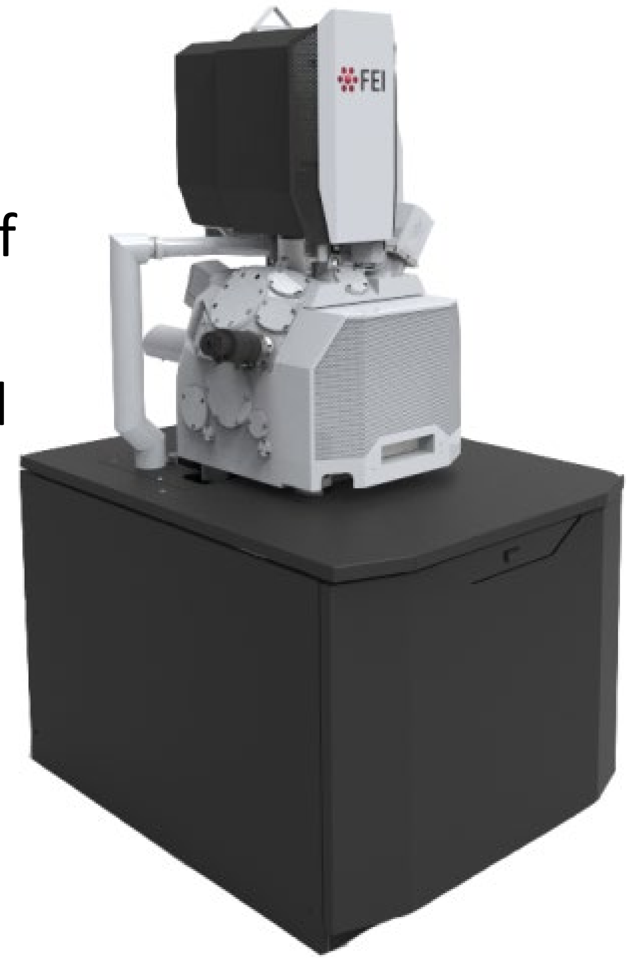
Teneo SEM

FEI™

Teneo

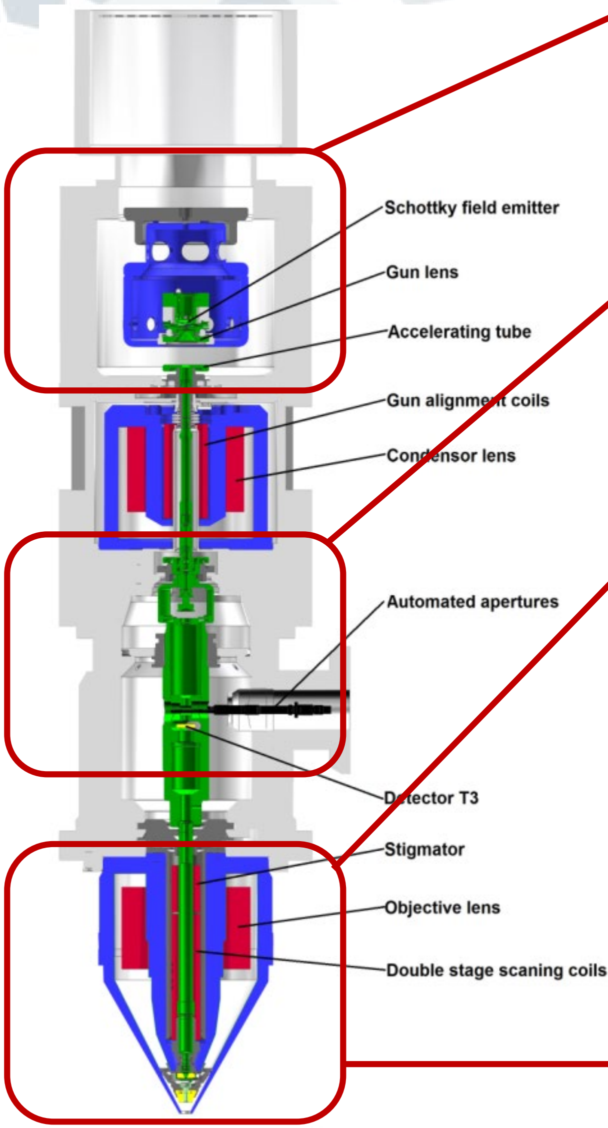
- A revolution in detection – the unique Trinity™ detection scheme delivers highest contrast on the widest range of samples
- Fastest and most accurate imaging and analysis of non-conductive materials
- Redefining SEM Workflows to deliver ease of use: User Guidance and NG User Interface ensures high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



Outline

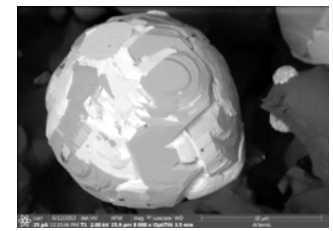
- Introduction
- NICol benefits
- Configurations
- Flexibility
- Analytical Performance
- Ease of use
- Additional information

NICol SEM Column

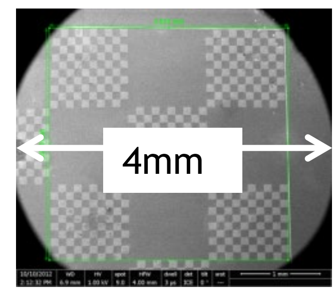


Faster and easier maintenance with auto bake-out, auto-start and fully automated alignments

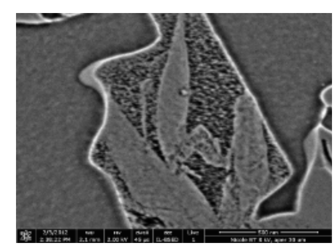
Optimum conditions at any beam current with automated, heated apertures



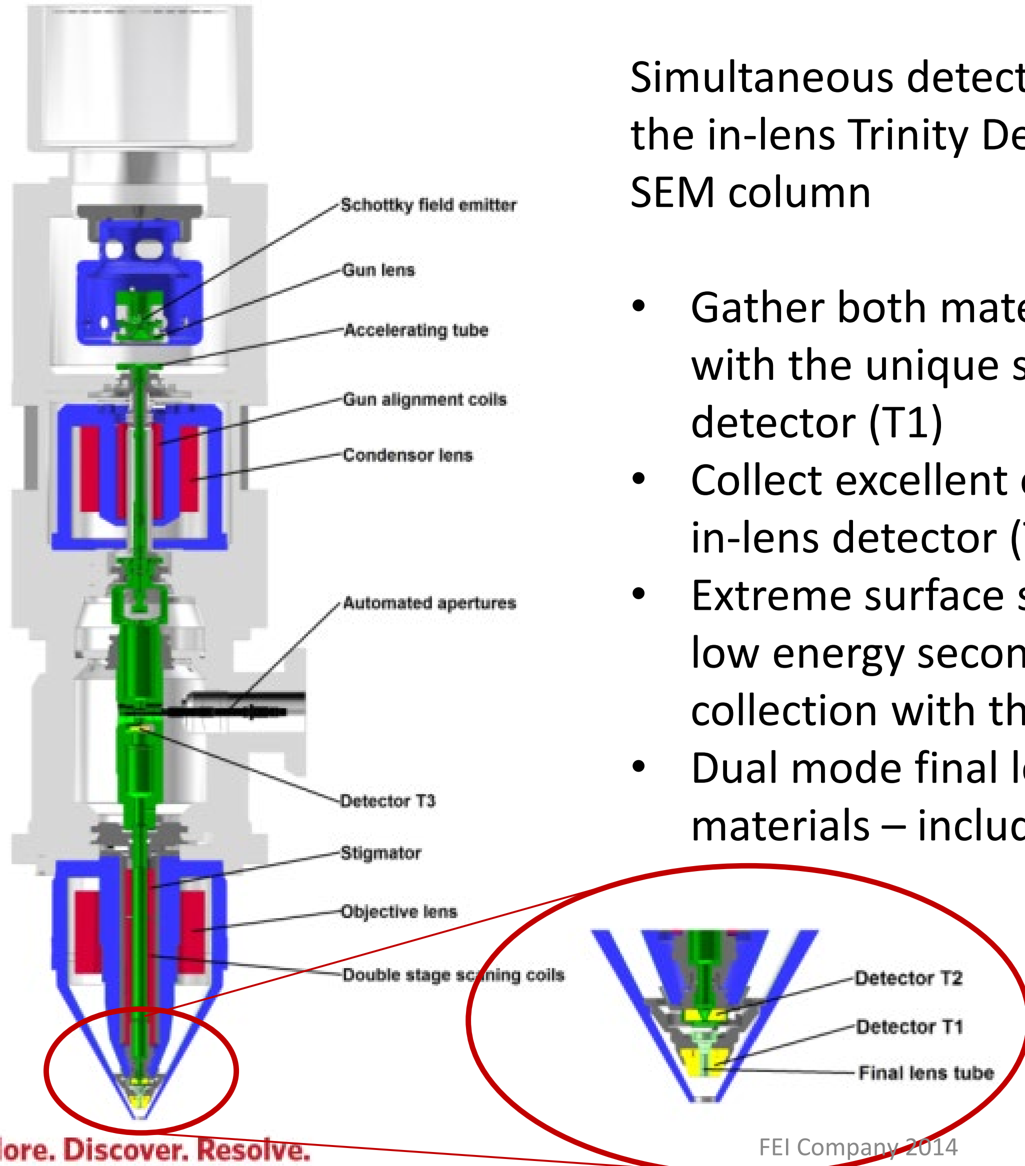
Accurate wide field of view imaging with double stage scanning coils



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

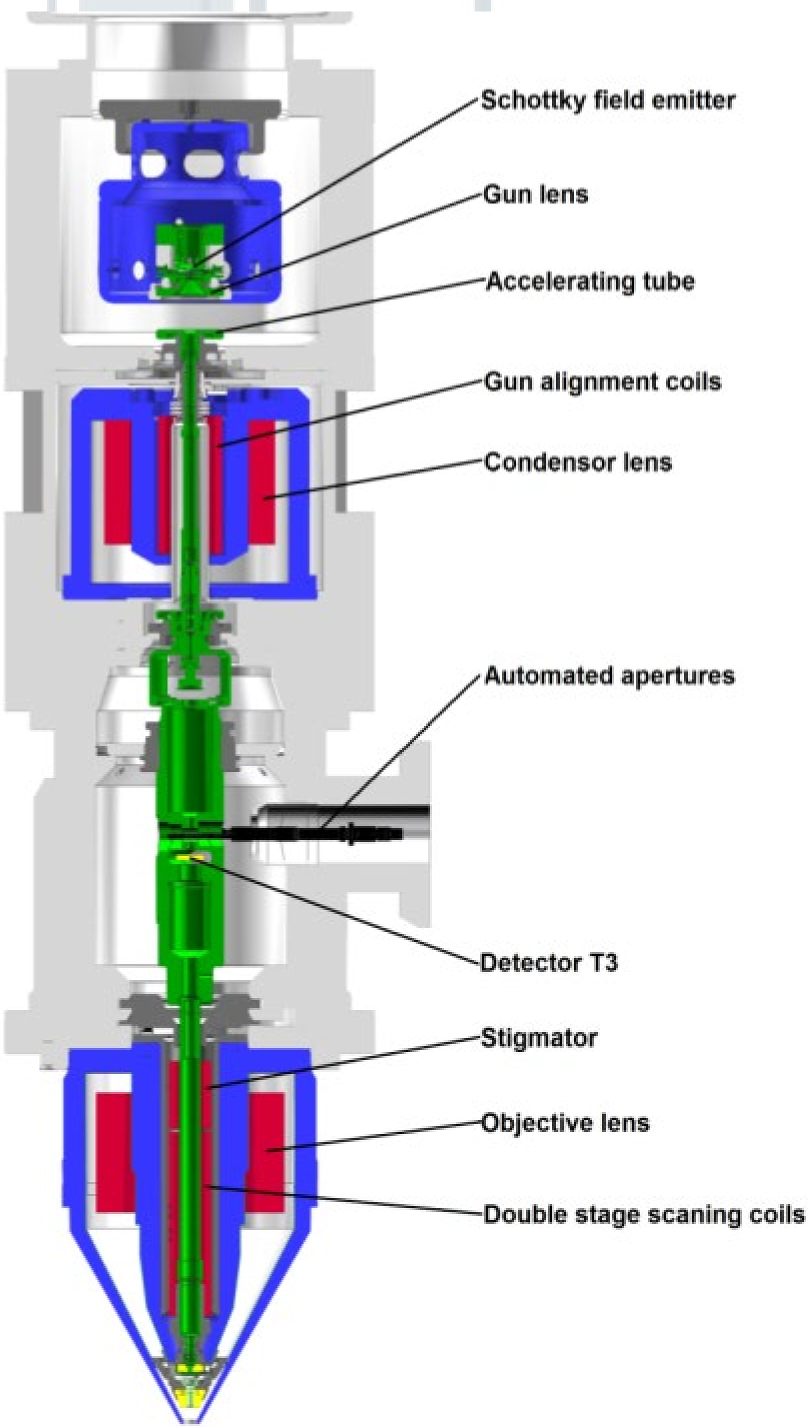


NICol Benefits

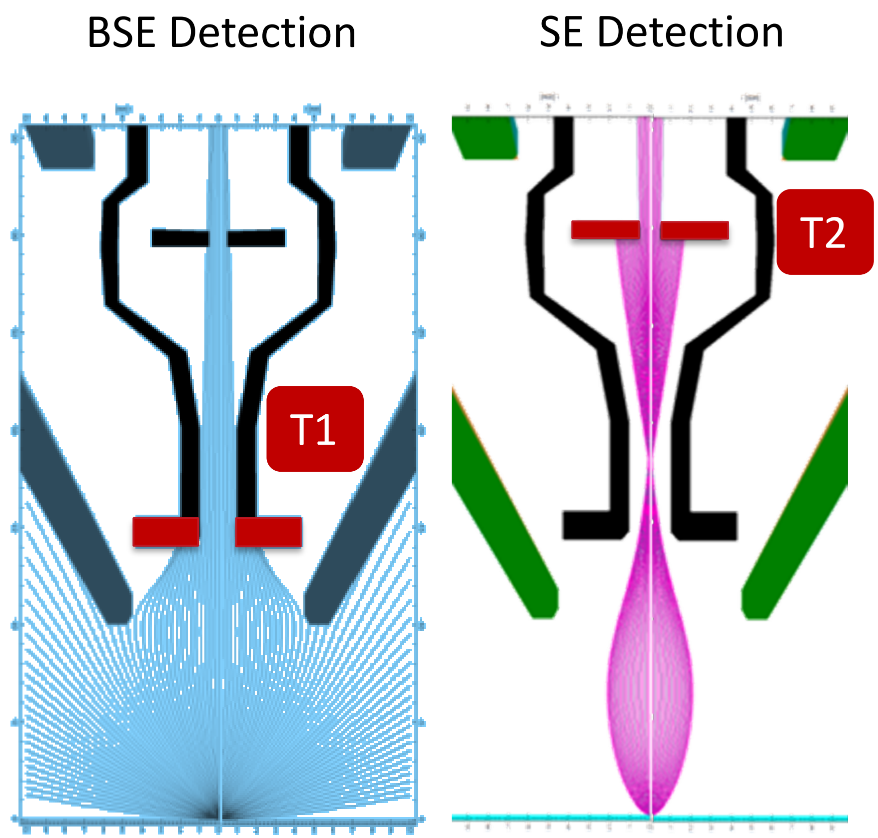


Simultaneous detection of all information with the in-lens Trinity Detection system and NICol SEM column

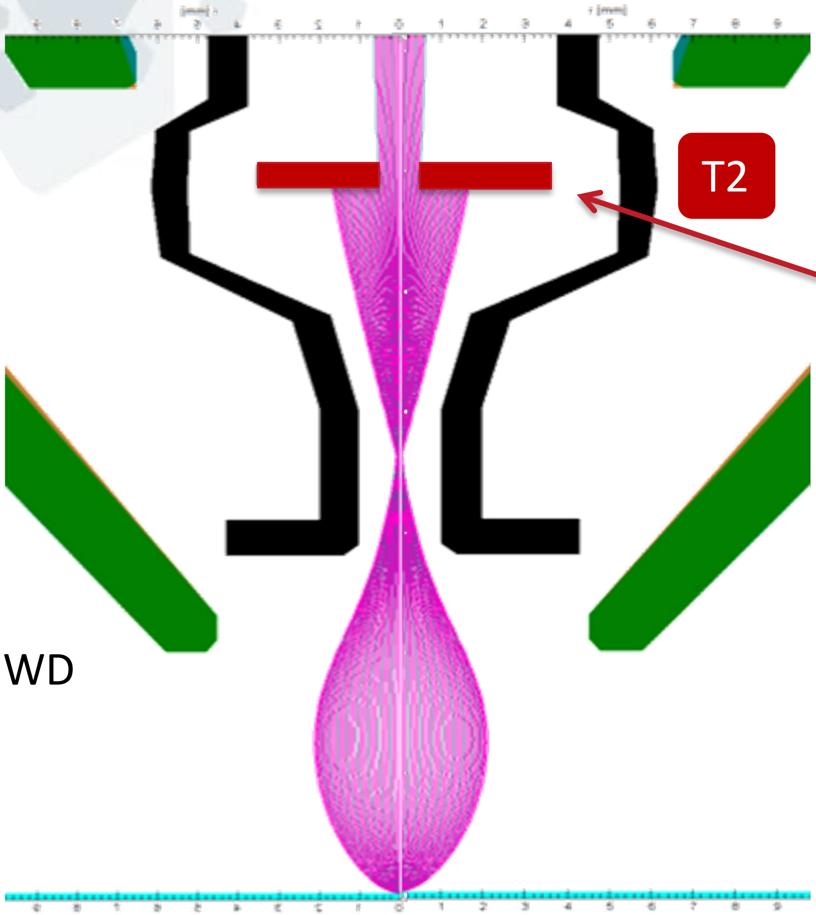
- Gather both material and topographic contrast with the unique segmented in-lens BSE detector (T1)
- Collect excellent edge contrast with the upper in-lens detector (T2).
- Extreme surface sensitivity is enabled through low energy secondary electron signal collection with the in-column detector (T3).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



Detection Concept



Secondary Electron Detection

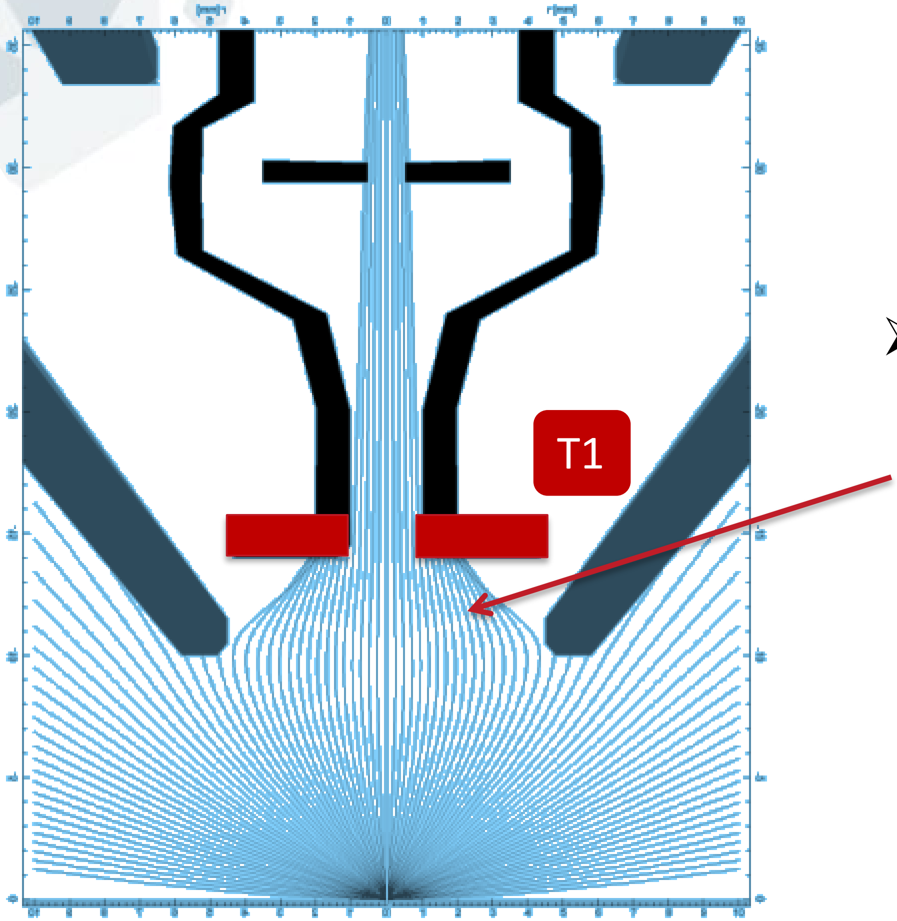


Eucentric WD

1keV

- T3
  - Collects slow SE's, high-angle (Charging, surface sensitivity)
- T2
  - Detects more energetic low-angle SE's (not sensitive to charging)

Backscattered Electron Detection

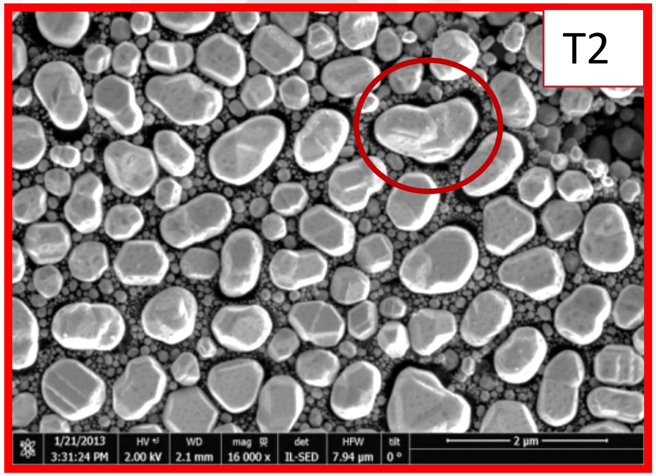


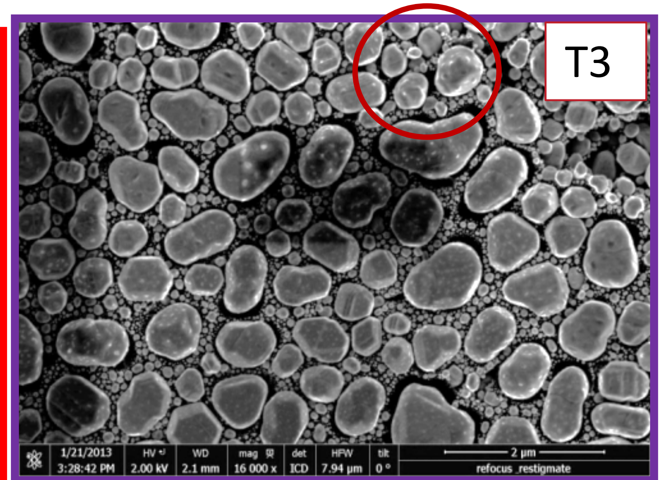
Eucentric WD

1keV

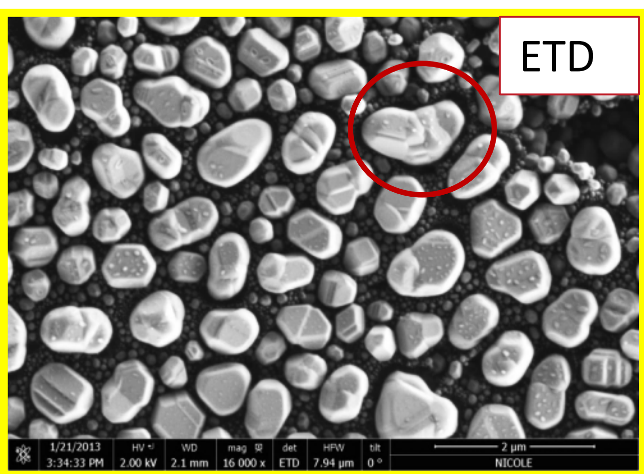
- T1 - IL-BSED
  - BSE’s are attracted ->Larger BSE solid angle
  - good signal at low LE – lowest detector in the column

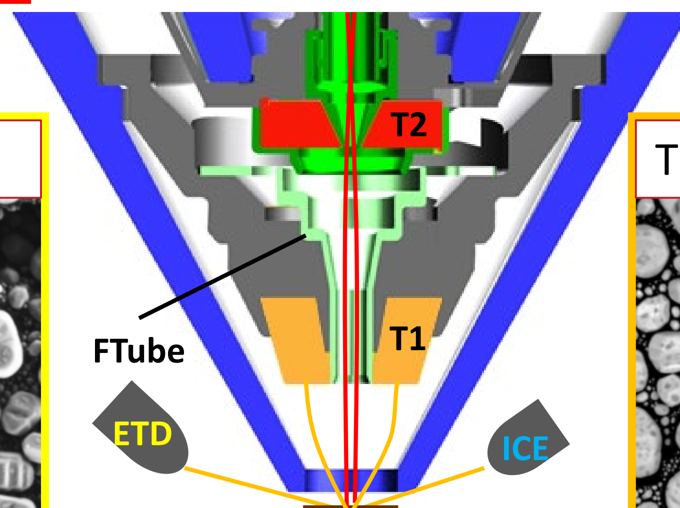
High contrast, fast imaging

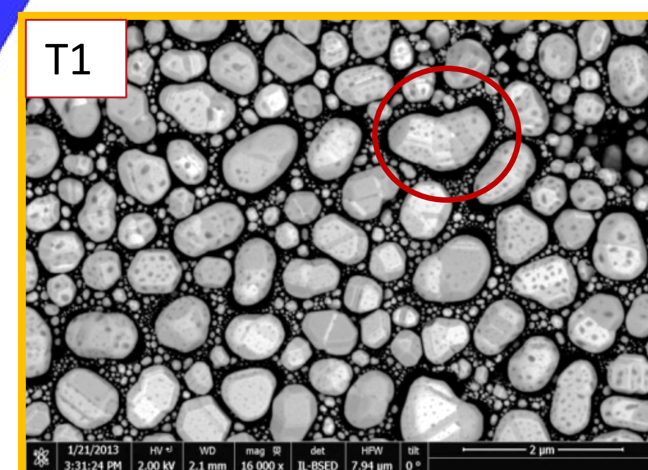




Simultaneous detection of all 4 images (T1, T2, T3, ETD), combining channeling contrast, materials contrast and surface topography information



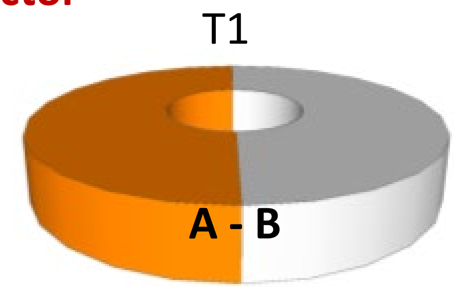


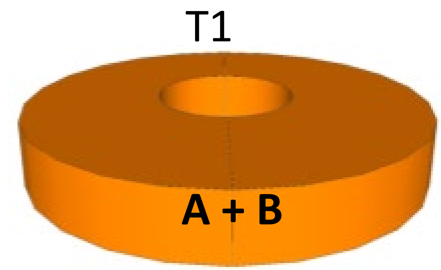


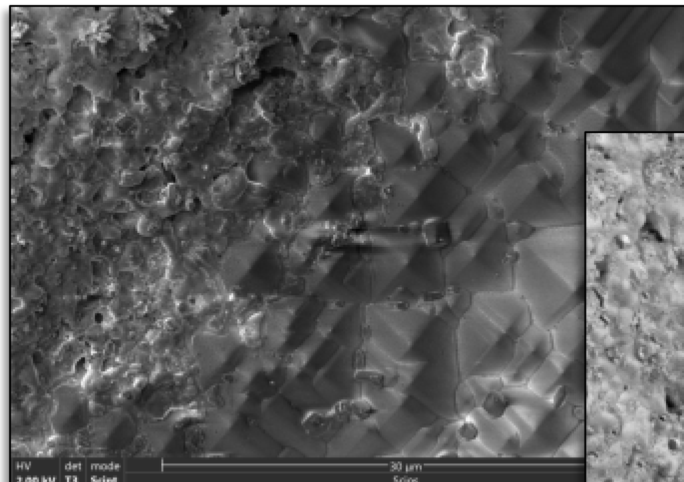
NICol Benefits: Detection

NICol Benefits: Detection

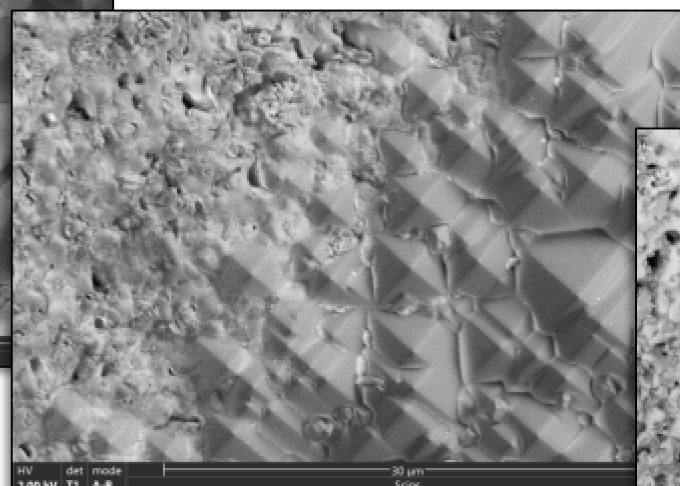
Unique segmented in-lens detector



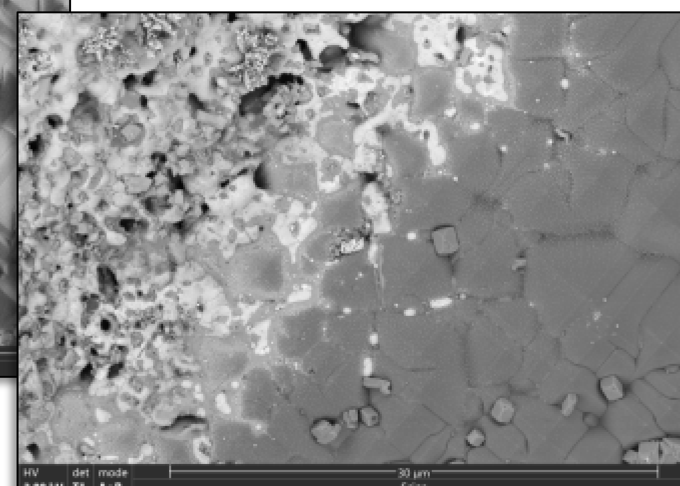




T3 – SE image showing charge

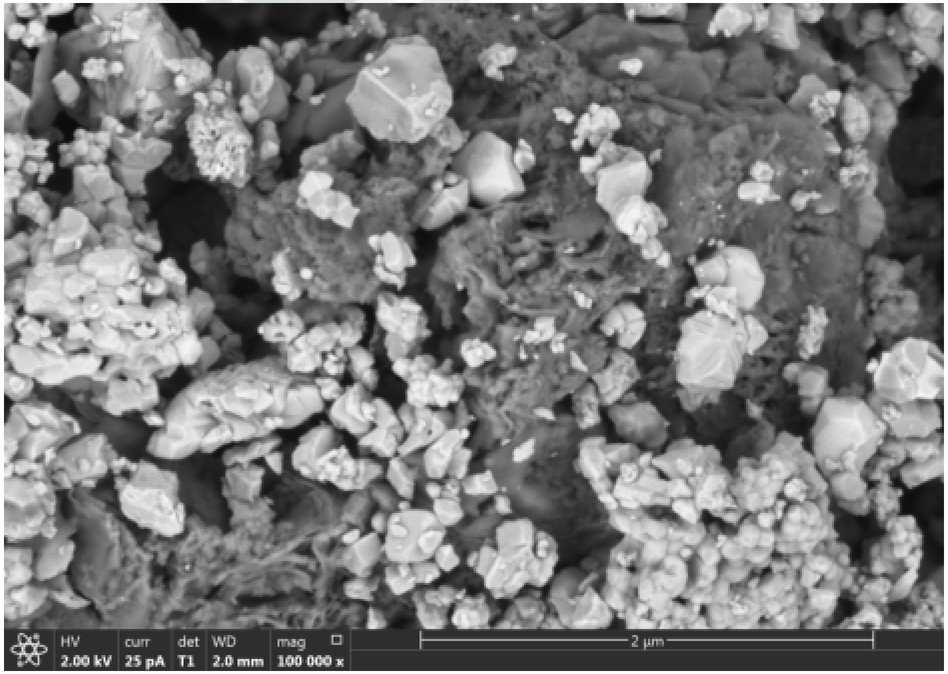


T1 (A-B) – image showing **<u>no charge and topography</u>**

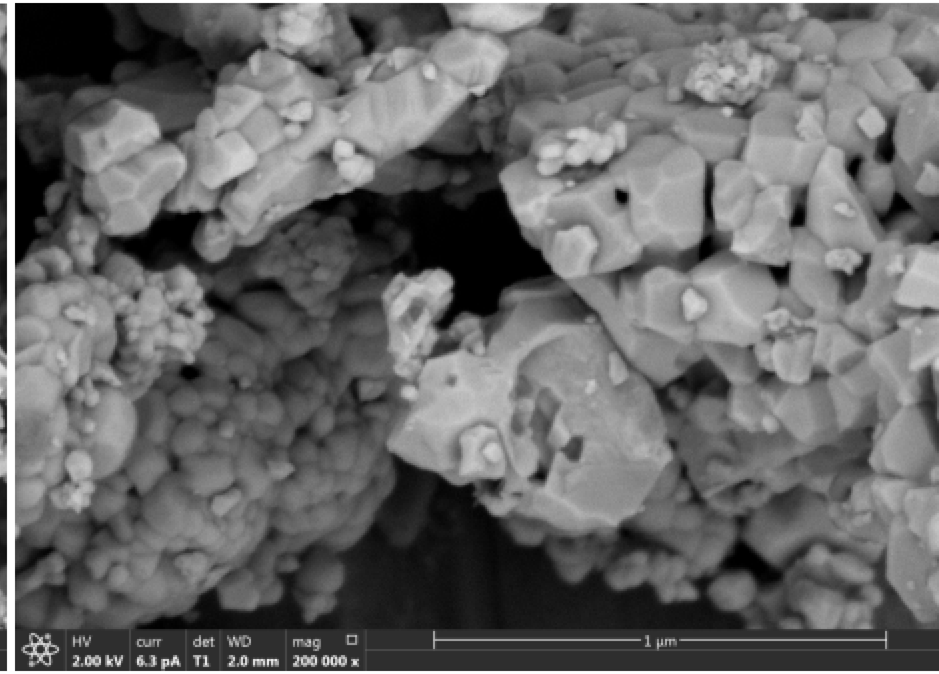


T1 (A+B) – image showing **<u>no charge and materials contrast</u>**

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

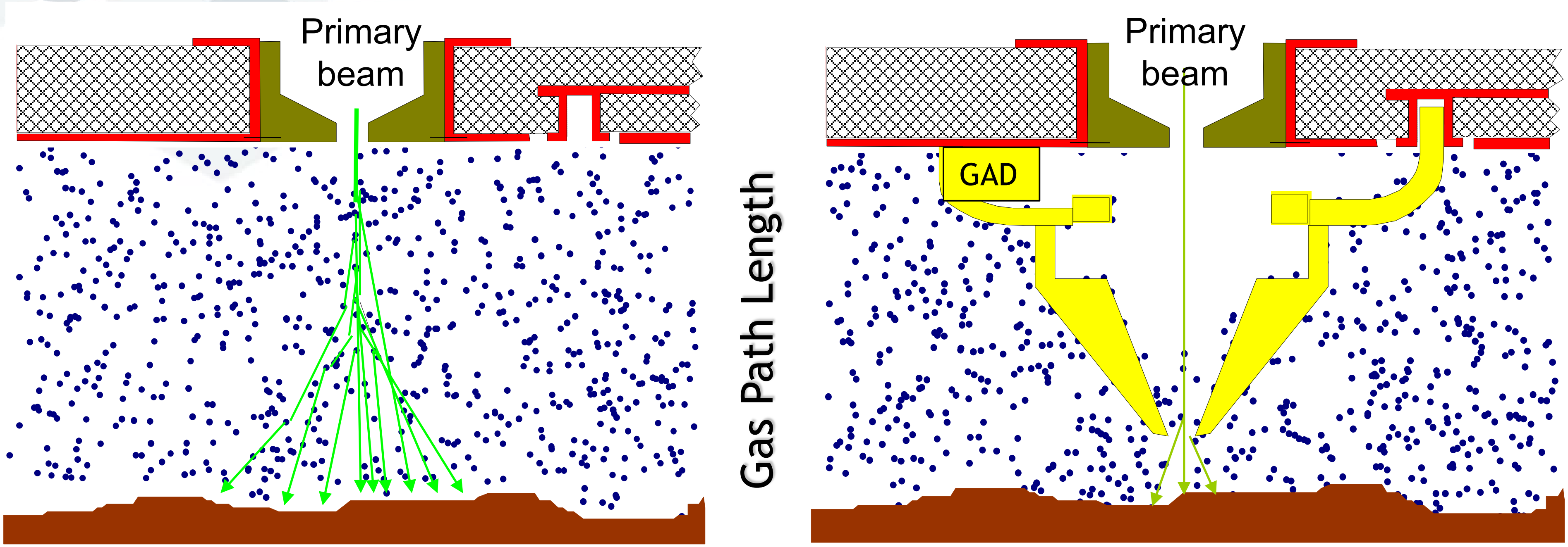
Standard system includes:

- 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):

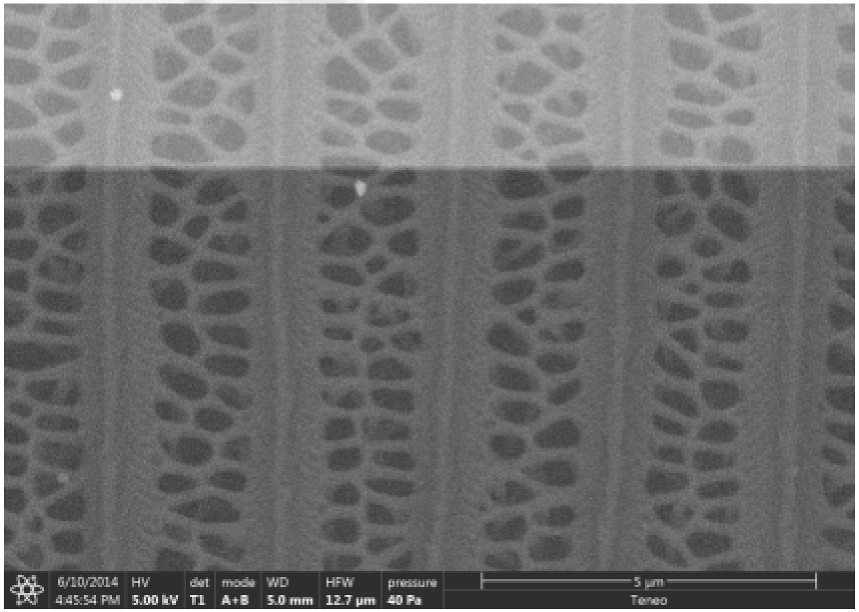
- T3 (In-column) detector
- DBS detector
- STEM 3 and STEM 3+ detector
- Low Vacuum (to 50Pa, includes LV SE detector)
- Directional GAD (Gaseous Analytical Detector) with full CBS/ABS segmentation

Low Vacuum Option

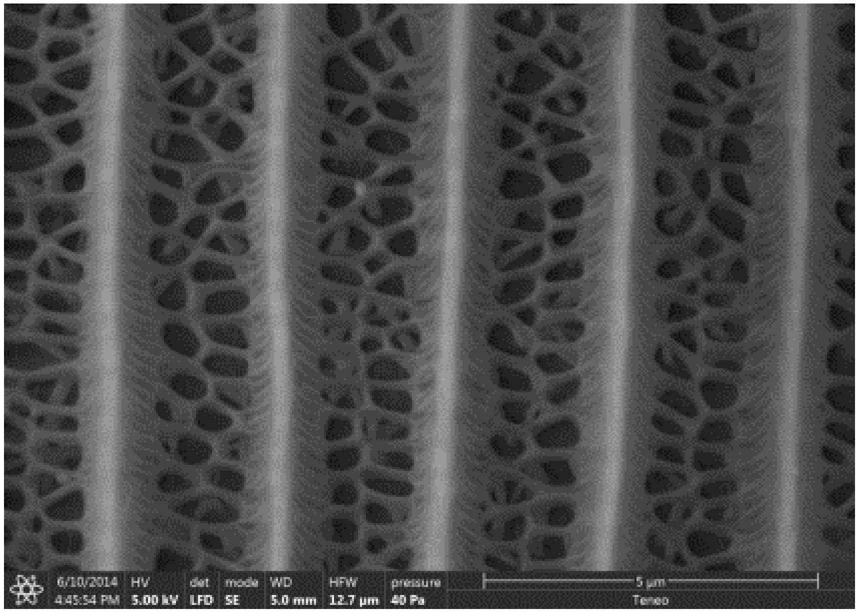


- Without a GAD or Pressure Limiting Aperture (PLA) the primary beam is broadened
- The longer the gas path length, the broader the beam becomes
- A GAD or PLA will reduce the gas path length, improving resolution and contrast.

Low Vacuum Option



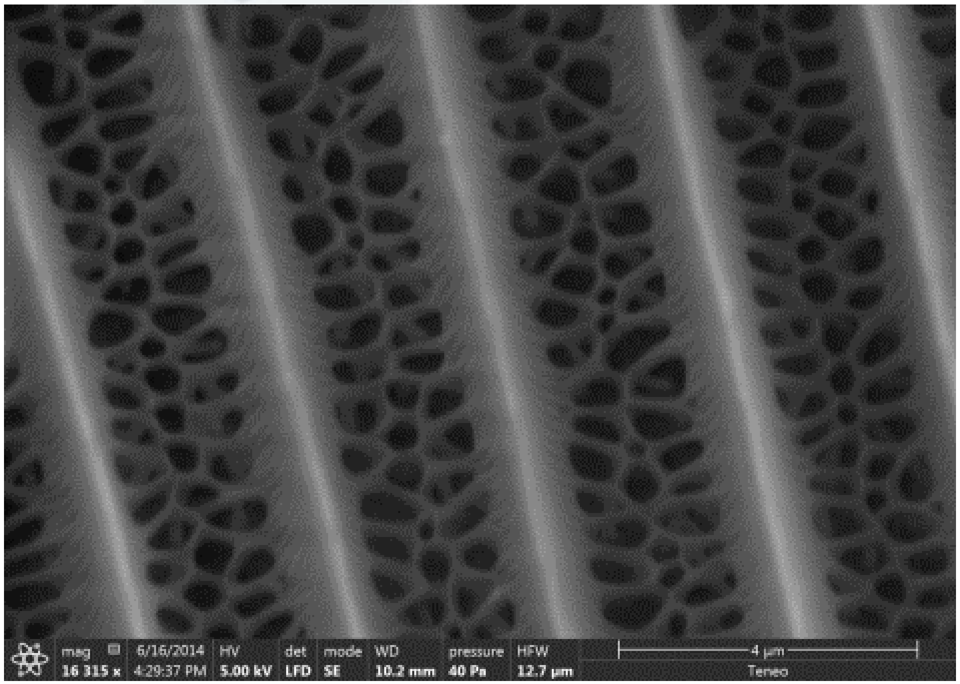
***<u>Without</u>* PLA / T1 Detector**
HV=5kV
Pressure = 40Pa
WD=5mm



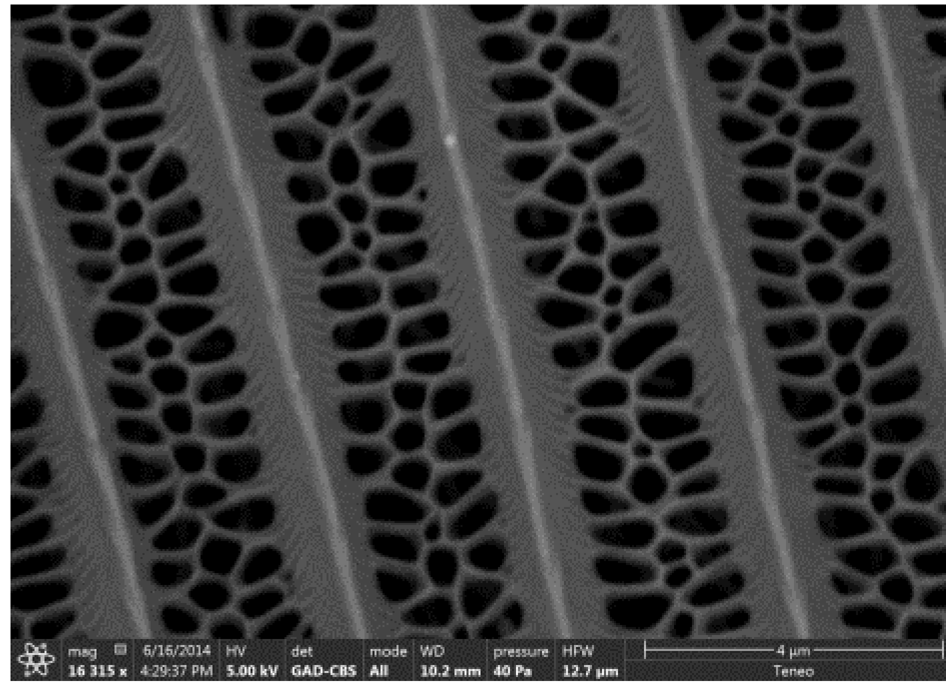
***<u>With</u>* PLA / GAD**
HV=5kV
Pressure = 40Pa
WD=5mm

Sample: Butterfly wing

Low Vacuum Option



Detector: LFD (SE)



Detector: GAD (BSE)

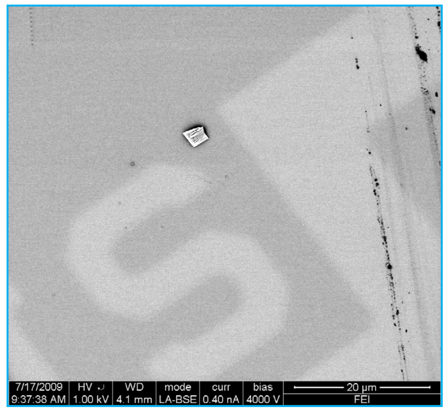
HV=5kV
Pressure = 40Pa
WD=10mm

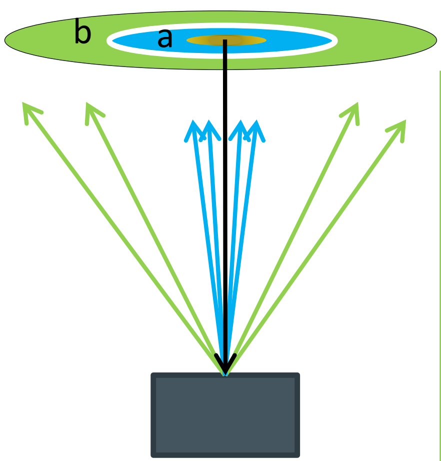
Sample: Butterfly wing

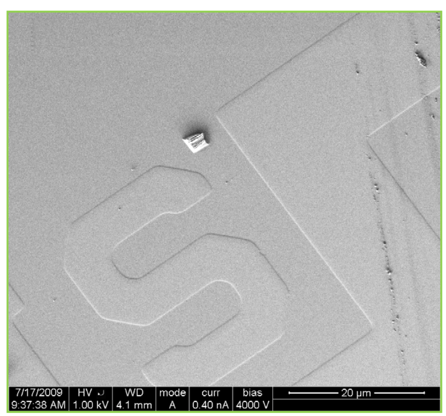
Explore. Discover. Resolve.

New DBS-GAD Detector

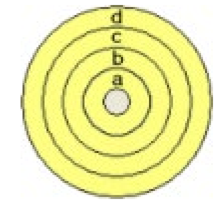
Old Style GAD
– 2 rings

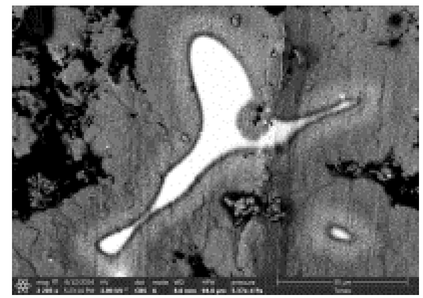


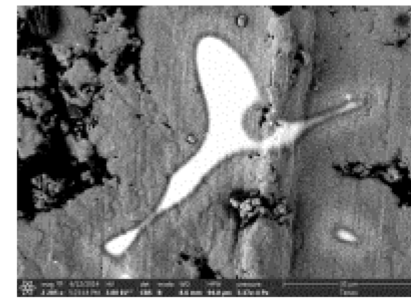


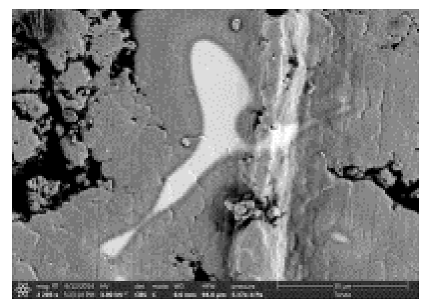


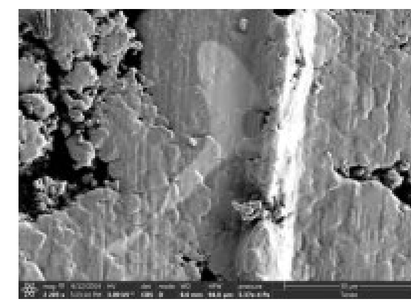
New Directional GAD
– 4 rings











- 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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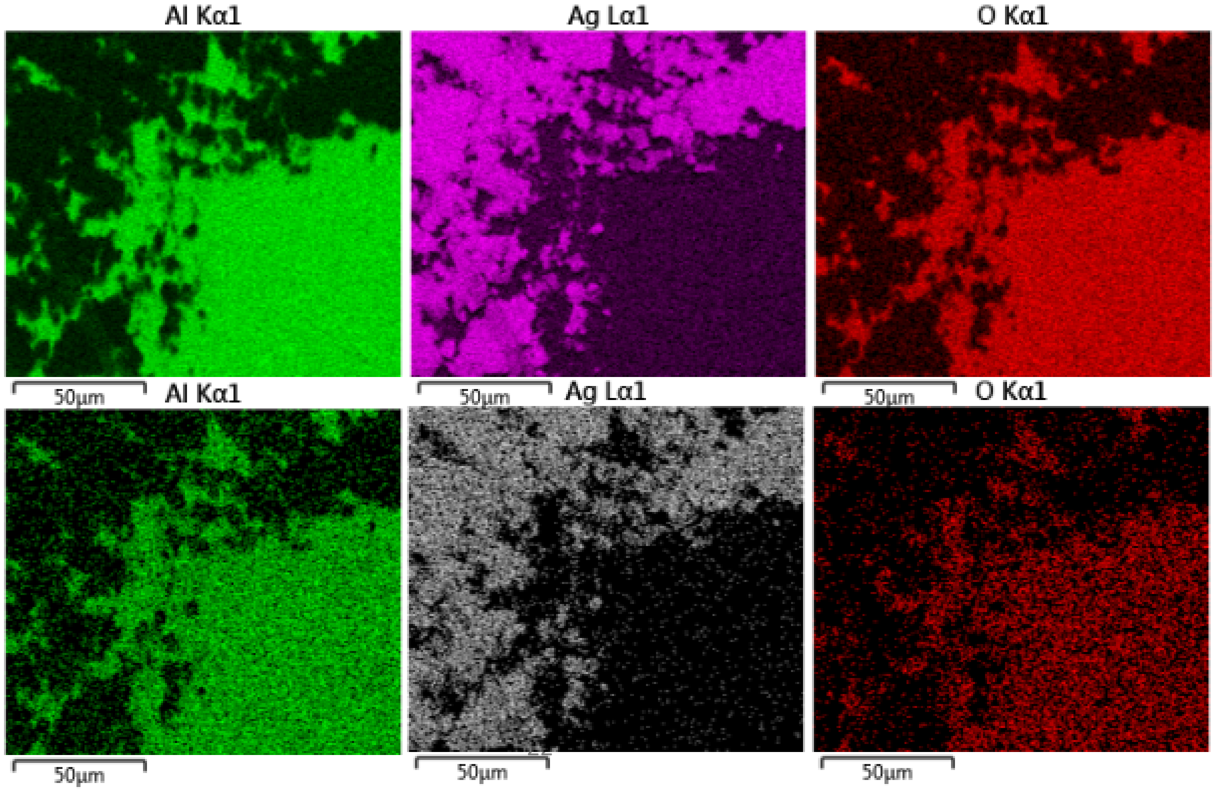
Analytical Performance

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

Teneo

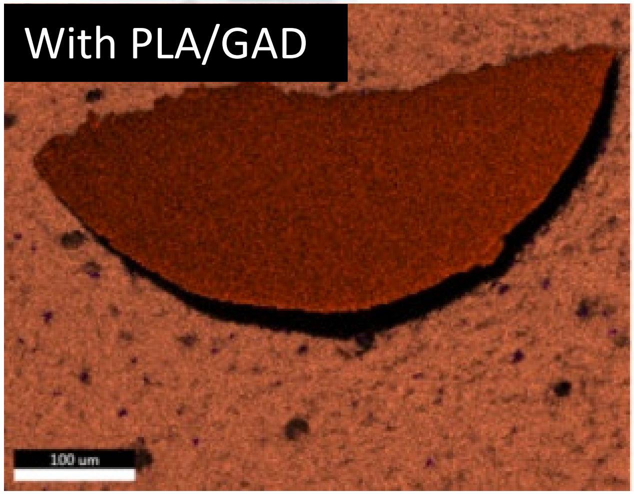
25 s Acquisition Time

Alternative Option

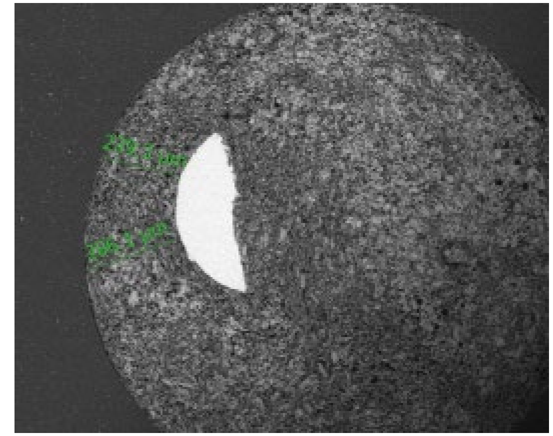


Analytical Performance

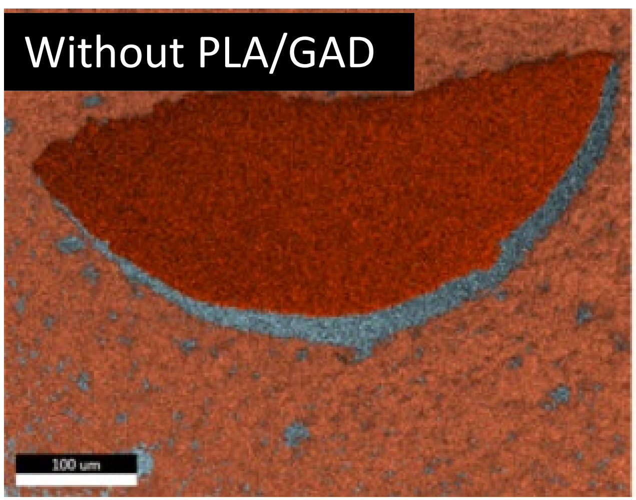
Quantitative, accurate EDX in Low Vacuum



12% C K
55% AgL
33% W L



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



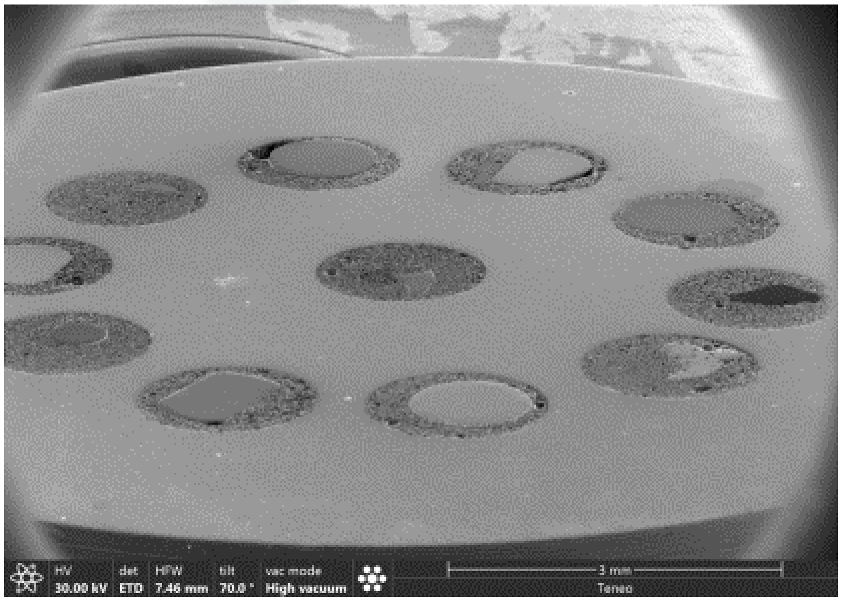
21% AlK
54% AgL
25% W L

Holes in the sample are identified as Aluminum!

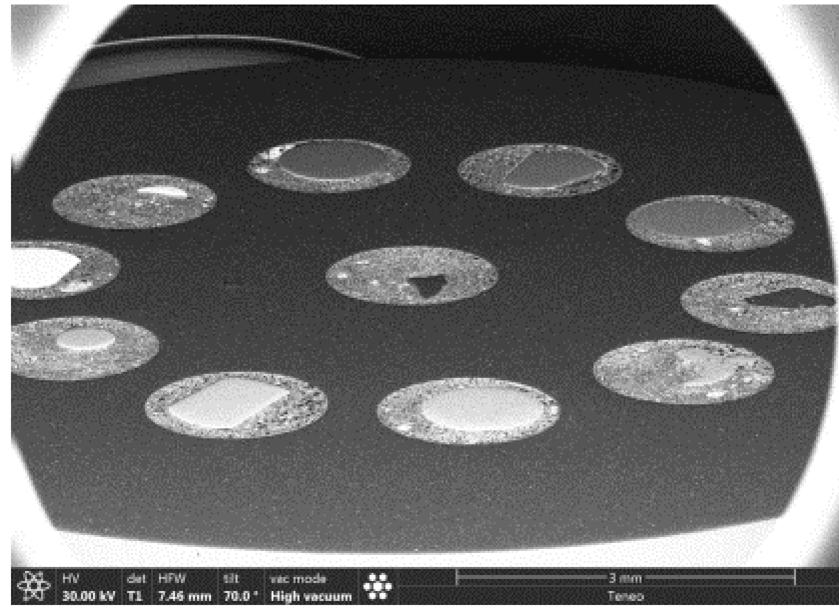
Same high currents available also in low vacuum mode – no loss of throughput

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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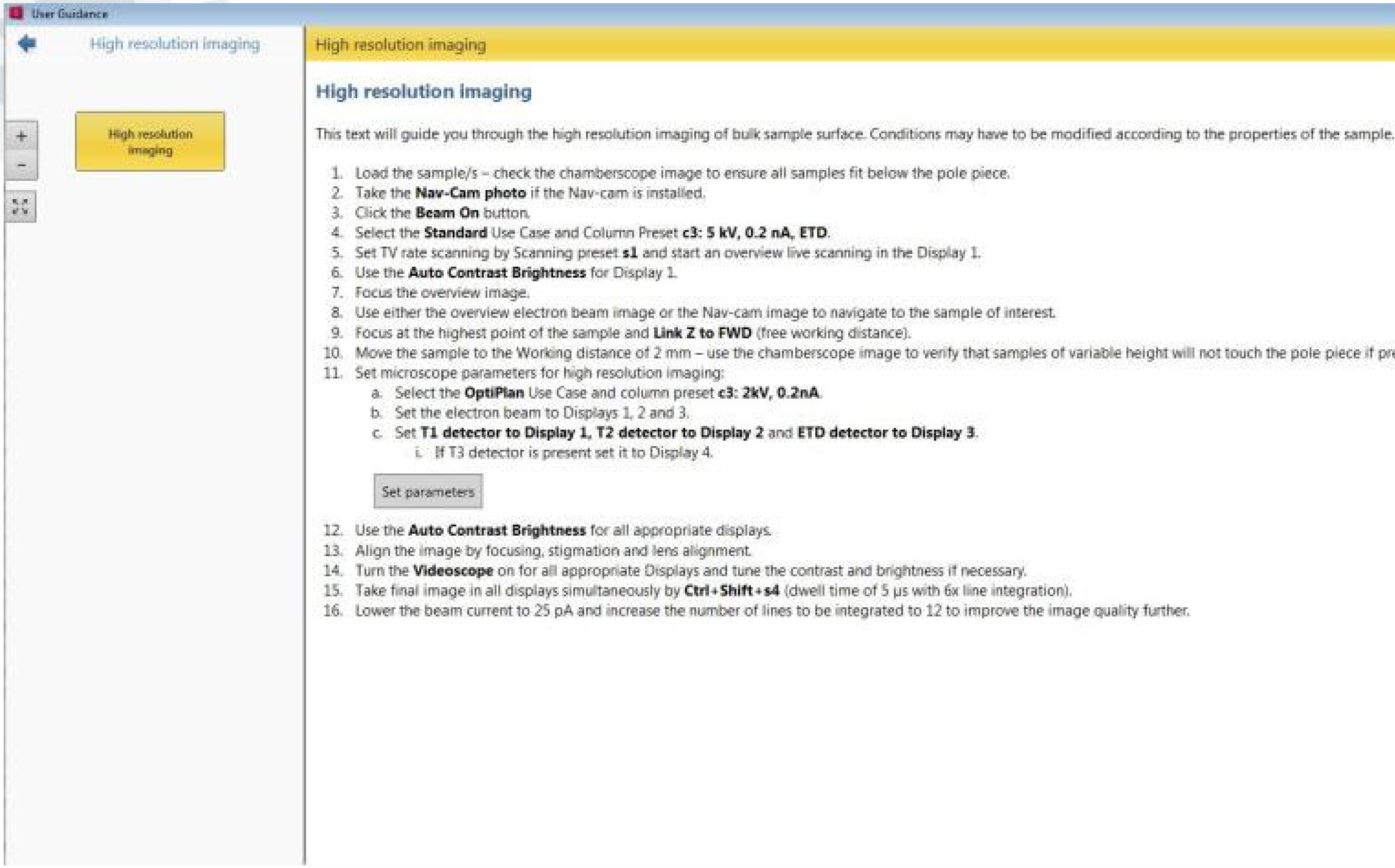
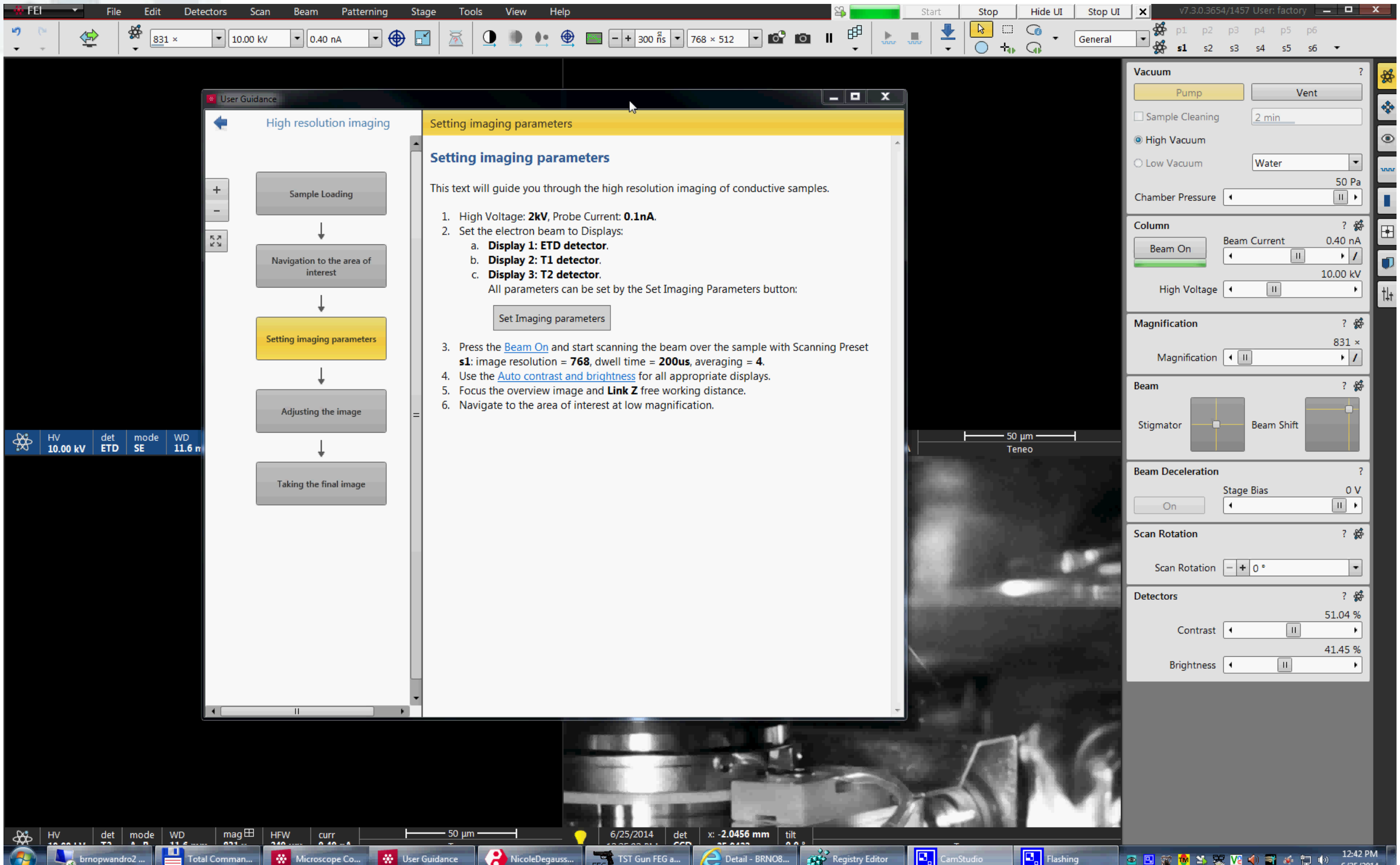
Ease of Use: User Guidance



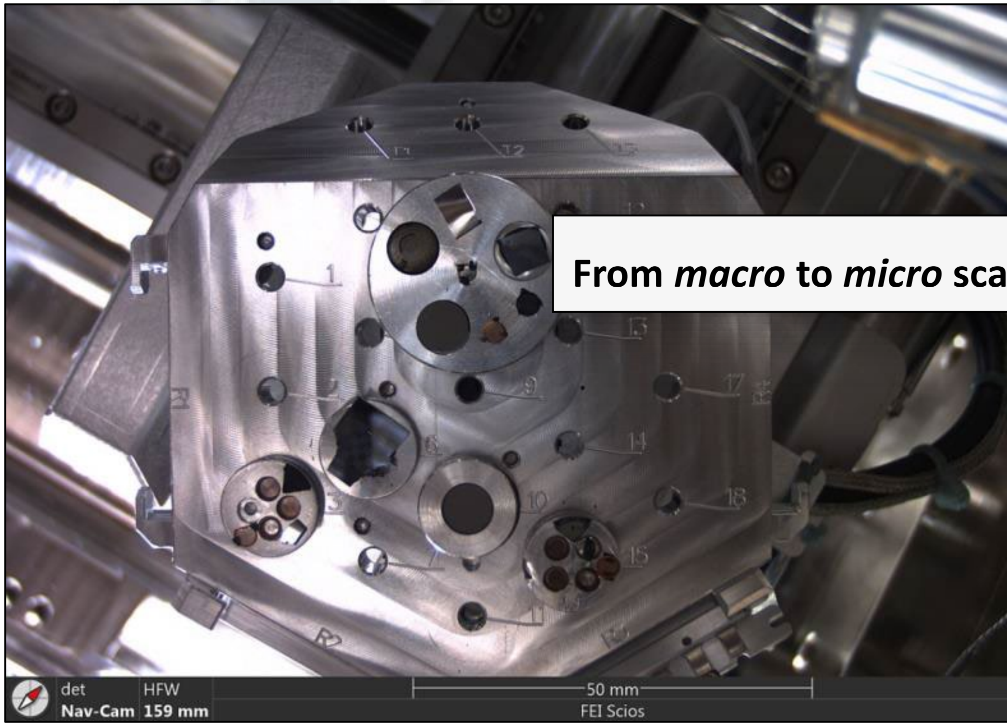
Workflows provided to guide all users to optimized results quickly

Ease of Use: User Guidance

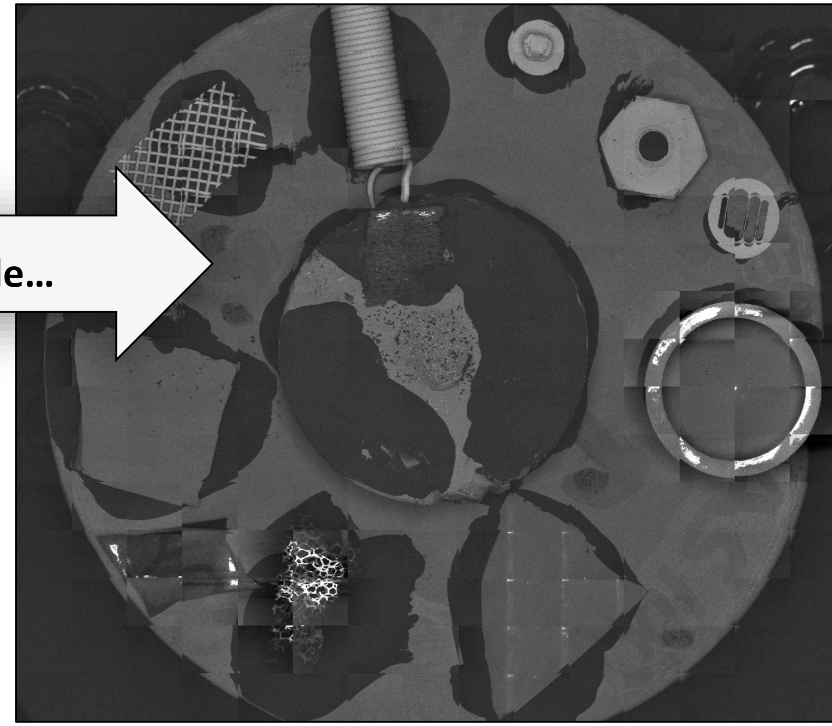


Easy Navigation

Comprehensive sample navigation options



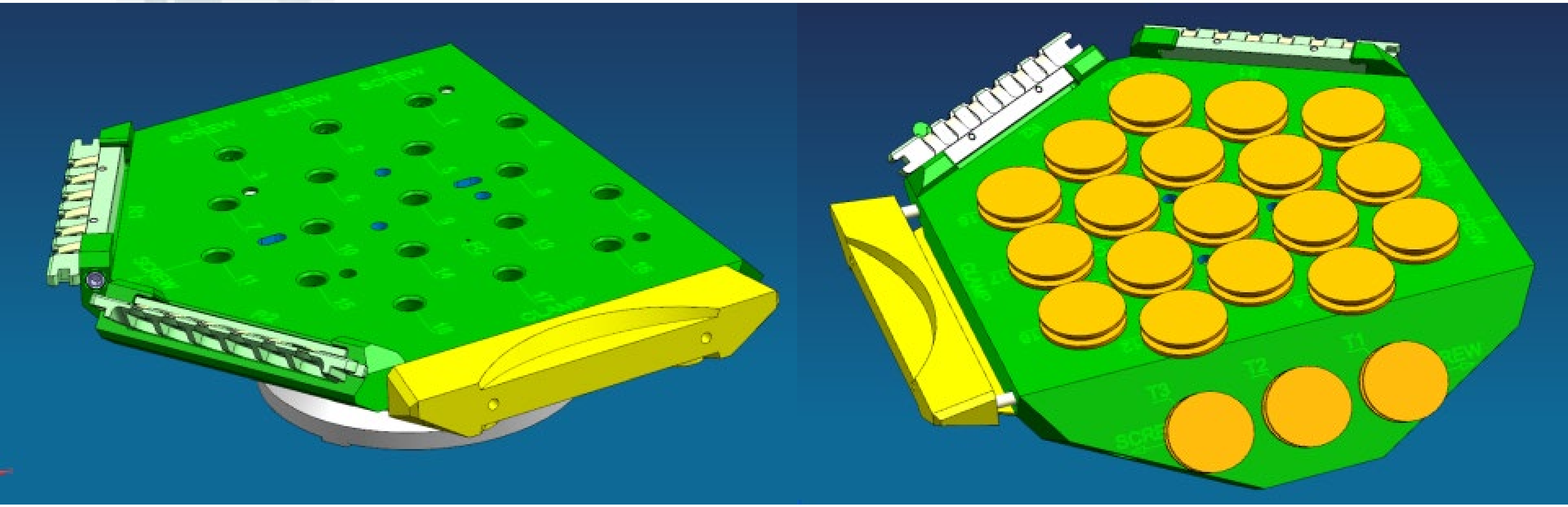
From *macro* to *micro* scale…



- Macro Color image of sample with Nav-Cam
- Point and click to drive to sample of interest

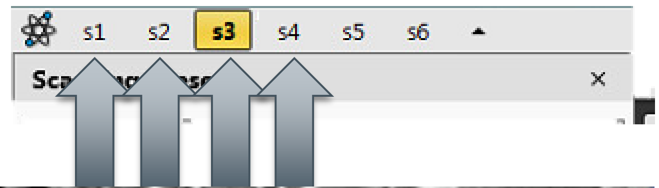
- 1X SEM image of sample with standard Navigation Montage
- Point and click to drive to sample of interest

Ease of Use: Sample Holder

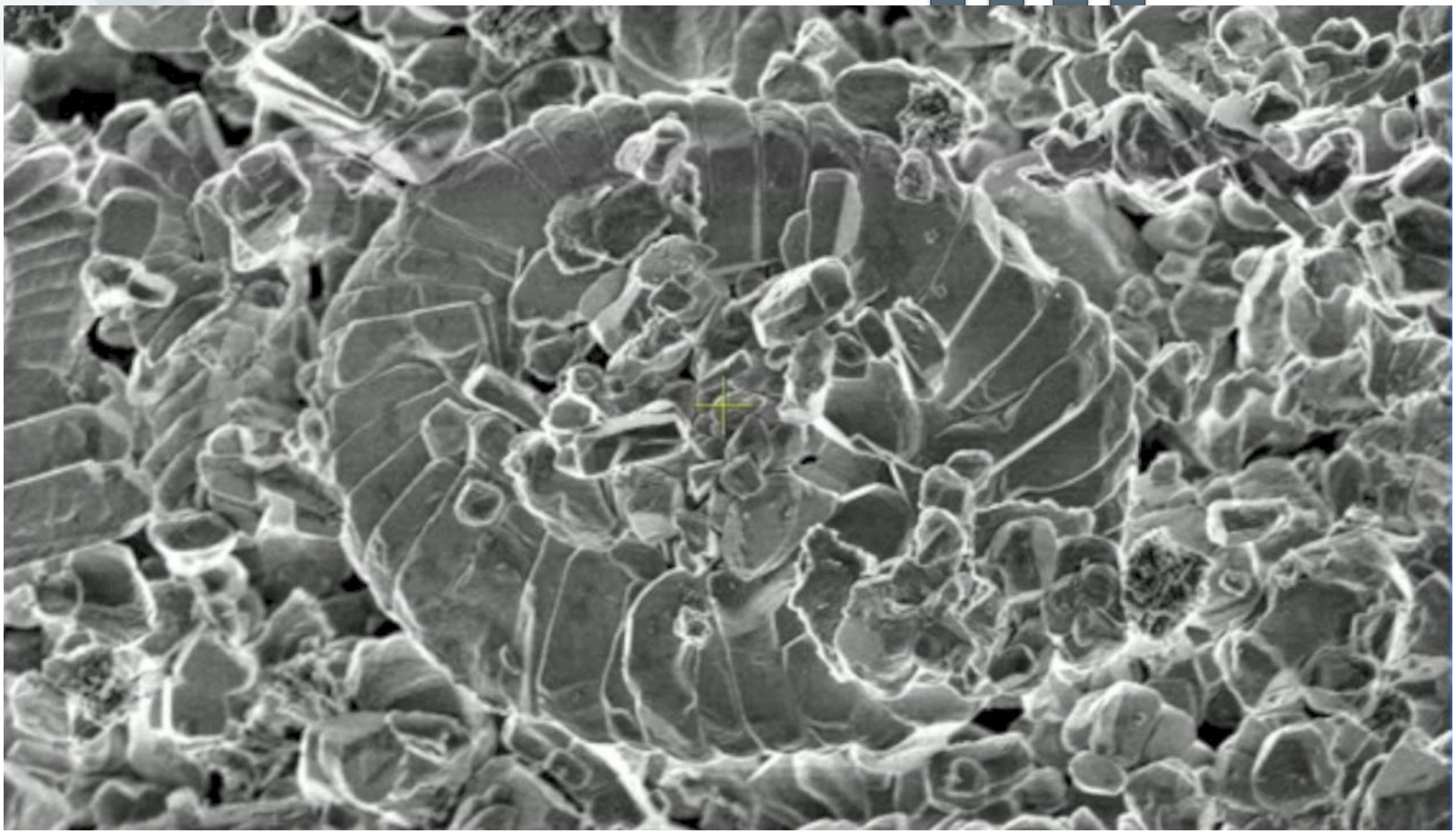


- Multi-sample holder holds up to 18 flat samples and 3 pre-tilted samples
- Same holder also used for STEM detector
- Spring loaded clamp enables easy imaging of cross-sections
- Requires no tools for sample loading

Point and shoot



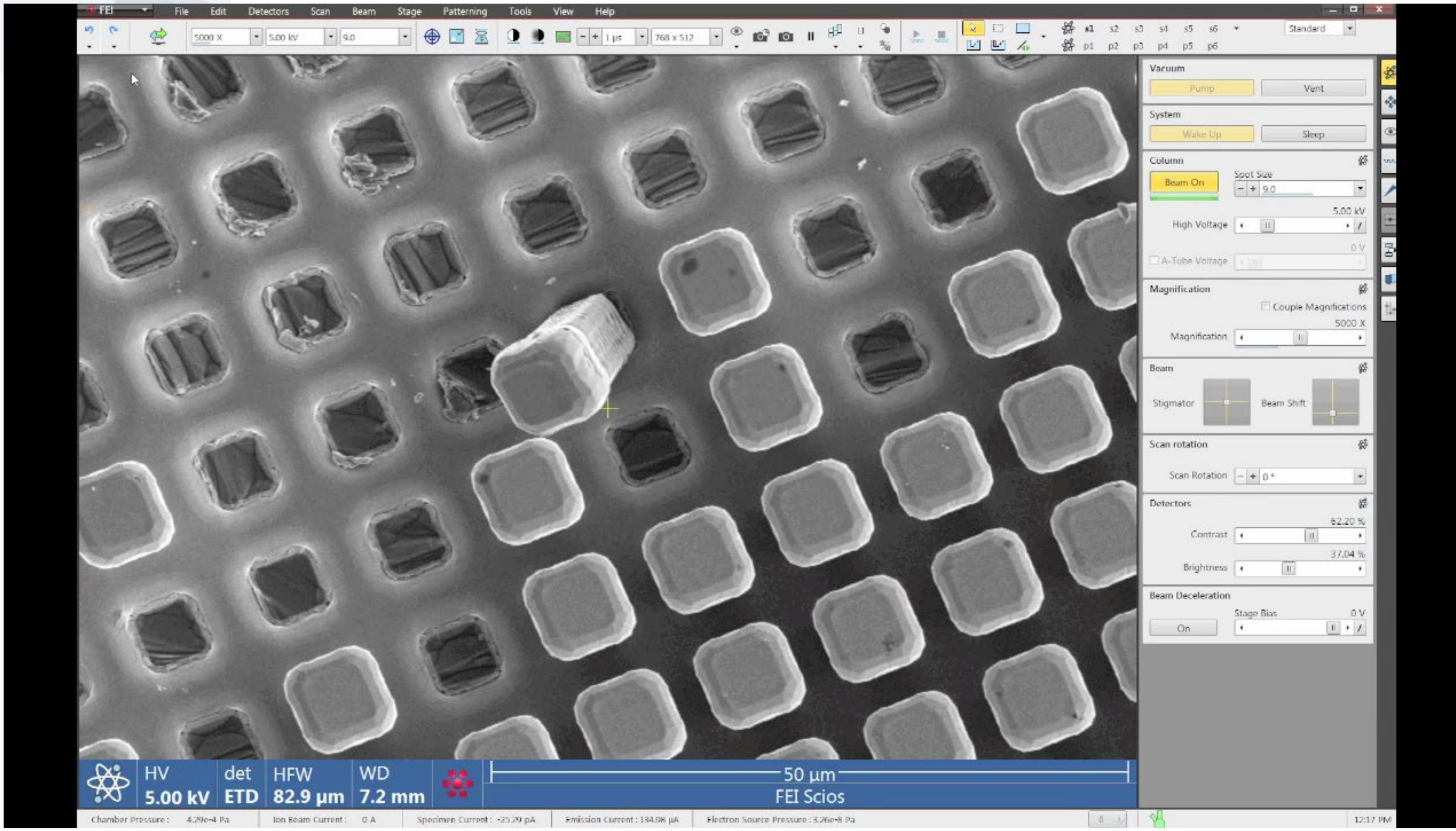
Use presets to get to an excellent result quickly



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

Learn by experimenting

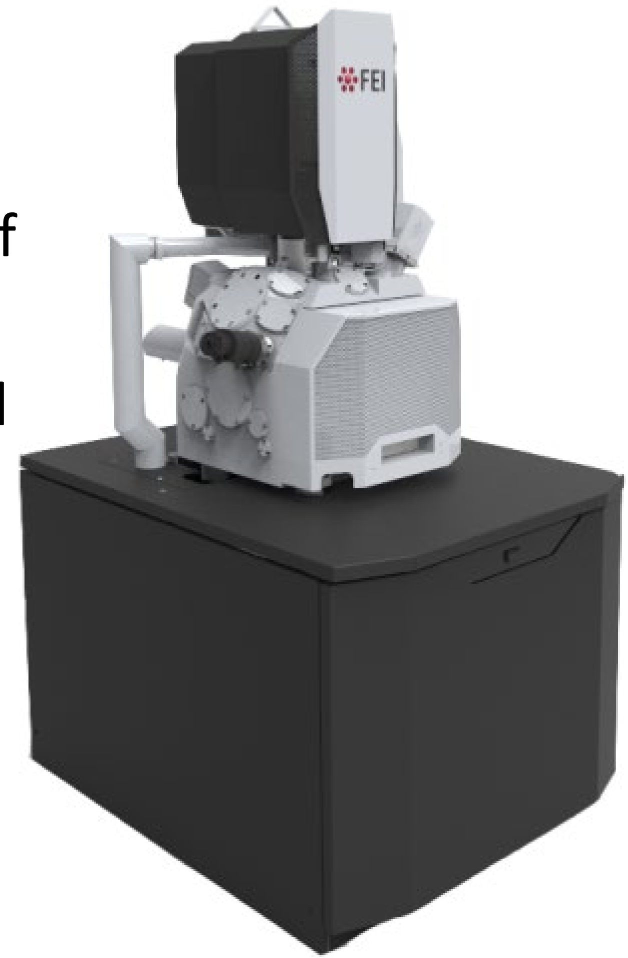
Use Undo/Redo to encourage experimentation with ease of mind



Use history and quickly go back to the best conditions

Summary

- A revolution in detection – the unique Trinity^{TM} 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

FEI™