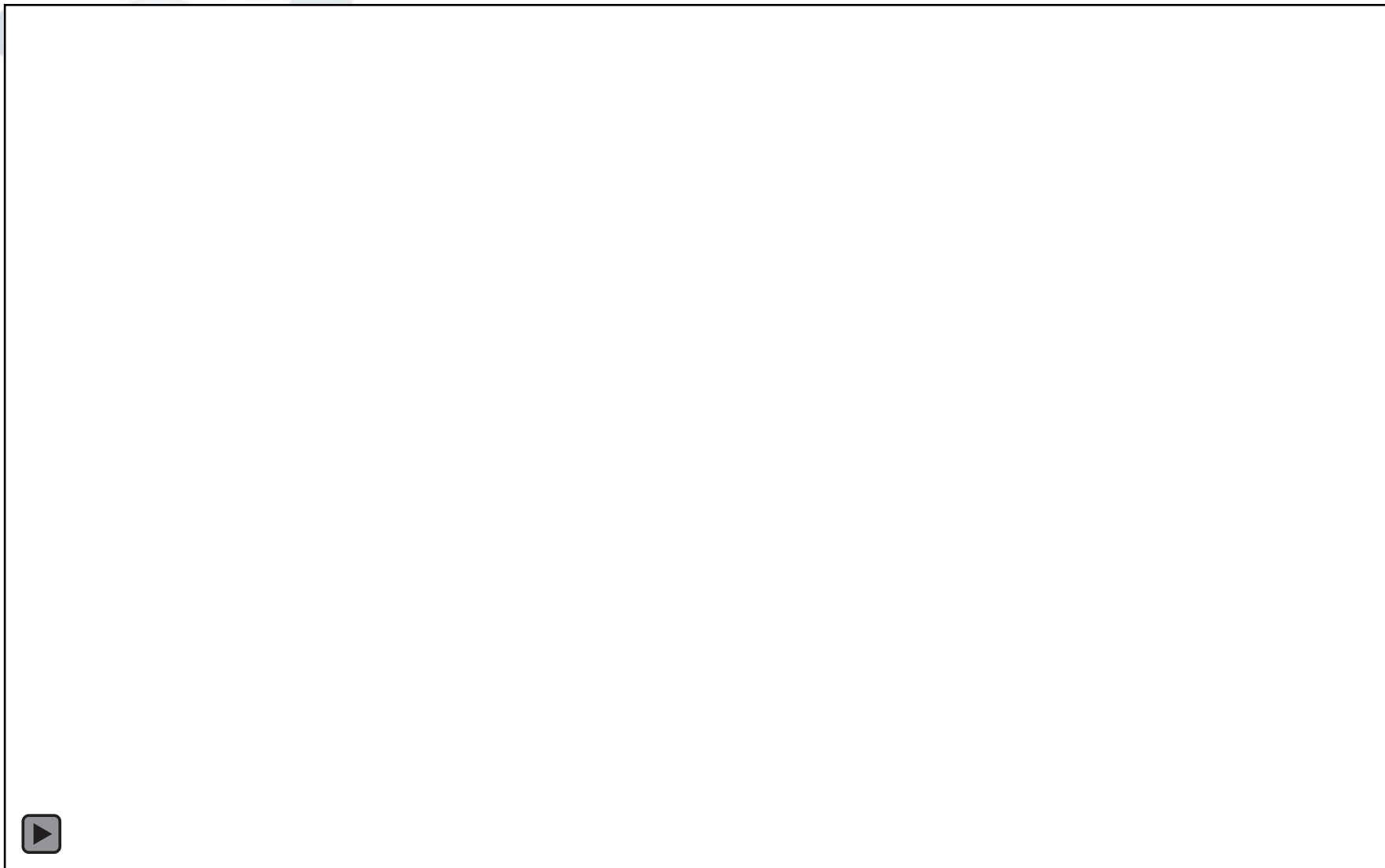
- BSE's are attracted -> Larger BSE solid angle
- good signal at low LE – lowest detector in the column

High contrast, fast imaging

Simultaneous detection of all 4 images (T1, T2, T3, ETD), combining channeling contrast, materials contrast and surface topography information

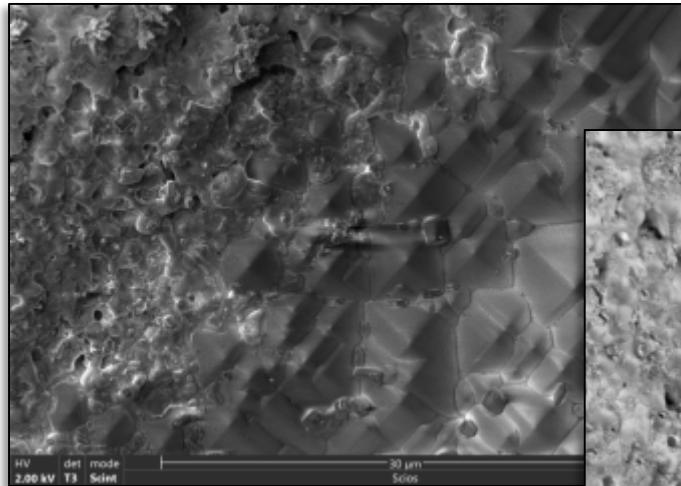
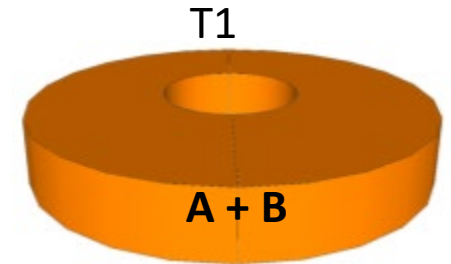
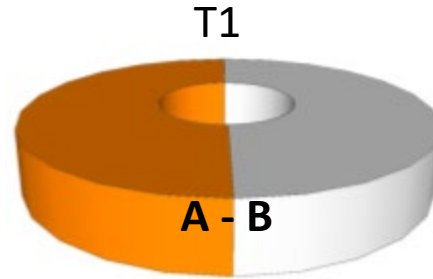


NICol Benefits: Detection

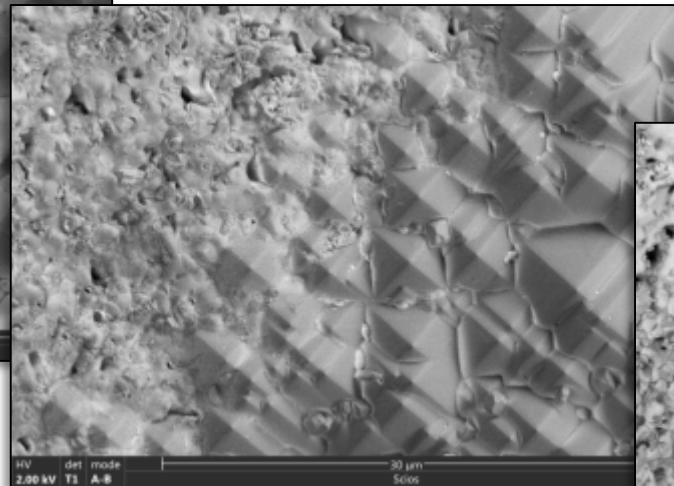


NICol Benefits: Detection

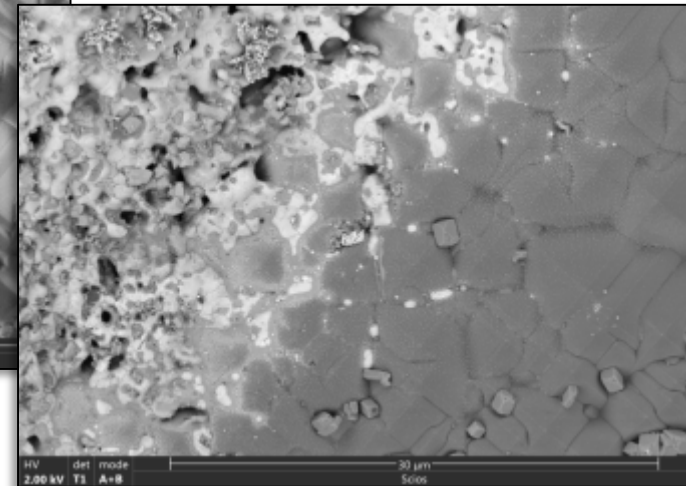
Unique segmented in-lens detector



T3 – SE image showing charge

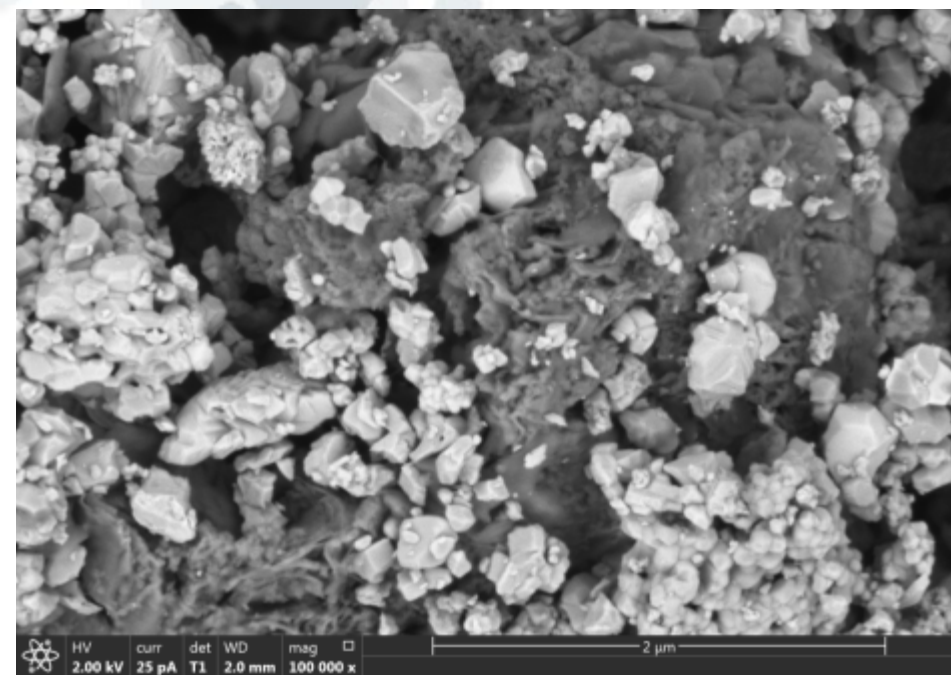


T1 (A-B) – image showing no charge and topography

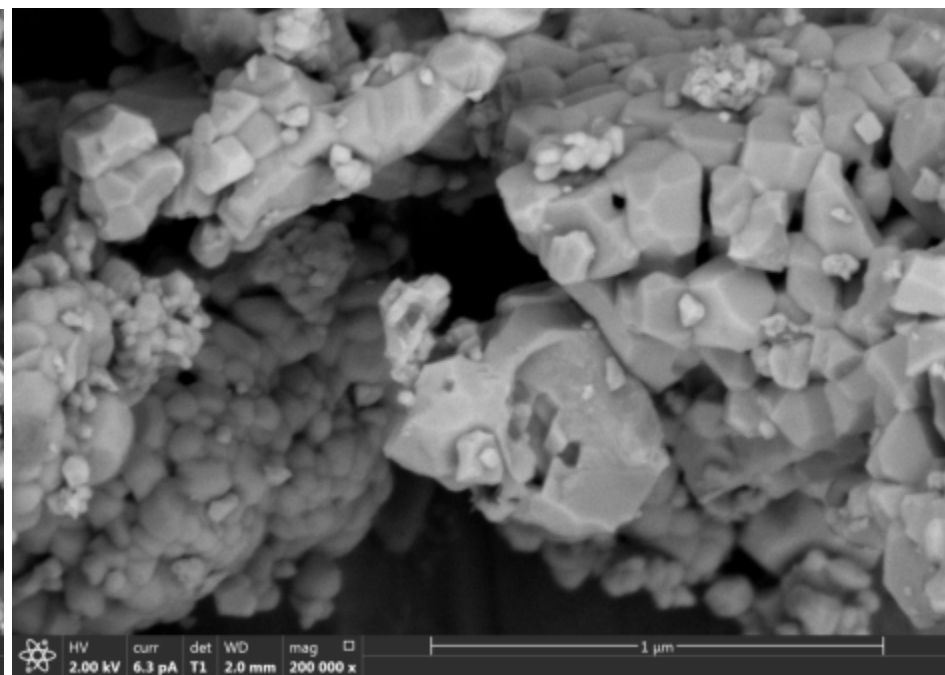


T1 (A+B) – image showing no charge and materials contrast

NICol Benefits: Magnetic Samples



2 kV 100 kX image of FeNdB magnetic particles



2 kV 200 kX image of FeNdB magnetic particles

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Configurations

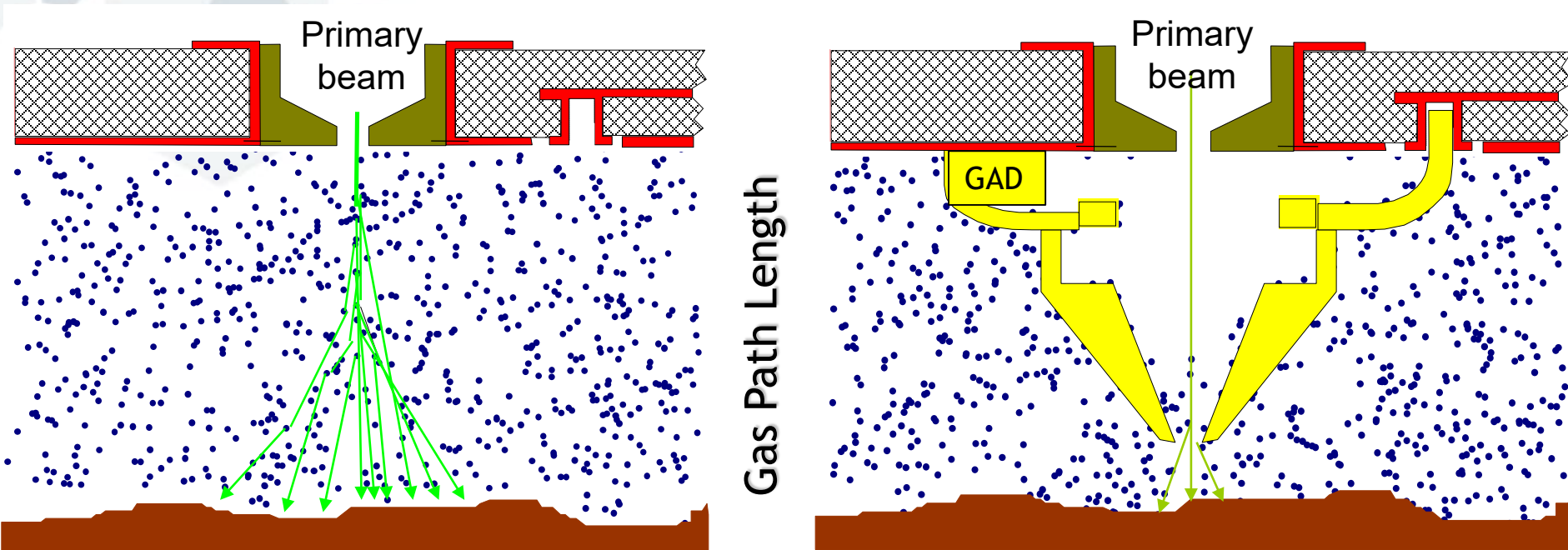
Standard system includes:

- High vacuum system
- In-lens SE and BSE detectors (T1 and T2)
- ETD chamber detector
- Automated aperture mechanism
- New multipurpose holder (including clamp for cross-sections, pre-tilted positions and STEM row-bar holder)
- 110mm stage with 90° tilt
- Windows 7 and NGUI
- User guidance

Options (selected):

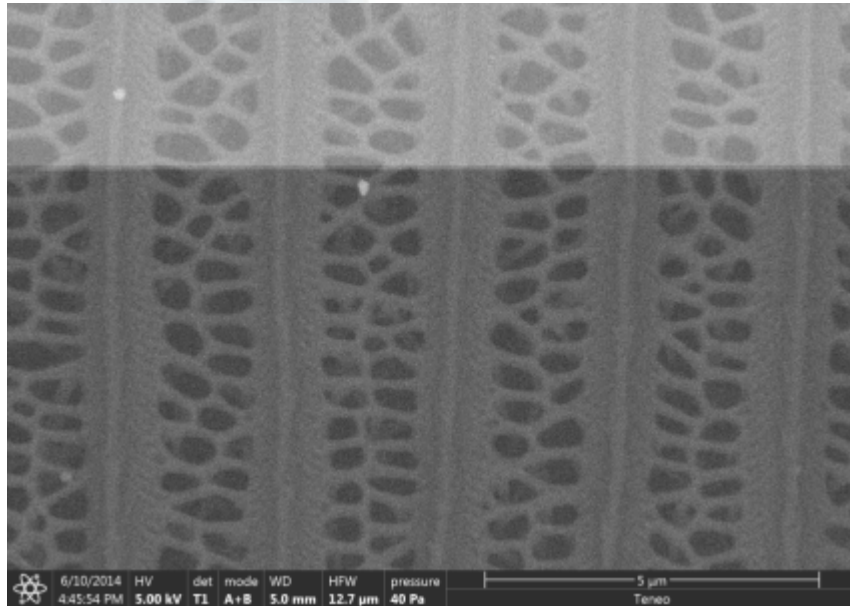
- T3 (In-column) detector
- DBS detector
- STEM 3 and STEM 3+ detector
- Low Vacuum (to 50Pa, includes LV SE detector)
- Directional GAD (Gaseous Analytical Detector) with full CBS/ABS segmentation

Low Vacuum Option



- Without a GAD or Pressure Limiting Aperture (PLA) the primary beam is broadened
- The longer the gas path length, the broader the beam becomes
- A GAD or PLA will reduce the gas path length, improving resolution and contrast.

Low Vacuum Option

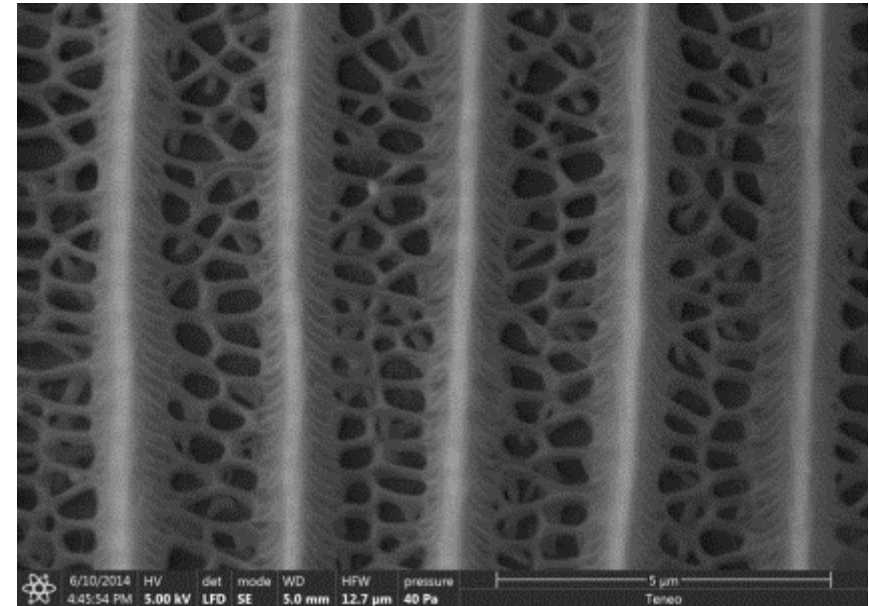


Without PLA / T1 Detector

HV=5kV

Pressure = 40Pa

WD=5mm



With PLA / GAD

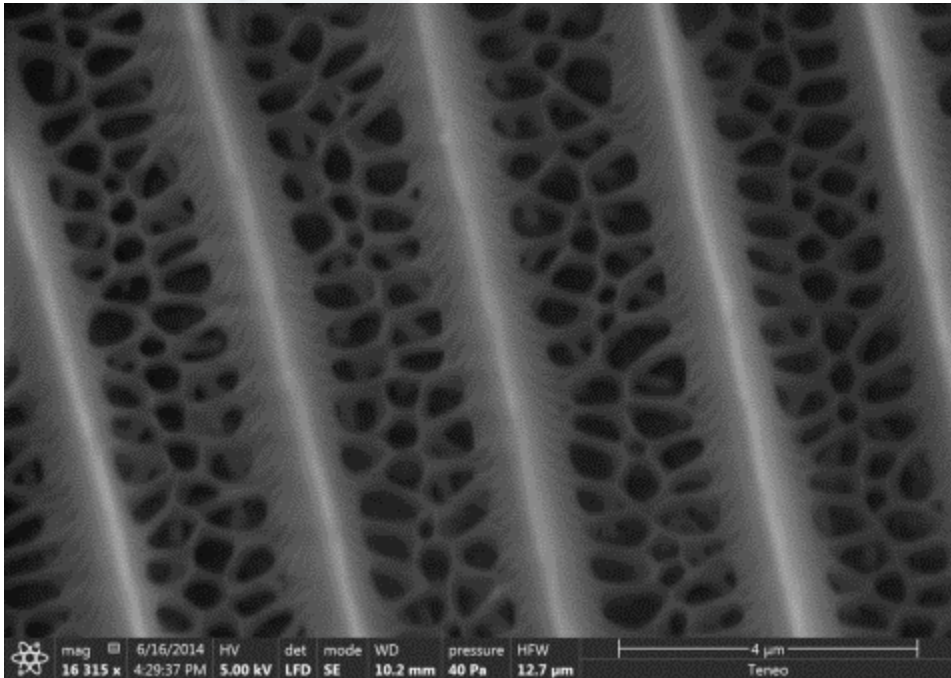
HV=5kV

Pressure = 40Pa

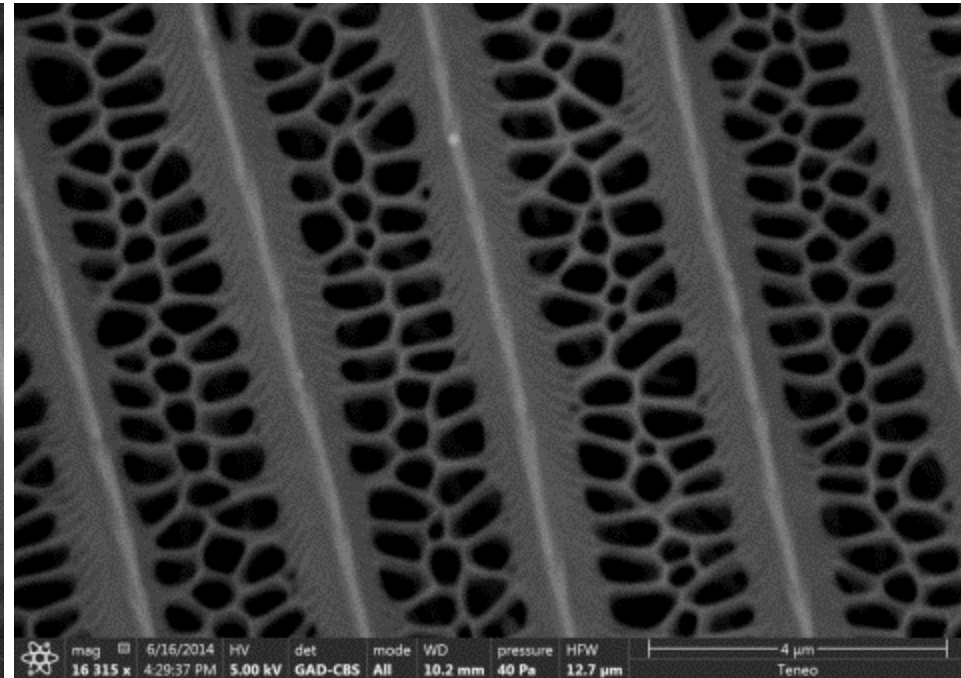
WD=5mm

Sample: Butterfly wing

Low Vacuum Option



Detector: LFD (SE)



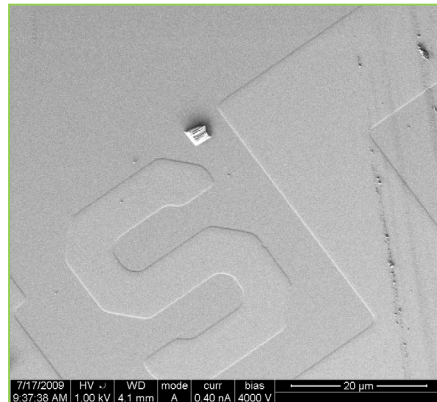
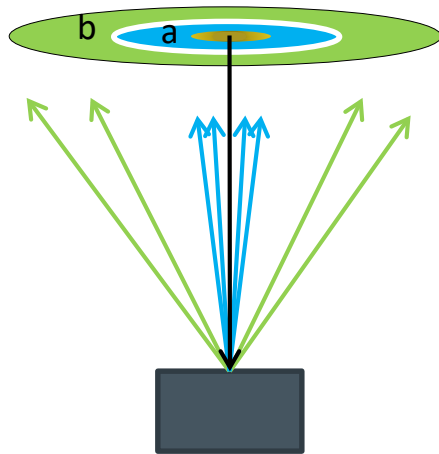
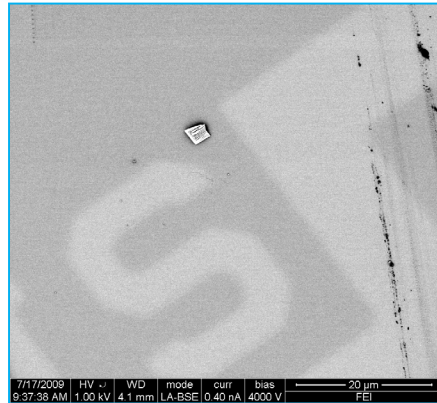
Detector: GAD (BSE)

HV=5kV
Pressure = 40Pa
WD=10mm

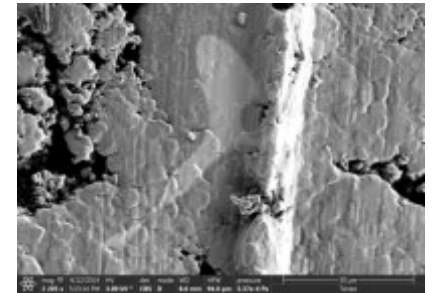
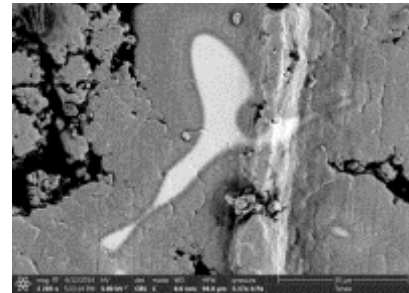
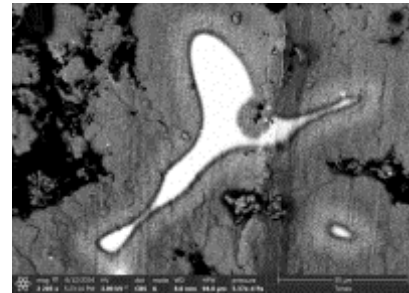
Sample: Butterfly wing

New DBS-GAD Detector

Old Style GAD
– 2 rings



New Directional GAD
– 4 rings



- Finer separation of materials and topographical contrast
- Easier to filter charge without losing overall signal

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Highest flexibility in loading samples

Teneo

Largest tilt range -15° to 90°

Flexibility to reach all angles on the sample. Perform perpendicular imaging after milling the sample.

Heaviest sample = 2kg

Keep bigger samples intact for analysis – no need to break them up to reduce the weight. Load heavier samples without affecting stage performance

Longest eucentric Working distance = 10mm

Space to do more: Add probing, sub-stages, nano-indentors etc.

Longer WD is more comfortable for new users afraid of damaging the final lens.

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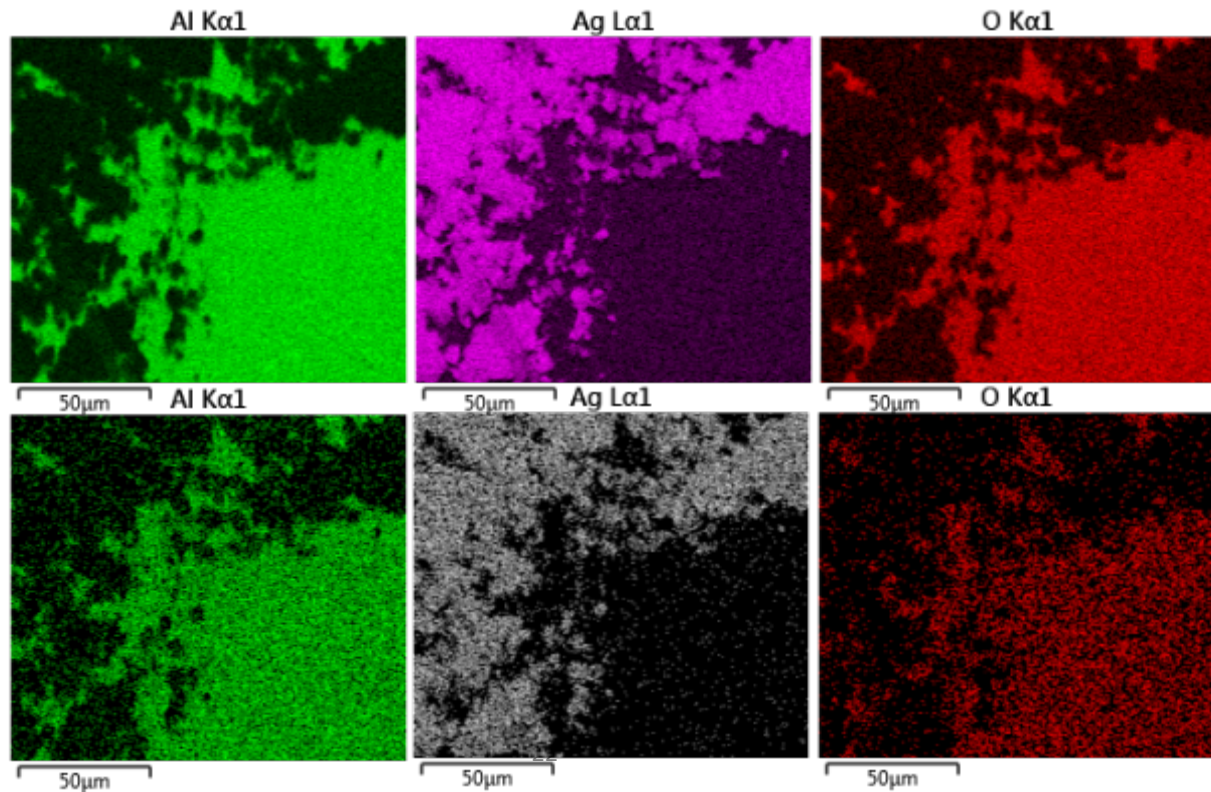
Analytical Performance

Fast mapping provided by large continuous beam current range up to 400nA

Teneo

25 s Acquisition
Time

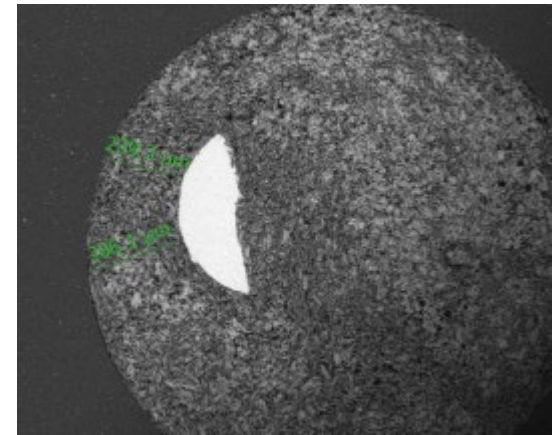
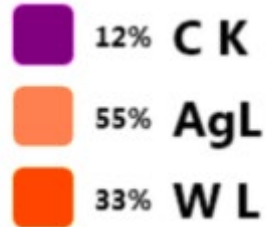
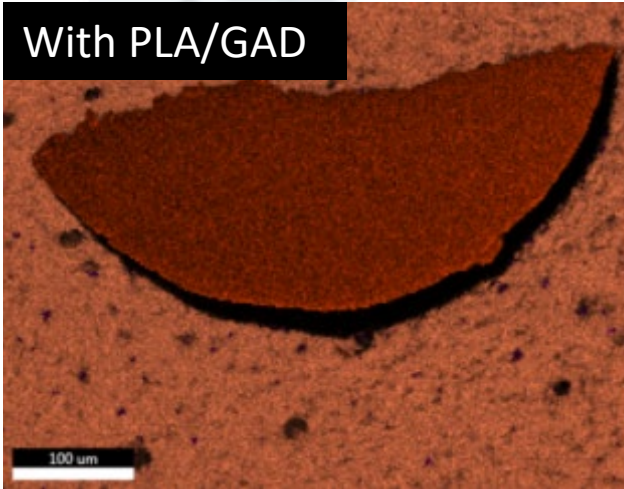
Alternative
Option



Analytical Performance

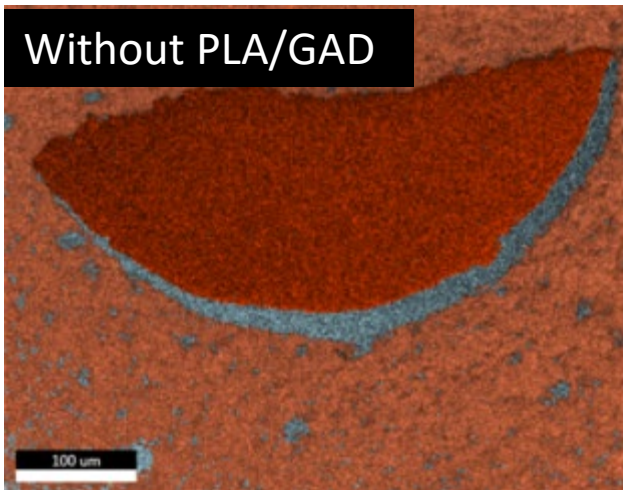
Quantitative, accurate EDX in Low Vacuum

With PLA/GAD



Tungsten embedded in silver epoxy. Nearest Al is more than 200um away.

Without PLA/GAD

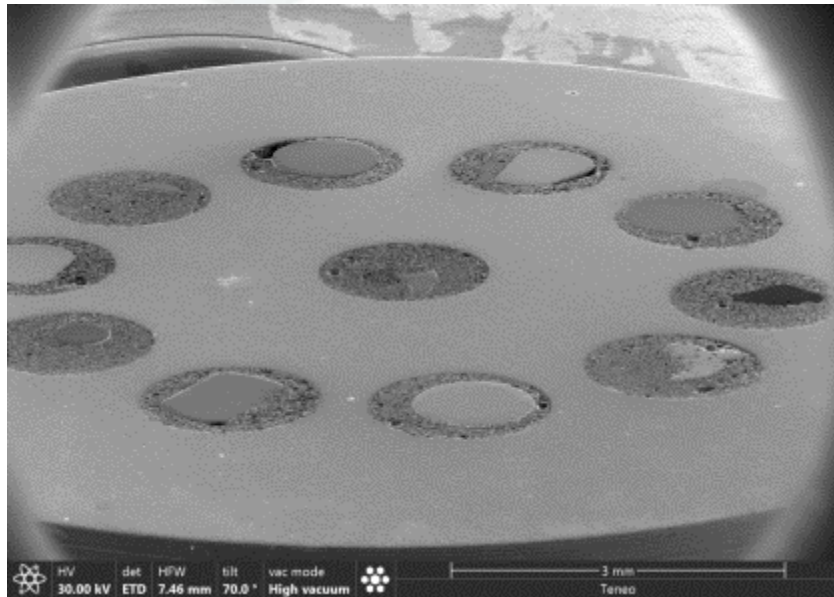


Holes in the sample are identified as Aluminum!

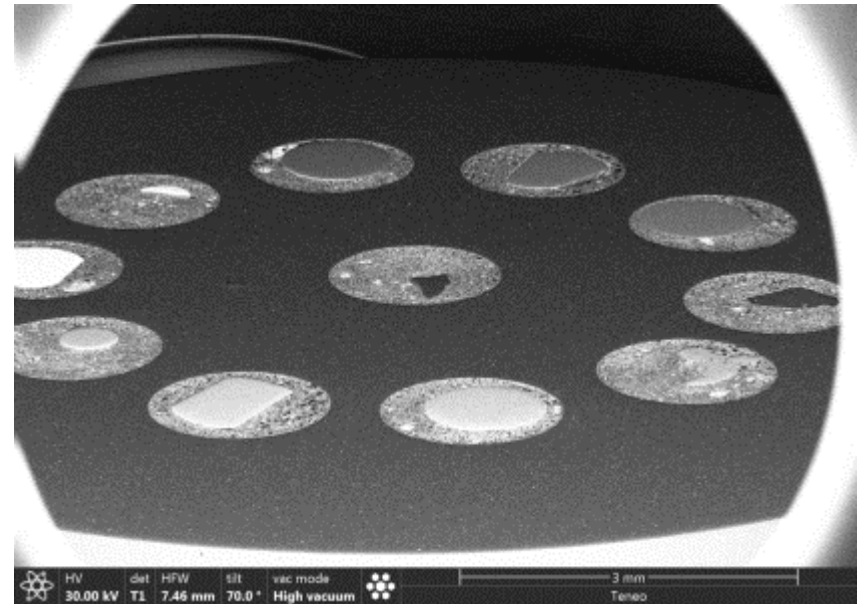
Same high currents available also in low vacuum mode – no loss of throughput

Analytical Performance

Dedicated Analytical mode with optimized aperture angle provides not only high current (density), but also large depth of focus for applications such as EBSD at 70°



Detector: ETD



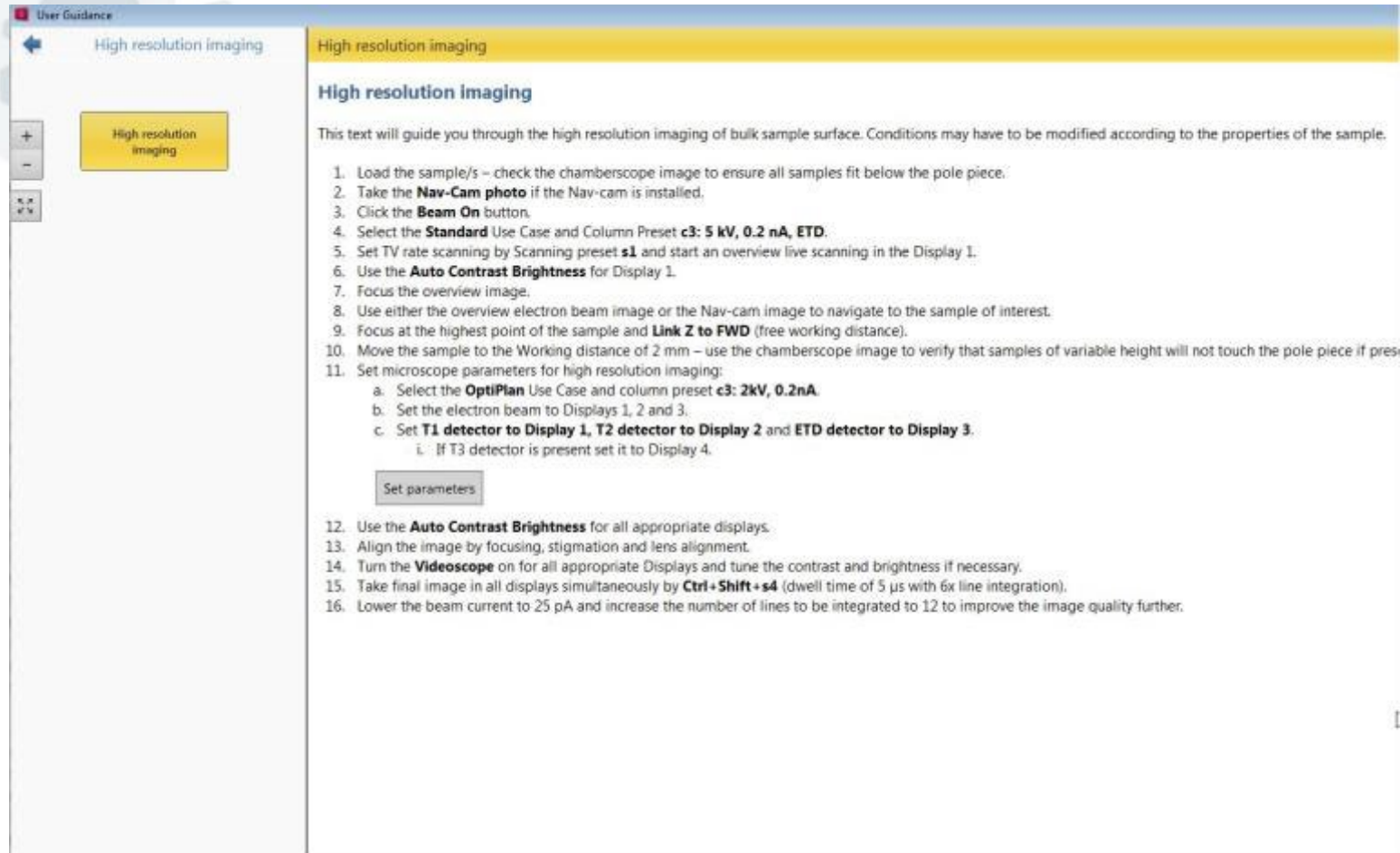
Detector: T1

Large depth of field image acquired in analytical mode with the sample tilted to 70°

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Ease of Use: User Guidance



The screenshot shows a software interface titled "User Guidance". On the left, there is a sidebar with a "High resolution imaging" button. The main content area has a yellow header with the text "High resolution imaging". Below the header, the text reads: "This text will guide you through the high resolution imaging of bulk sample surface. Conditions may have to be modified according to the properties of the sample." This is followed by a numbered list of 16 steps for the imaging process. A "Set parameters" button is located between steps 11 and 12.

High resolution imaging

High resolution imaging

This text will guide you through the high resolution imaging of bulk sample surface. Conditions may have to be modified according to the properties of the sample.

1. Load the sample/s – check the chamberscope image to ensure all samples fit below the pole piece.
2. Take the **Nav-Cam photo** if the Nav-cam is installed.
3. Click the **Beam On** button.
4. Select the **Standard** Use Case and Column Preset **c3: 5 kV, 0.2 nA, ETD**.
5. Set TV rate scanning by Scanning preset **s1** and start an overview live scanning in the Display 1.
6. Use the **Auto Contrast Brightness** for Display 1.
7. Focus the overview image.
8. Use either the overview electron beam image or the Nav-cam image to navigate to the sample of interest.
9. Focus at the highest point of the sample and **Link Z to FWD** (free working distance).
10. Move the sample to the Working distance of 2 mm – use the chamberscope image to verify that samples of variable height will not touch the pole piece if present.
11. Set microscope parameters for high resolution imaging:
 - a. Select the **OptiPlan** Use Case and column preset **c3: 2kV, 0.2nA**.
 - b. Set the electron beam to Displays 1, 2 and 3.
 - c. Set **T1 detector to Display 1, T2 detector to Display 2** and **ETD detector to Display 3**.
 - i. If T3 detector is present set it to Display 4.

Set parameters

12. Use the **Auto Contrast Brightness** for all appropriate displays.
13. Align the image by focusing, stigmation and lens alignment.
14. Turn the **Videoscope** on for all appropriate Displays and tune the contrast and brightness if necessary.
15. Take final image in all displays simultaneously by **Ctrl+Shift+s4** (dwell time of 5 μ s with 6x line integration).
16. Lower the beam current to 25 pA and increase the number of lines to be integrated to 12 to improve the image quality further.

Workflows provided to guide all users to optimized results quickly

Ease of Use: User Guidance

The screenshot displays the FEI software interface with a 'User Guidance' window open. The window is titled 'High resolution imaging' and contains a flowchart on the left and a 'Setting imaging parameters' panel on the right. The flowchart shows the following steps: Sample Loading, Navigation to the area of interest, Setting imaging parameters (highlighted in yellow), Adjusting the image, and Taking the final image. The 'Setting imaging parameters' panel includes the following text and instructions:

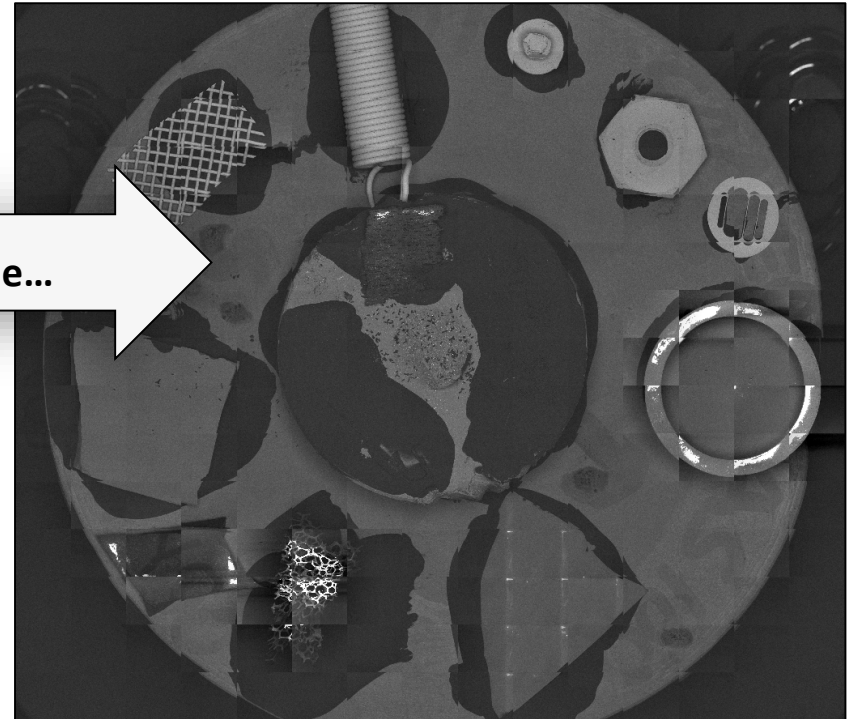
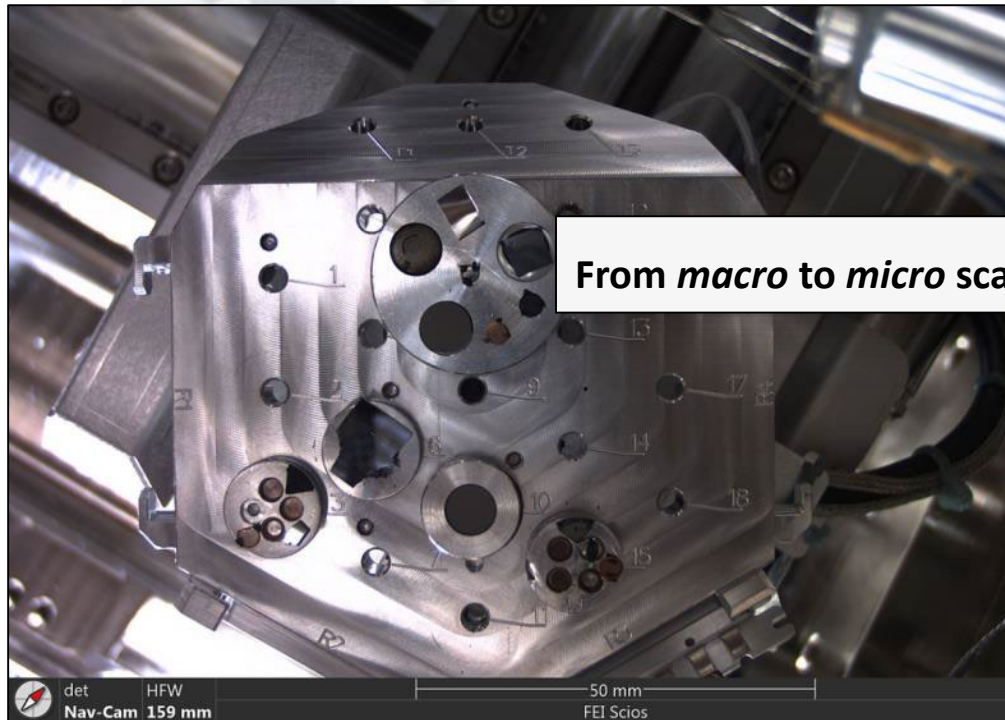
This text will guide you through the high resolution imaging of conductive samples.

- High Voltage: **2kV**, Probe Current: **0.1nA**.
- Set the electron beam to Displays:
 - Display 1: ETD detector.**
 - Display 2: T1 detector.**
 - Display 3: T2 detector.**All parameters can be set by the Set Imaging Parameters button:
- Press the **Beam On** and start scanning the beam over the sample with Scanning Preset **s1**: image resolution = **768**, dwell time = **200us**, averaging = **4**.
- Use the **Auto contrast and brightness** for all appropriate displays.
- Focus the overview image and **Link Z** free working distance.
- Navigate to the area of interest at low magnification.

The background shows the main software interface with various control panels on the right, including Vacuum, Column, Magnification, Beam, Beam Deceleration, Scan Rotation, and Detectors. The top menu bar includes File, Edit, Detectors, Scan, Beam, Patterning, Stage, Tools, View, and Help. The bottom taskbar shows several open applications, including User Guidance, NicoleDeGauss, TST Gun FEG, and Detail - BRN08.

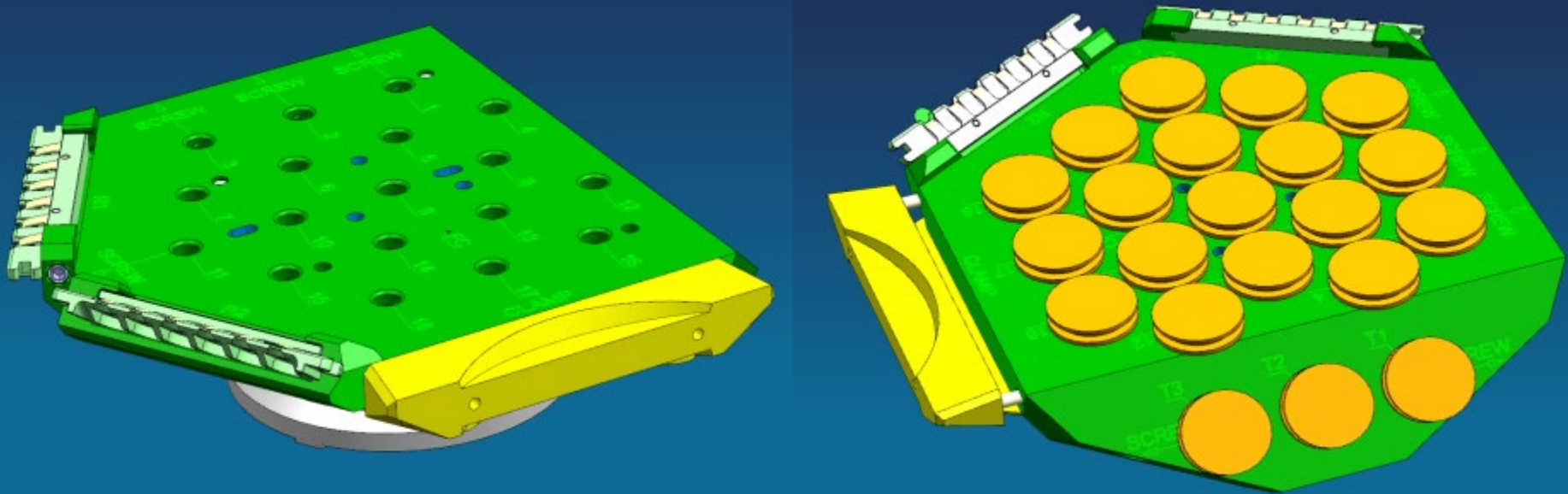
Easy Navigation

Comprehensive sample navigation options



- Macro Color image of sample with Nav-Cam
- Point and click to drive to sample of interest
- 1X SEM image of sample with standard Navigation Montage
- Point and click to drive to sample of interest

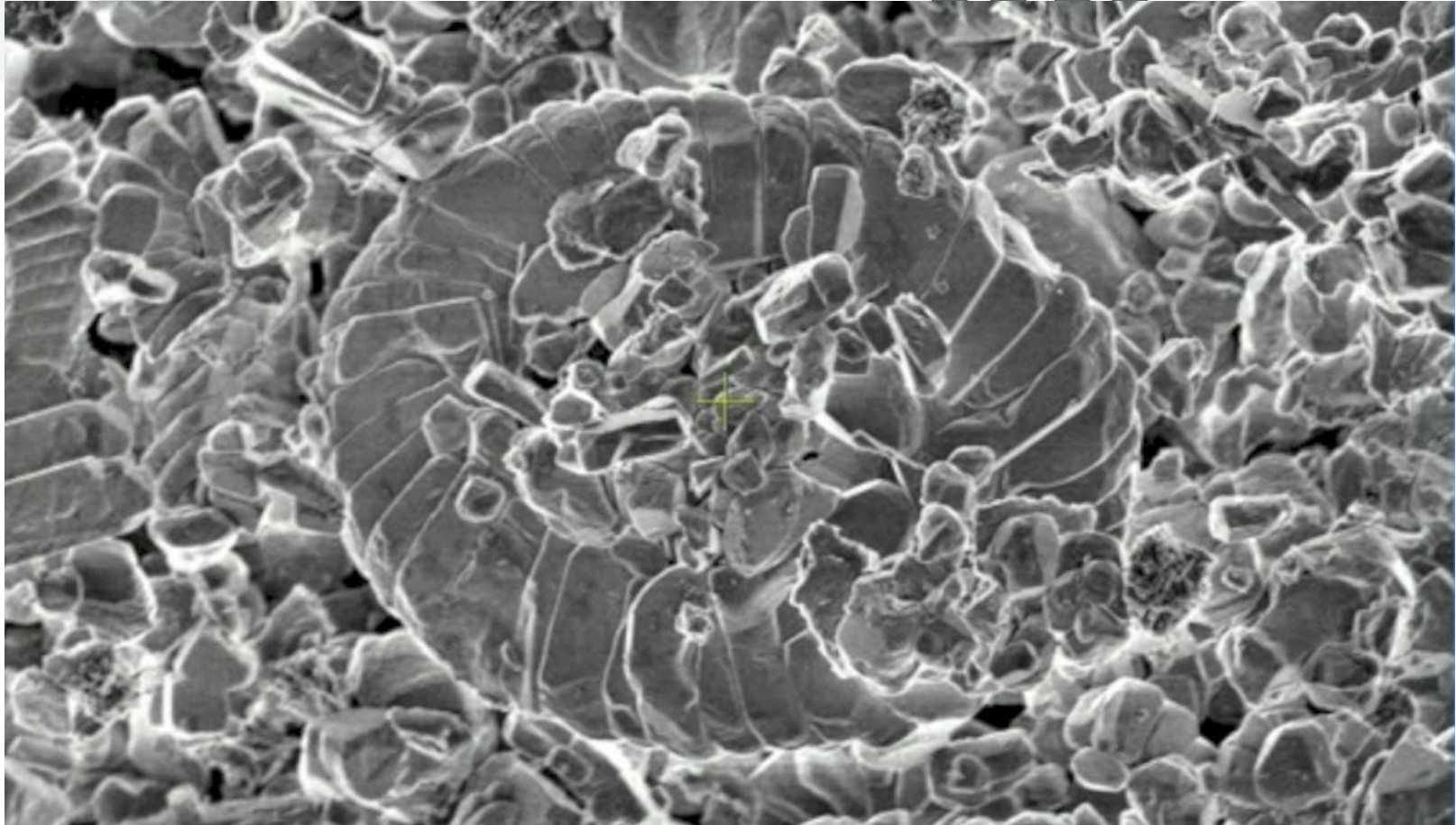
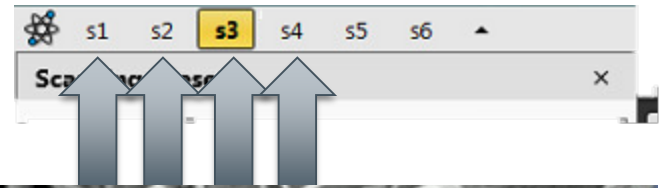
Ease of Use: Sample Holder



- Multi-sample holder holds up to 18 flat samples and 3 pre-tilted samples
- Same holder also used for STEM detector
- Spring loaded clamp enables easy imaging of cross-sections
- Requires no tools for sample loading

Point and shoot

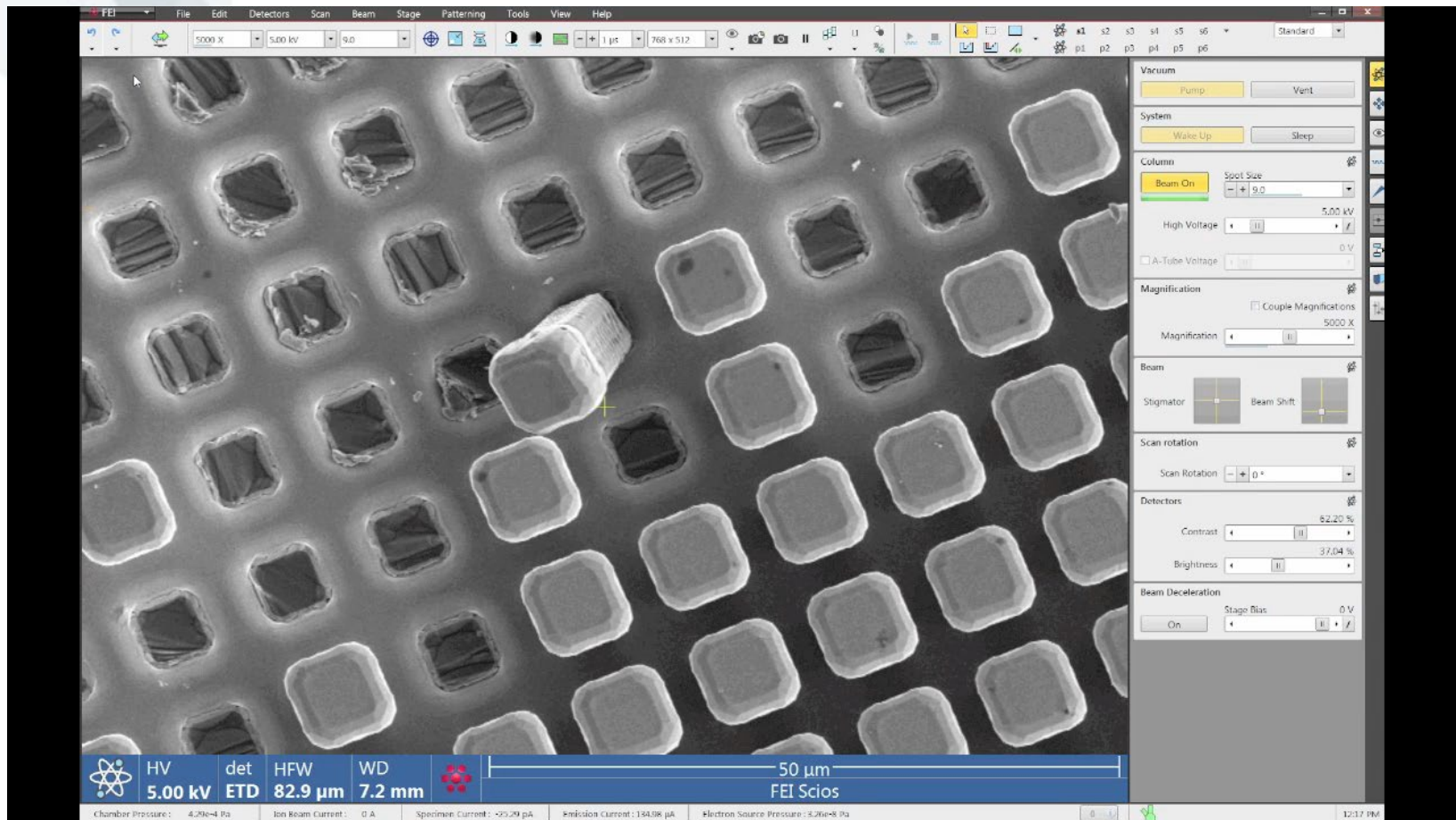
Use presets to get to an excellent result quickly



Presets for scanning and column settings make operation as simple as 1-2-3

Learn by experimenting

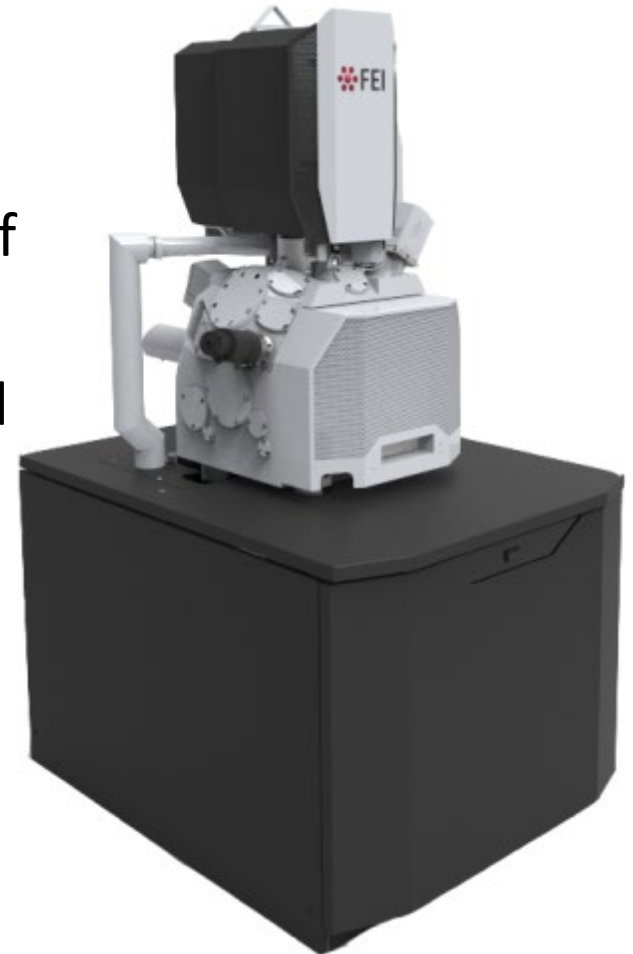
Use Undo/Redo to encourage experimentation with ease of mind



Use history and quickly go back to the best conditions

Summary

- A revolution in detection – the unique Trinity™ detection scheme delivers highest contrast on the widest range of samples
- Fastest and most accurate imaging and analysis of non-conductive materials
- Redefining SEM Workflows to deliver ease of use: User Guidance and NG User Interface ensures high performance for all users
- Smallest footprint, fastest installation and reduced cost-of-ownership with ‘ship-as-one’ concept



Key specifications

15kV Resolution	1.0 nm
1kV Resolution	1.6 nm 1.4 nm (with BD)
In-lens Detectors	T1 (segmented A +B), T2, T3*
Analytical WD	10mm
Stage Range XYZ/RT	110 x 110 x 65mm / 180° 105°
Beam Current range	1pA-400nA
Low Vacuum	Optional
Low Vacuum	50 Pa

Thank You

