Introducing the New Hitachi SU8700 SEM & Remote Data Analysis

Nick Gogola, Krysten Villalon, Tirzah Abbott, Roberto dos Reis

Outline

Hitachi SU8700 SEM

- Specification
- Imaging Modes
- Analytical Modes

Remote Data

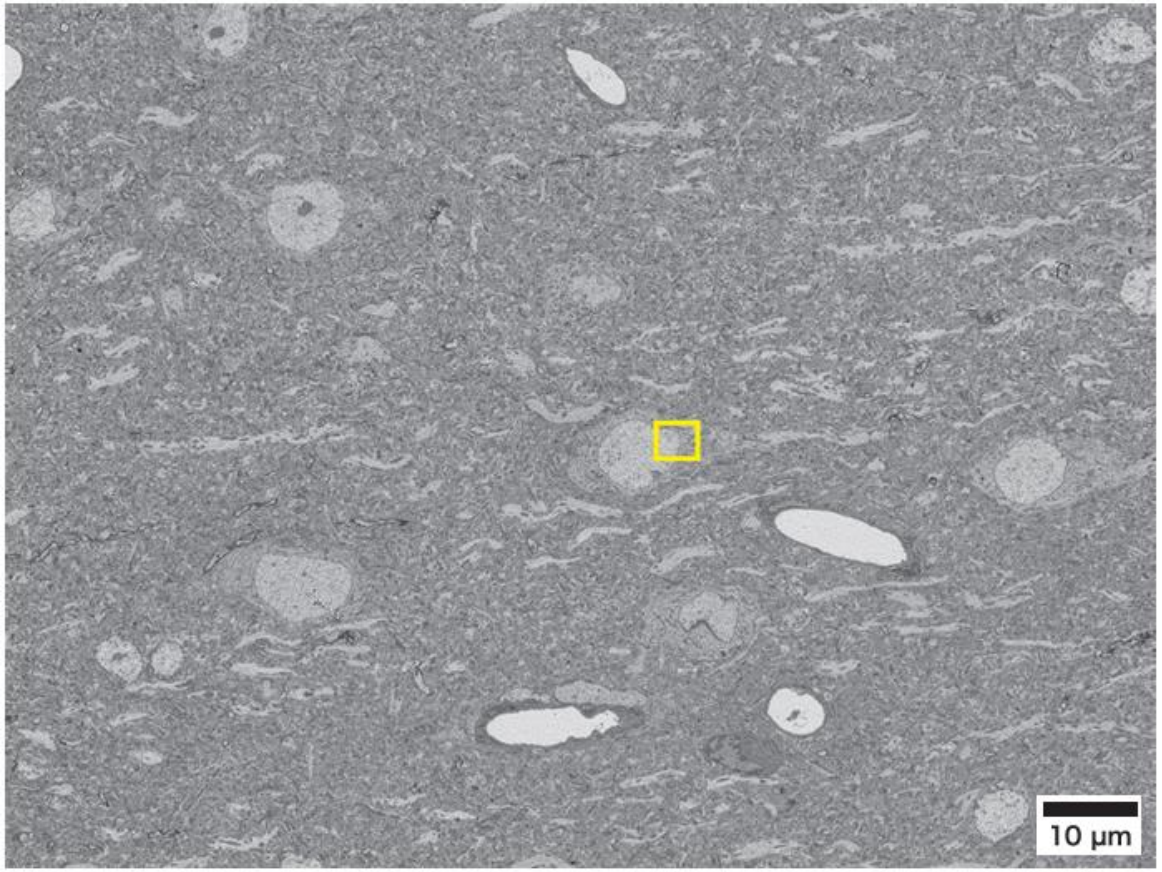
- Remote Data Access
- Remote Data Analysis
- Available Software

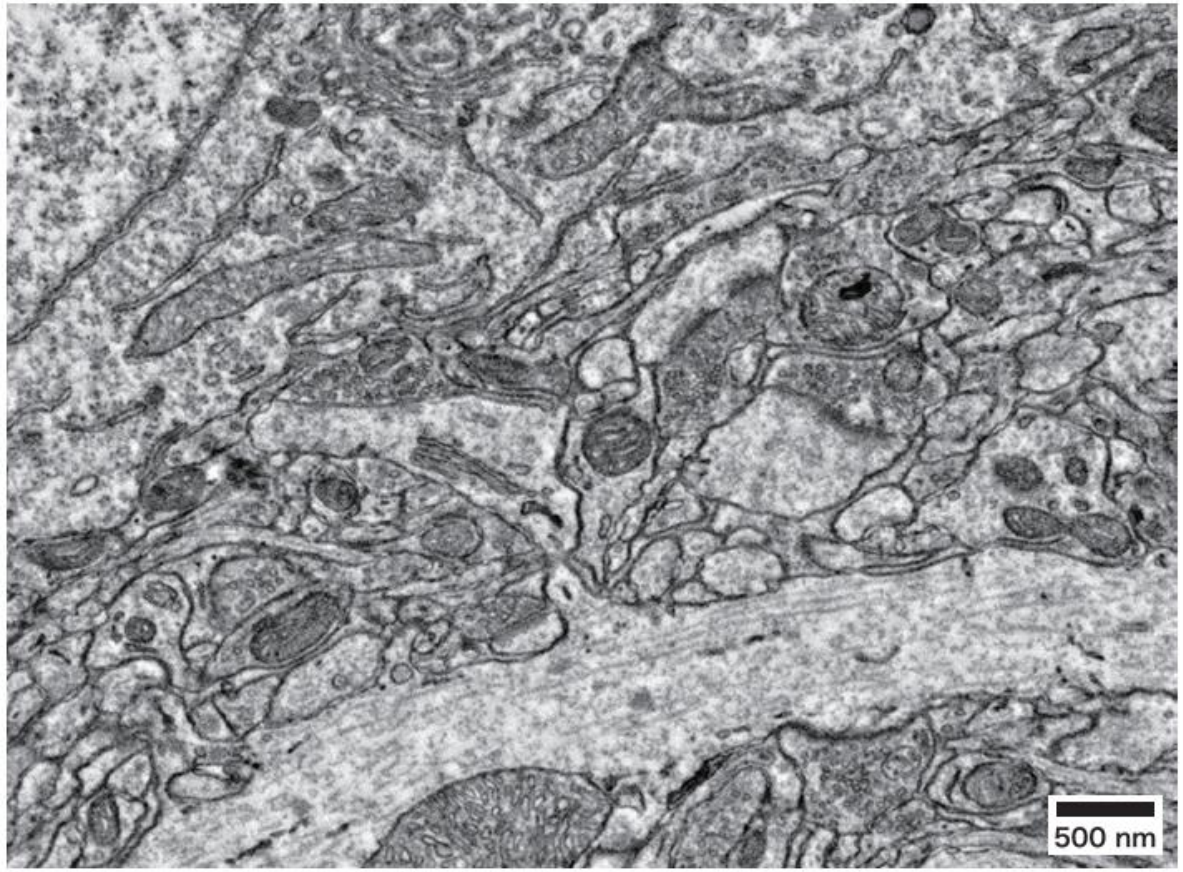
Specifications

Specifications

- Schottky Emitter
- 0.1 to 30 kV
- 0.6 nm @15 kV; 0.8 nm @1 kV ; 0.9 nm @0.3 kV
- 20 to 2,000,000 x
- Max. 200 nA
- Up to 40,960 x 30,720 pixels
- > 120 micrometers

Imaging Modes



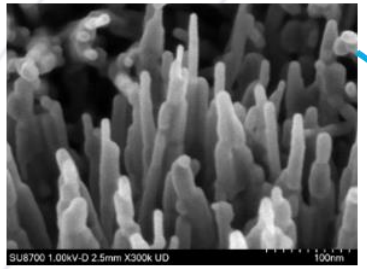


https://www.hitachi-hightech.com/file/global/pdf/sinews/technical_explanation/130316.pdf

Imaging Modes

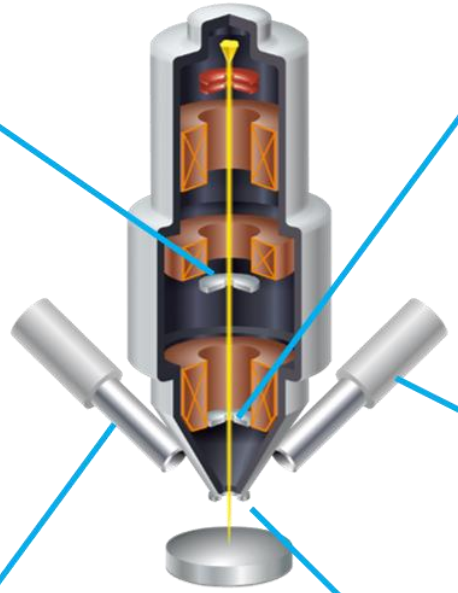
Upper Detector(UD)

Surface



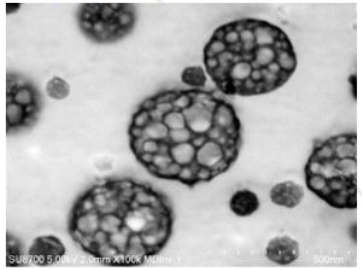
TiO_2/ 1 kV

Specimen courtesy of Prof.
Che Shunai,
School of Chemistry and
Chemical Engineering, SJTU



Middle Detector(MD)*

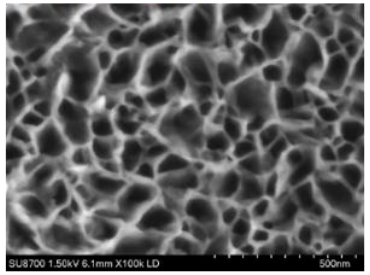
Composition



Stained ABS resin/ 5 kV

Lower Detector(LD)

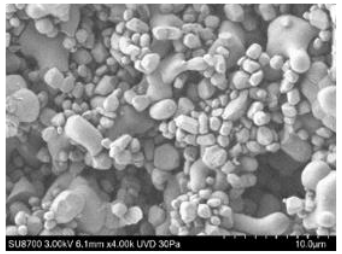
Topographic



Anodized aluminum oxide/ 1.5 kV

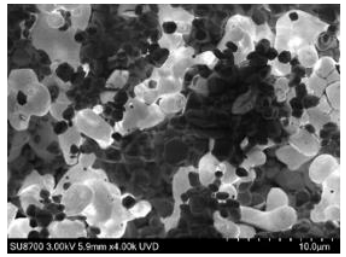
Ultra Variable-Pressure Detector (UVD)*

Topographic



Fluorescent pigments/ 3 kV
(Low vacuum conditions)

Luminescence



Fluorescent pigments/ 3 kV
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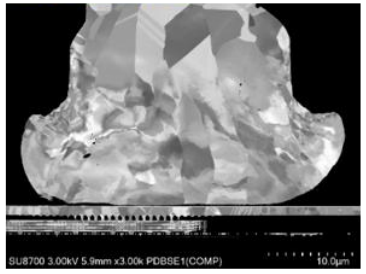
Semiconductor Type BSED (PD-BSED)*

Crystalline

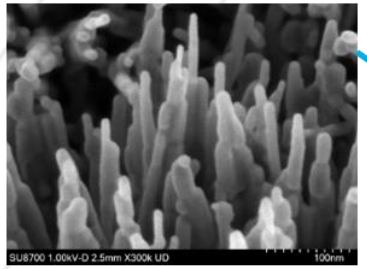


Bonded gold wire's cross section/ 3 kV

https://www.hitachi-hightech.com/global/en/products/microscopes/sem-tem-stem/fe-sem/su8700.html

Upper Detector(UD)

Surface



TiO_2/ 1 kV

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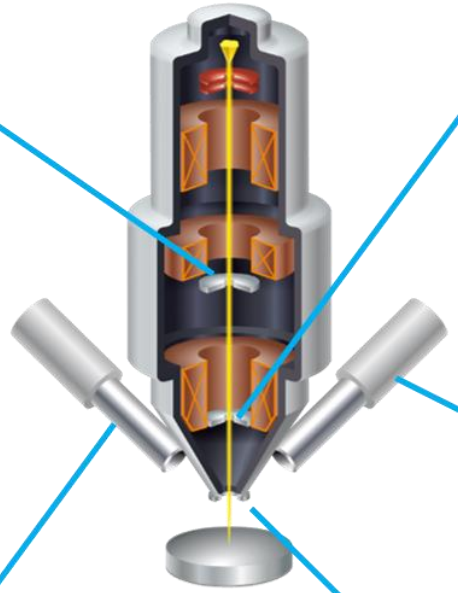
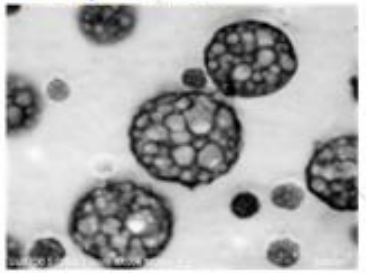


Middle Detector(MD)*

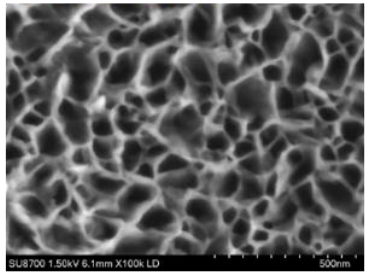
Composition



Stained ABS resin/ 5 kV

Lower Detector(LD)

Topographic



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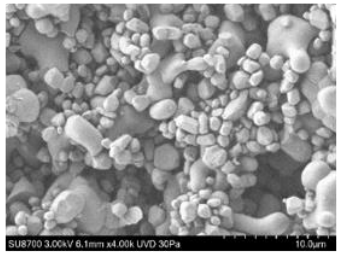
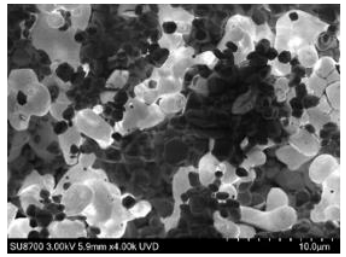


Fluorescent pigments/ 3 kV
(Low vacuum conditions)

Luminescence



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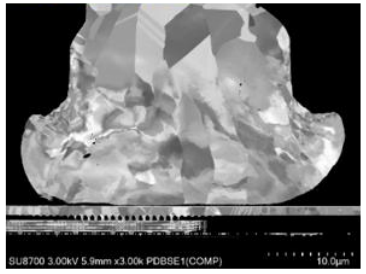
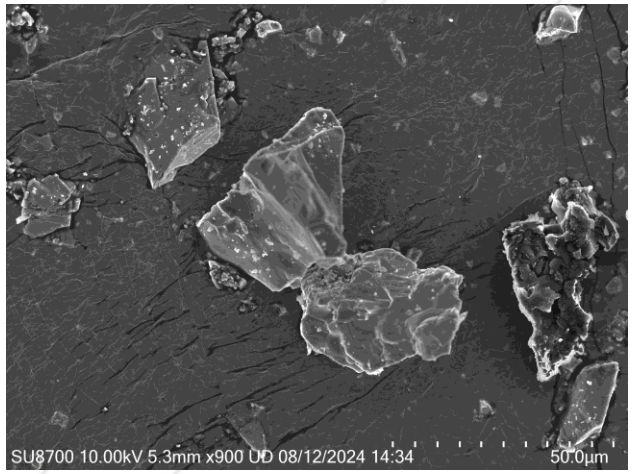
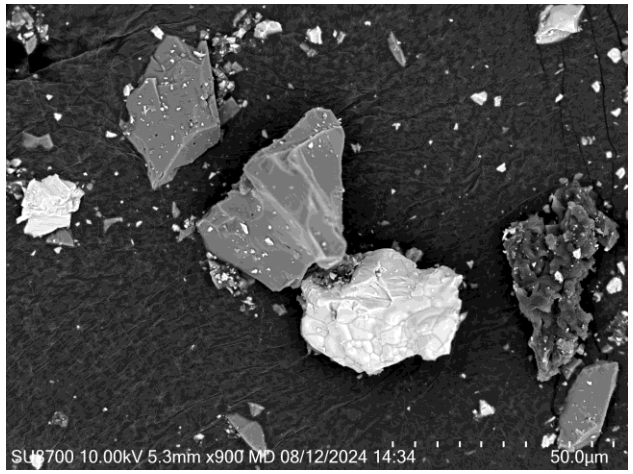


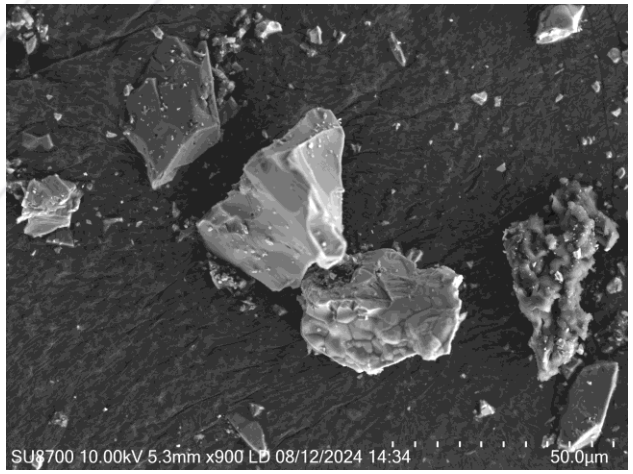
Bonded gold wire's cross section/ 3 kV

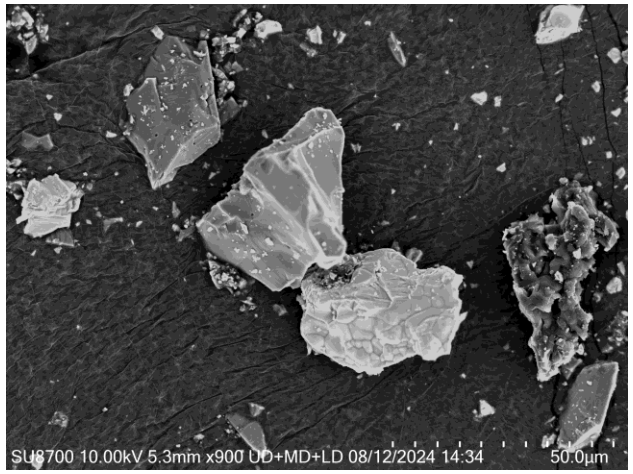
https://www.hitachi-hightech.com/global/en/products/microscopes/sem-tem-stem/fe-sem/su8700.html

Middle Detector

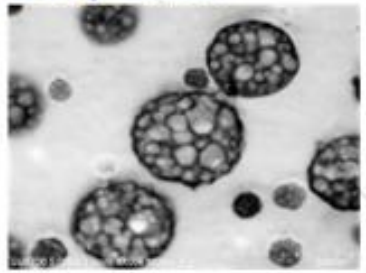








Middle Detector(MD)*
Composition



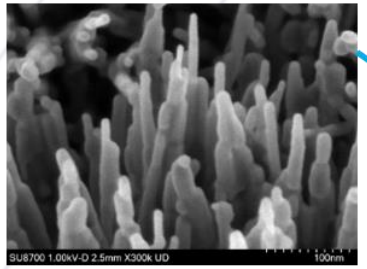
Stained ABS resin/ 5 kV

- In-column BSE imaging
- Short working distances (high resolution)
- Composition and topography
- Overlays

https://www.hitachi-hightech.com/global/en/products/microscopes/sem-tem-stem/fe-sem/su8700.html

Upper Detector(UD)

Surface



TiO_2/ 1 kV

Specimen courtesy of Prof.
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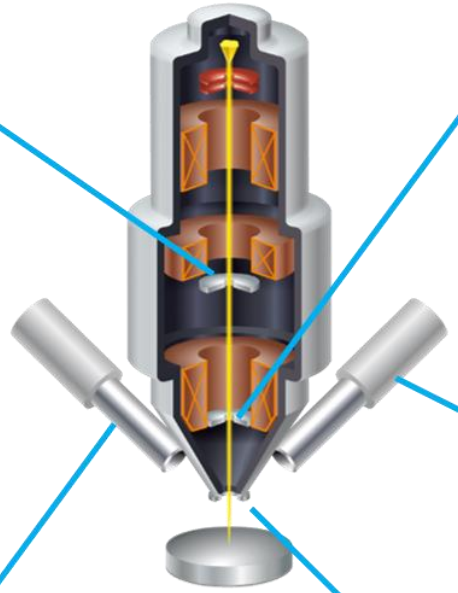

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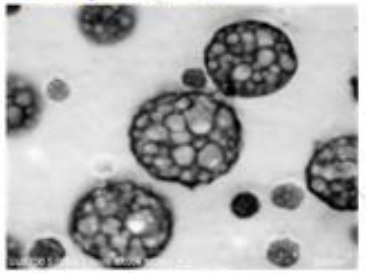
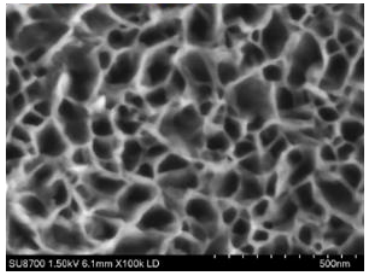


Stained ABS resin/ 5 kV

Lower Detector(LD)

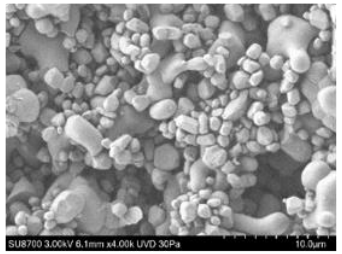
Topographic



Anodized aluminum oxide/ 1.5 kV

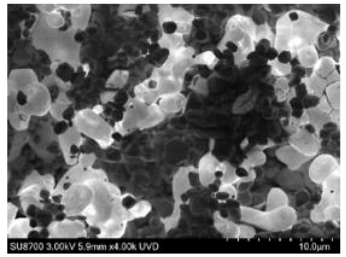
Ultra Variable-Pressure Detector (UVD)*

Topographic



Fluorescent pigments/ 3 kV
(Low vacuum conditions)

Luminescence



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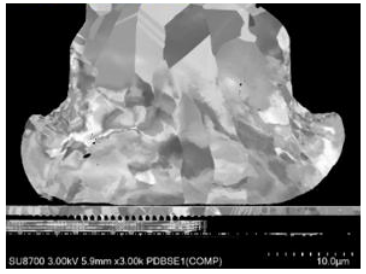

Bonded gold wire's cross section/ 3 kV

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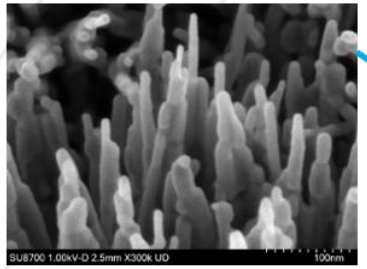
Upper Detector(UD)

Surface



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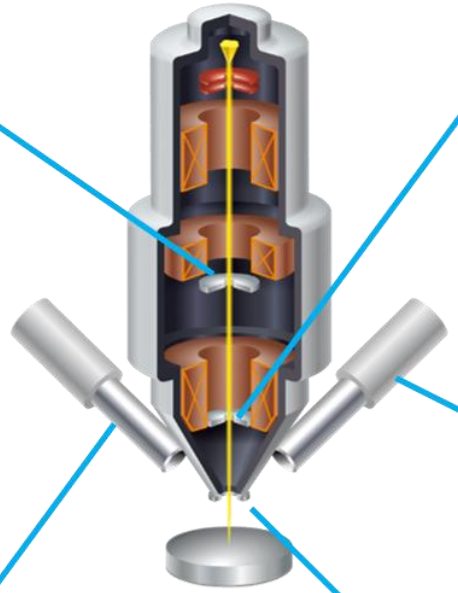
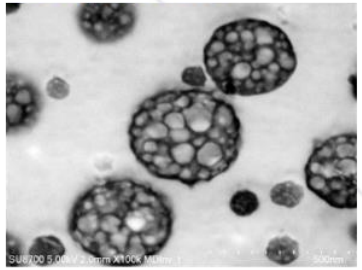


Middle Detector(MD)*

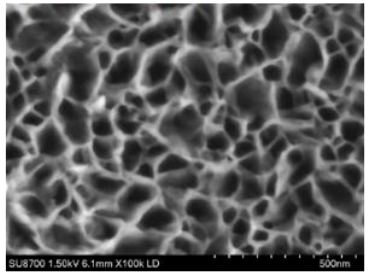
Composition



Stained ABS resin/ 5 kV

Lower Detector(LD)

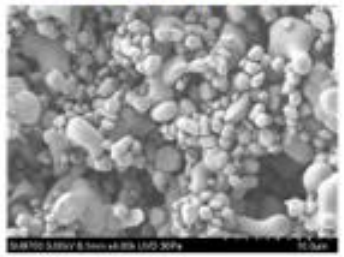
Topographic



Anodized aluminum oxide/ 1.5 kV

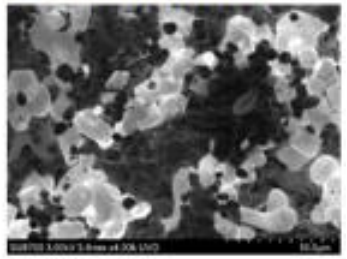
Ultra Variable-Pressure Detector (UVD)*

Topographic



Fluorescent pigments/ 3 kV
(Low vacuum conditions)

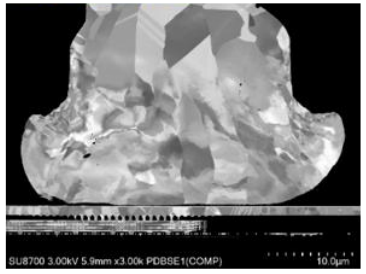
Luminescence



Fluorescent pigments/ 3 kV
(High vacuum conditions)

Semiconductor Type BSED (PD-BSED)*

Crystalline



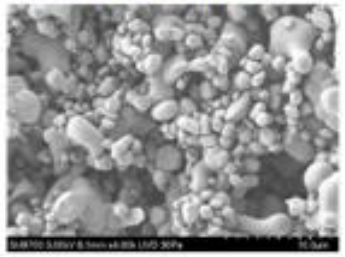
Bonded gold wire's cross section/ 3 kV

https://www.hitachi-hightech.com/global/en/products/microscopes/sem-tem-stem/fe-sem/su8700.html

Ultra Variable-Pressure Detector

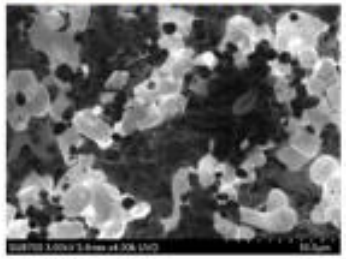
Ultra Variable-Pressure Detector (UVD)*

Topographic



Fluorescent pigments/ 3 kV
(Low vacuum conditions)

Luminescence



Fluorescent pigments/ 3 kV
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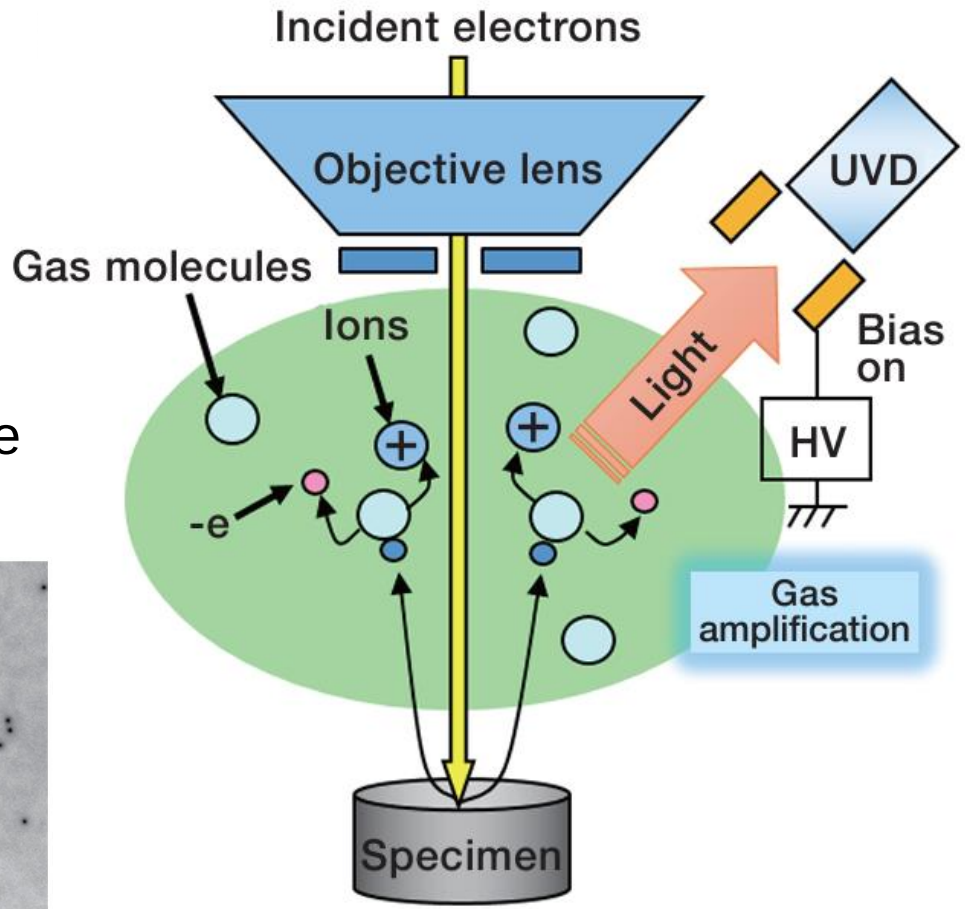
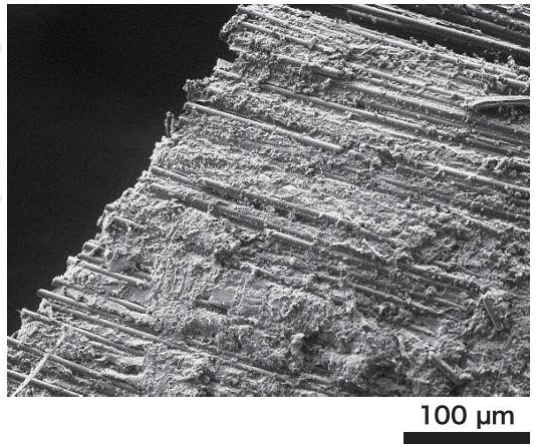
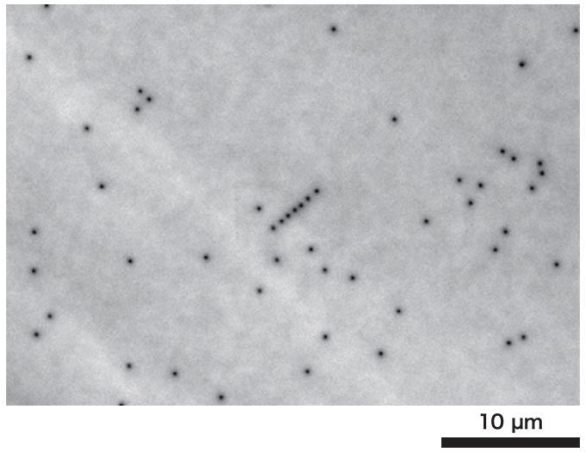


Low-vacuum mode for charge suppression



Cathodoluminescence observation

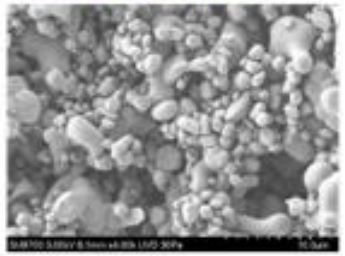


https://www.hitachi-hightech.com/file/global/pdf/sinews/technical_explanation/130312.pdf

Ultra Variable-Pressure Detector

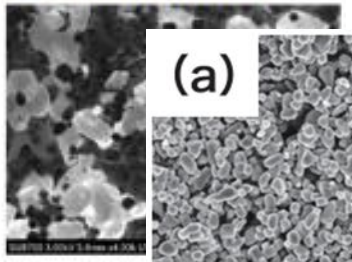
Ultra Variable-Pressure Detector (UVD)*

Topographic



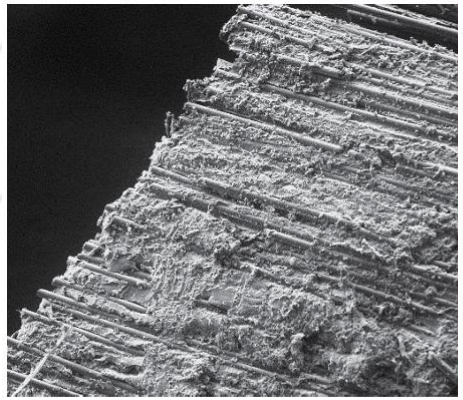
Fluorescent pigments/ 3 kV
(Low vacuum conditions)

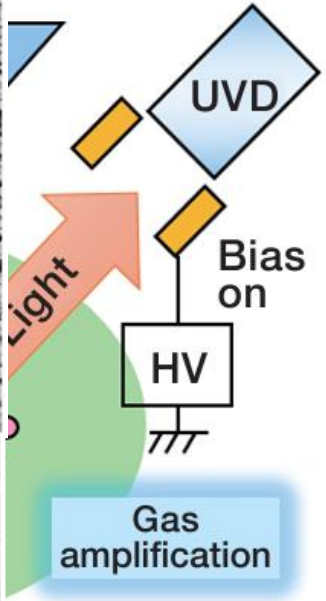
Luminescence



Fluorescent
(High vacu

Low-vacuum mode
charge suppressior





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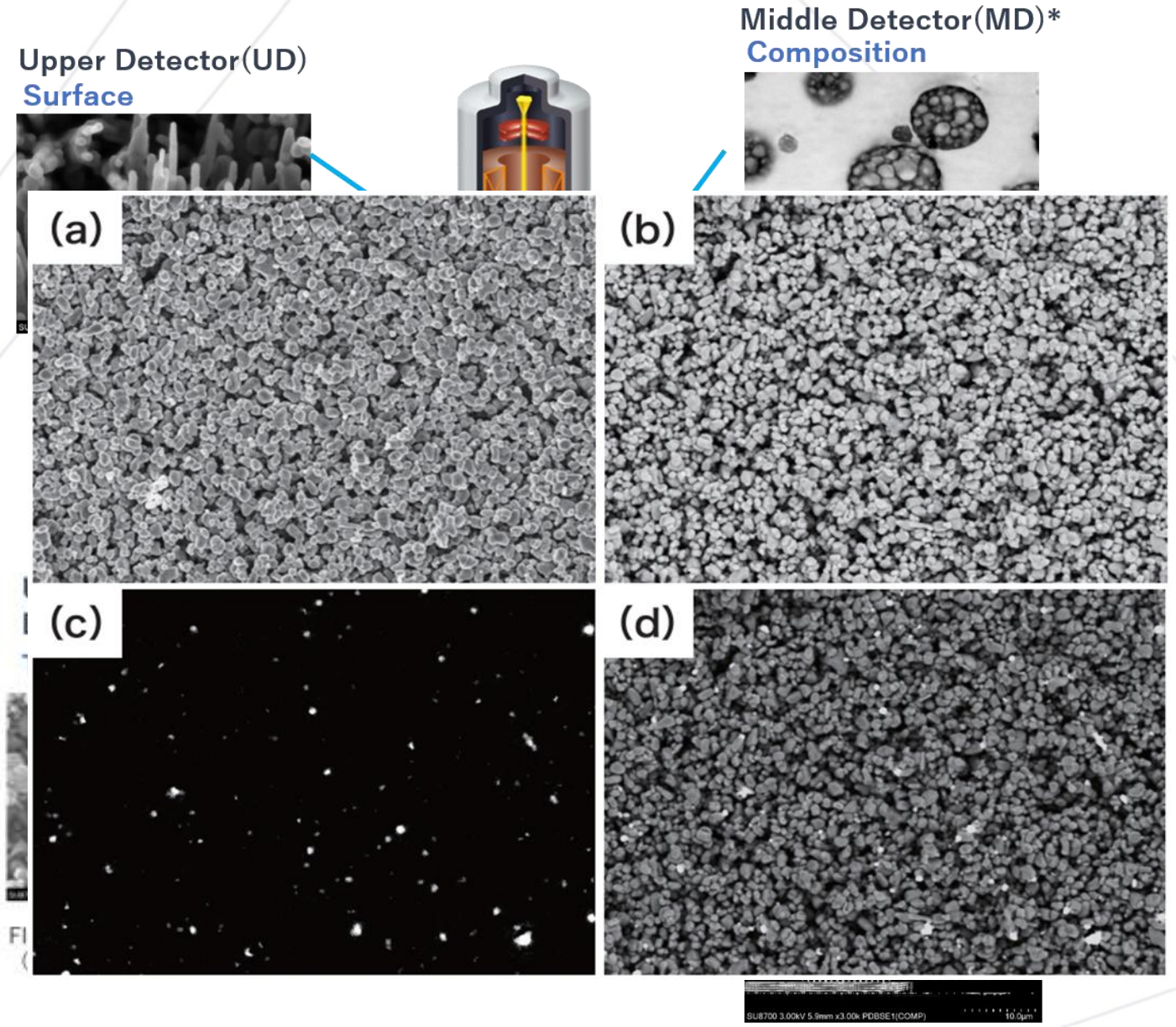


Bonded gold wire's cross section/ 3 kV

https://www.hitachi-hightech.com/global/en/products/microscopes/sem-tem-stem/fe-sem/su8700.html

Low kV STEM Detector

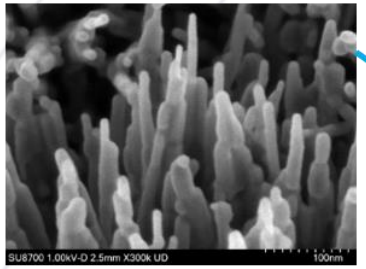
Internal Structure

Carbon Nanotube/ 30kV

Image courtesy of
Atsushi Muto
Hitachi High-Tech
America

Upper Detector(UD)

Surface



TiO_2/ 1 kV

Specimen courtesy of Prof.
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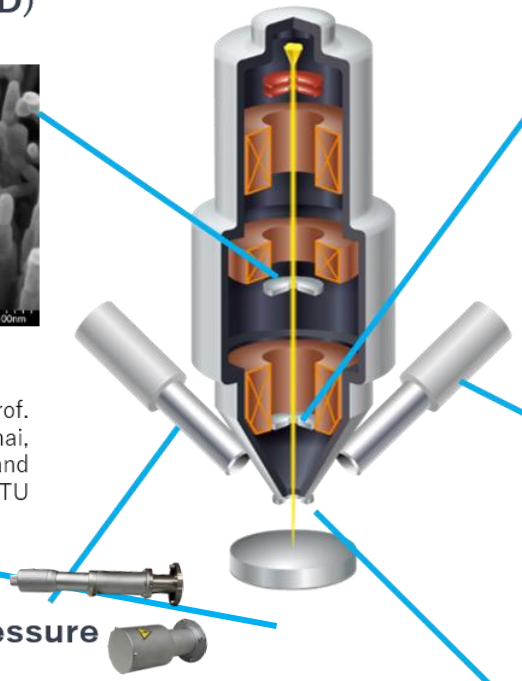
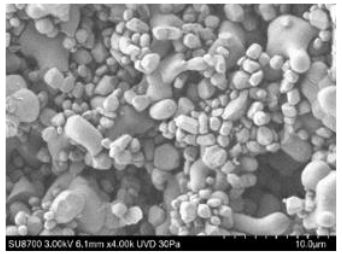


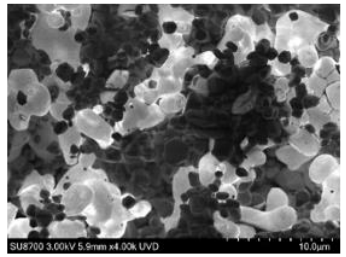
Ultra Variable-Pressure Detector (UVD)*

Topographic



Fluorescent pigments/ 3 kV
(Low vacuum conditions)

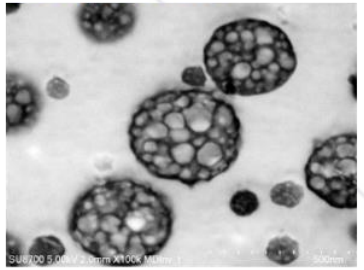
Luminescence



Fluorescent pigments/ 3 kV
(High vacuum conditions)

Middle Detector(MD)*

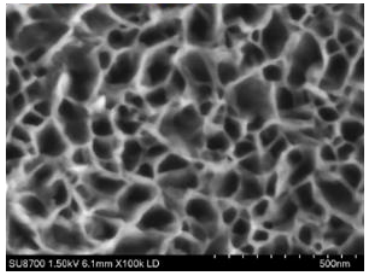
Composition



Stained ABS resin/ 5 kV

Lower Detector(LD)

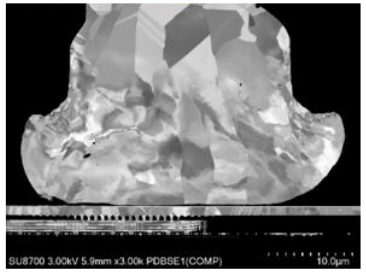
Topographic



Anodized aluminum oxide/ 1.5 kV

Semiconductor Type BSED (PD-BSED)*

Crystalline



Bonded gold wire's cross section/ 3 kV

https://www.hitachi-hightech.com/global/en/products/microscopes/sem-tem-stem/fe-sem/su8700.html

STEM-in-SEM (BF and DF)

Low kV STEM Detector

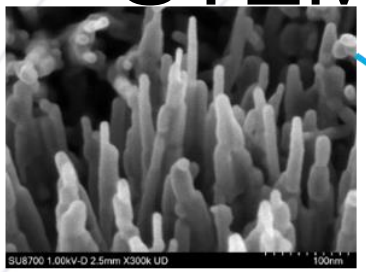
Internal Structure

Carbon Nanotube/ 30kV

Image courtesy of
Atsushi Muto
Hitachi High-Tech
America

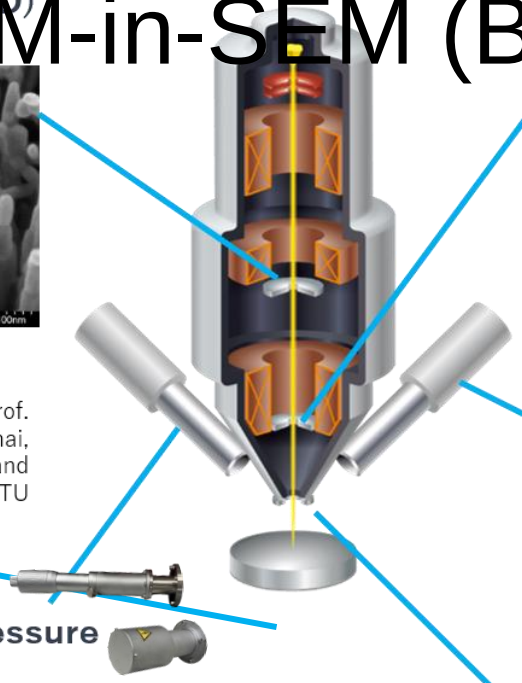
Upper Detector(UD)

Surface



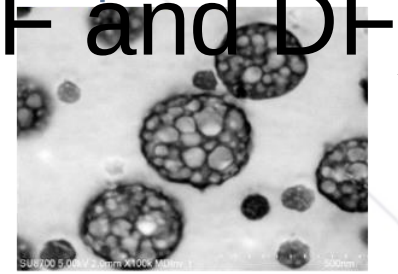
TiO_2/ 1 kV

Specimen courtesy of Prof.
Che Shunai,
School of Chemistry and
Chemical Engineering, SJTU



Middle Detector(MD)*

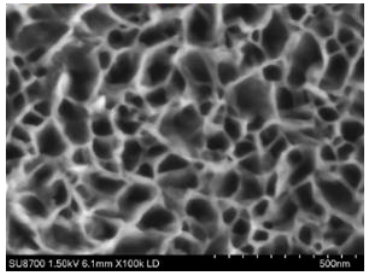
Composition



Stained ABS resin/ 5 kV

Lower Detector(LD)

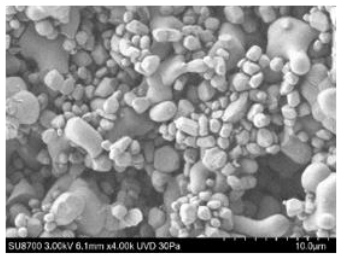
Topographic



Anodized aluminum oxide/ 1.5 kV

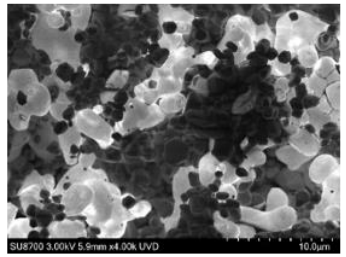
Ultra Variable-Pressure Detector (UVD)*

Topographic



Fluorescent pigments/ 3 kV
(Low vacuum conditions)

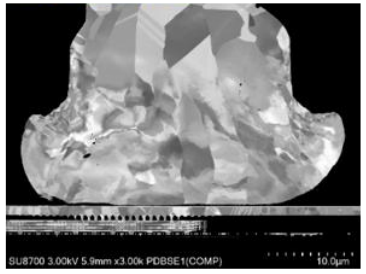
Luminescence



Fluorescent pigments/ 3 kV
(High vacuum conditions)

Semiconductor Type BSED (PD-BSED)*

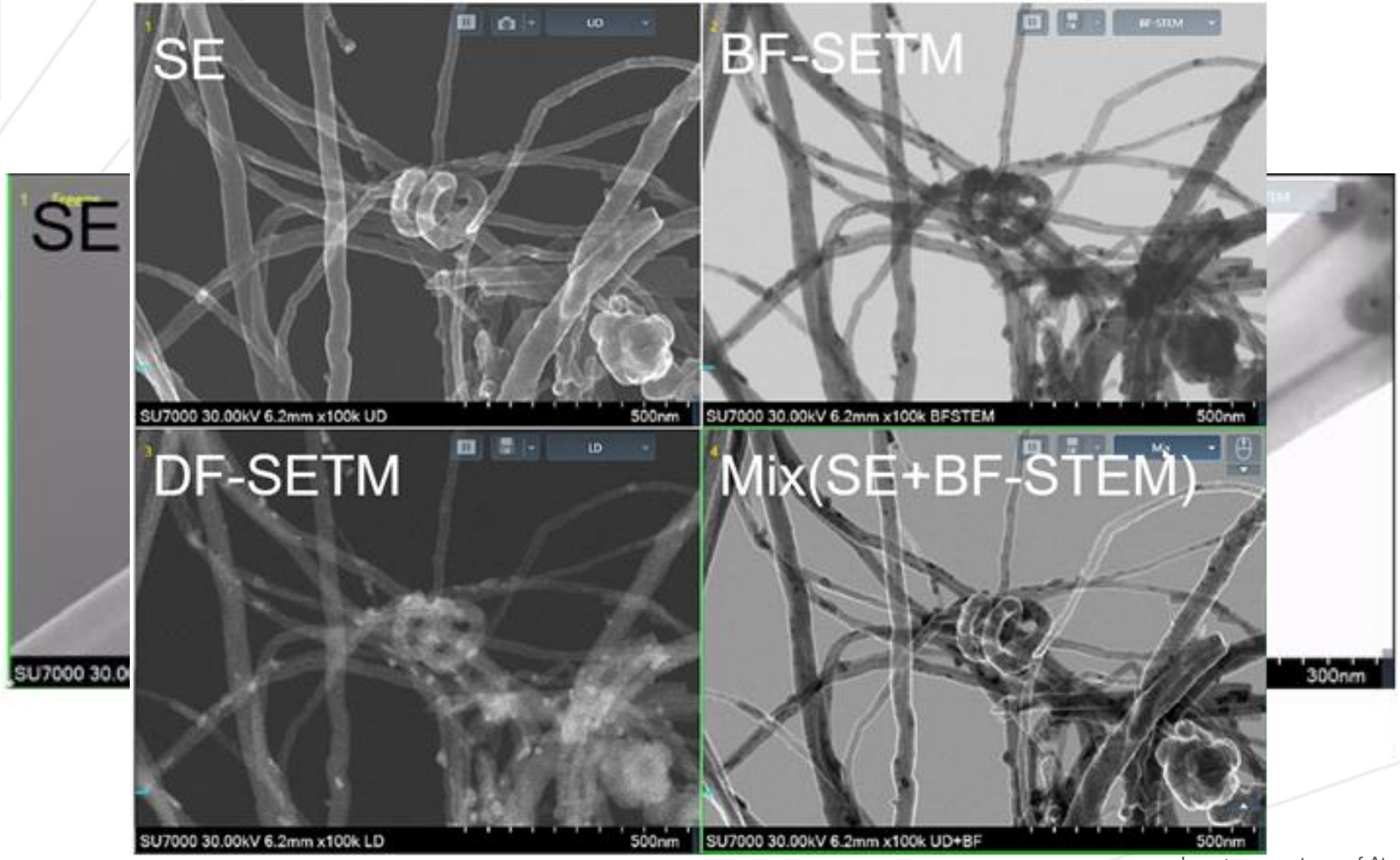
Crystalline



Bonded gold wire's cross section/ 3 kV

https://www.hitachi-hightech.com/global/en/products/microscopes/sem-tem-stem/fe-sem/su8700.html

STEM-in-SEM (BF and DF)



Images courtesy of Atsushi Muto Hitachi High-Tech America

STEM-in-SEM (BF and DF)

Low kV STEM Detector

Internal Structure

Carbon Nanotube/ 30kV

Image courtesy of
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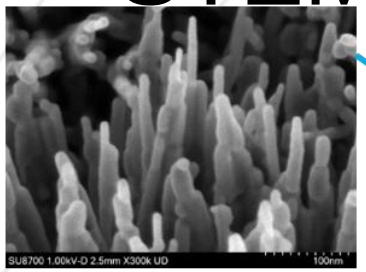
Hitachi High-Tech
America

Upper Detector(UD)

Surface



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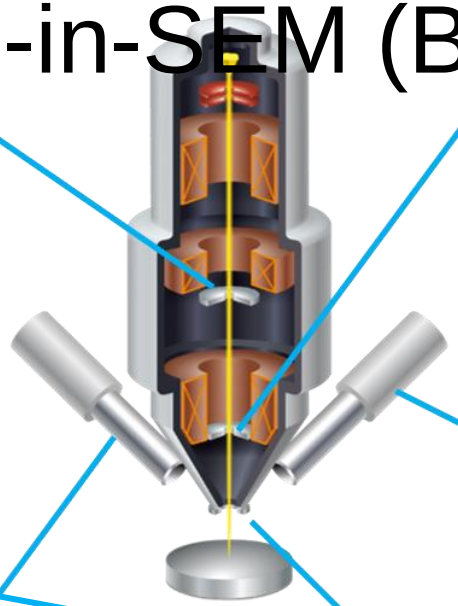
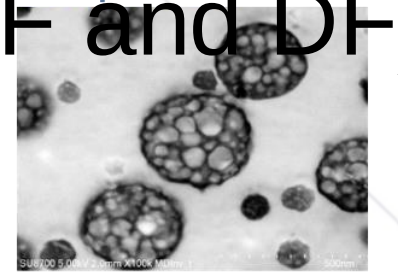


Middle Detector(MD)*

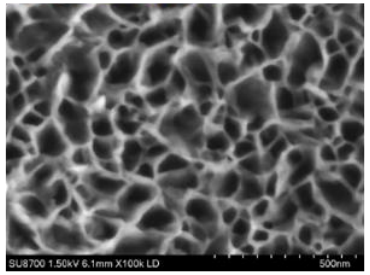
Composition



Stained ABS resin/ 5 kV

Lower Detector(LD)

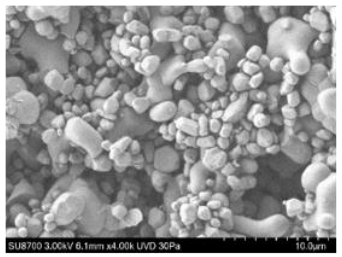
Topographic



Anodized aluminum oxide/ 1.5 kV

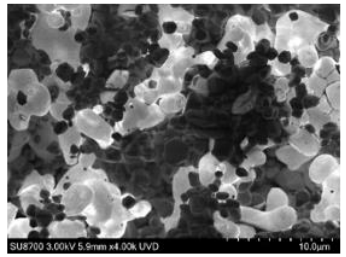
Ultra Variable-Pressure Detector (UVD)*

Topographic



Fluorescent pigments/ 3 kV
(Low vacuum conditions)

Luminescence



Fluorescent pigments/ 3 kV
(High vacuum conditions)

Semiconductor Type BSED (PD-BSED)*

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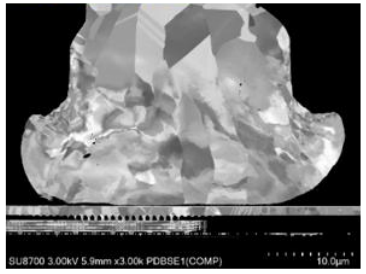


Bonded gold wire's cross section/ 3 kV

https://www.hitachi-hightech.com/global/en/products/microscopes/sem-tem-stem/fe-sem/su8700.html

Analytical Modes

EDS

- Ultim Max 170 mm^2 Large Area
- Ultim Extreme Windowless
- Unity BEX

EBSD

- Symmetry S3

EDS

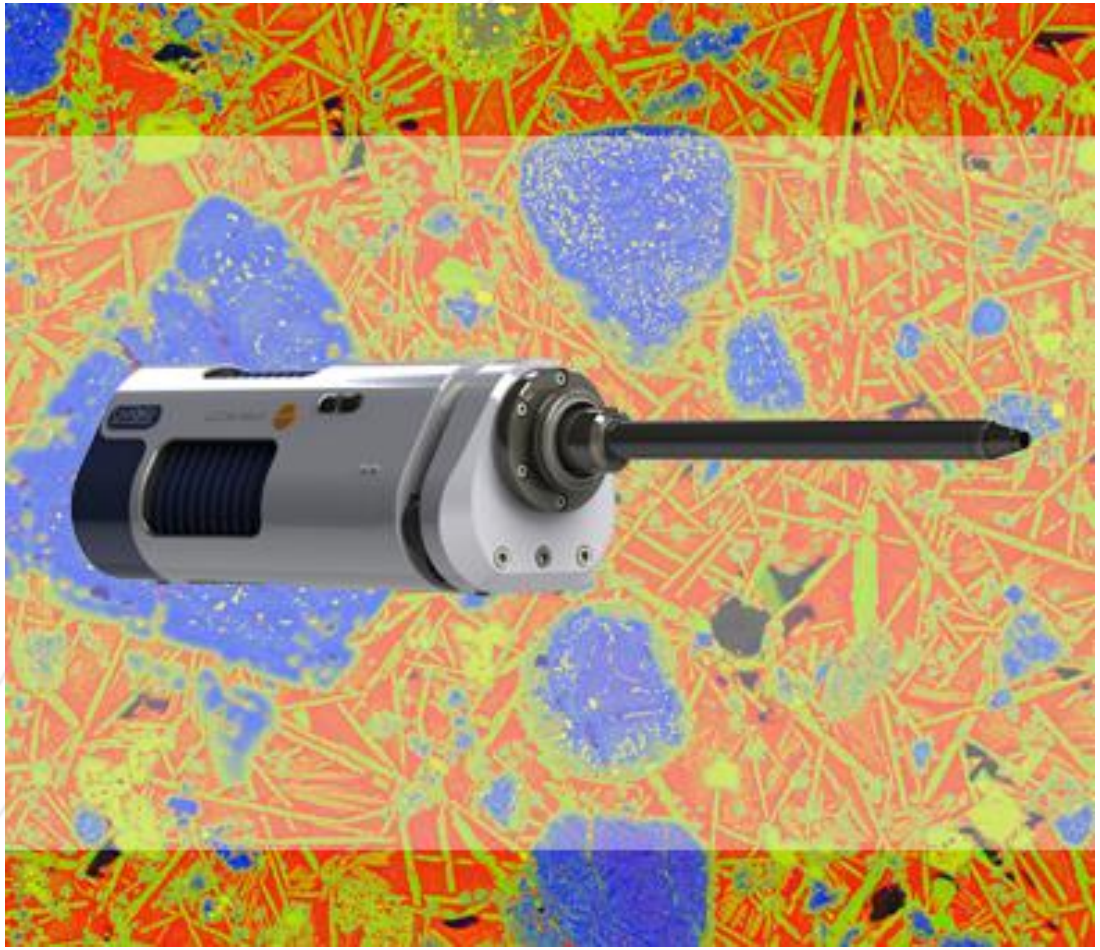
- Ultim Max 170 mm^2 Large Area
- Ultim Extreme Windowless
- Unity BEX

EBSD

- Symmetry S3

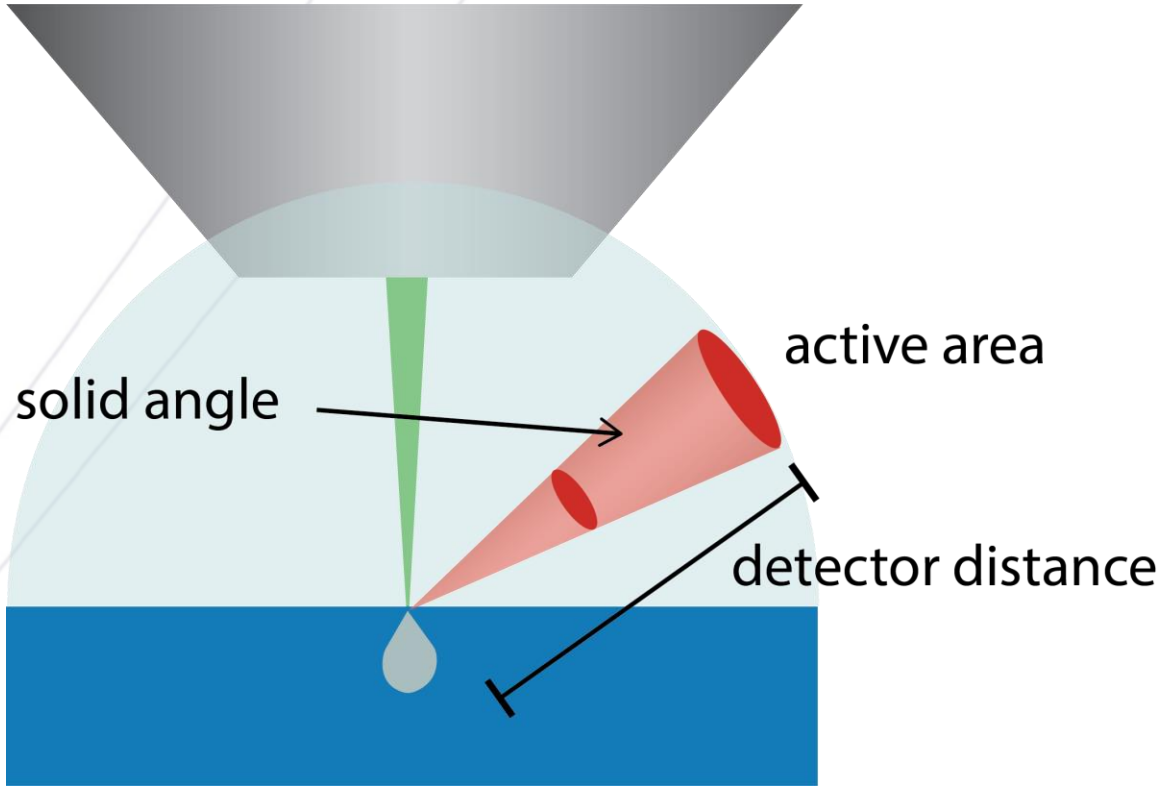
Scan me to learn more about EDS detectors and how they work!

Ultim Max 170 mm^2 large area



- General-purpose EDS
- Go-to for quantitative analysis (especially at high kV/high Z)

Ultim Max 170 mm^2 large area



Why large area? More counts!

- Better accuracy/statistics
- Faster
- Easier to use low kV and low beam current
- Better low concentration detection
- Better light element detection:
  Be (4) to Cf (98)

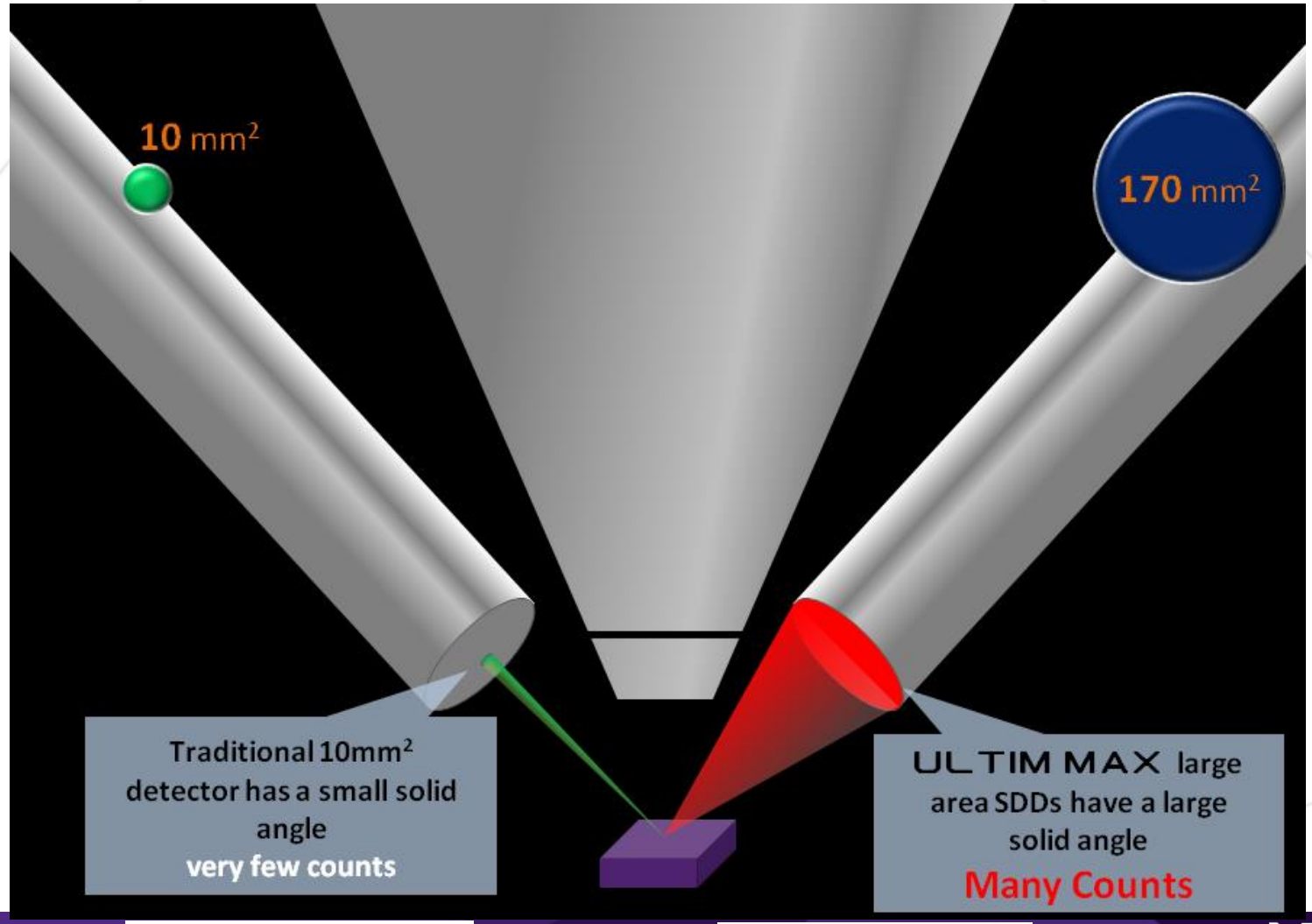
Ultim Max 170 mm^2 large area



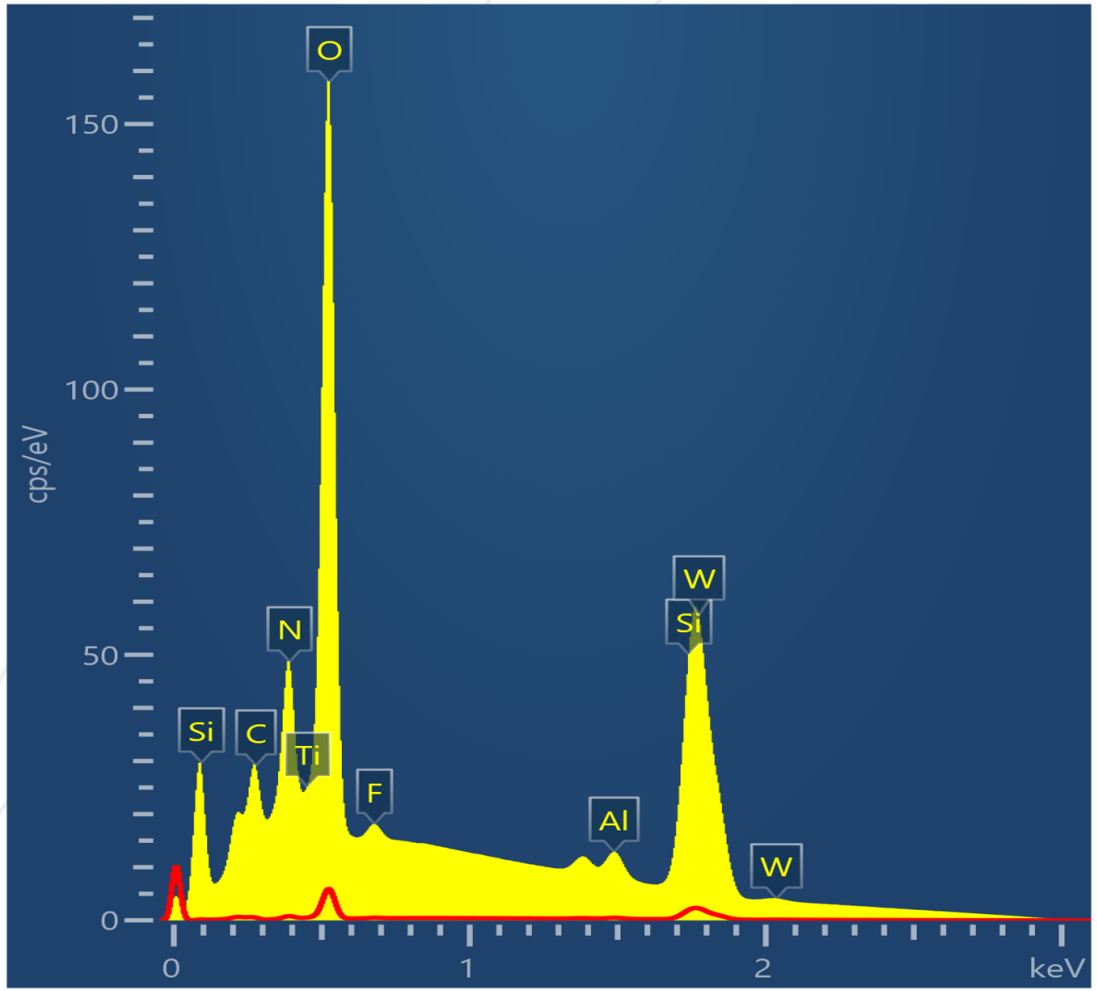


Hitachi S-3400N	Hitachi SU8030	Quanta 650	JEOL 7900F	Hitachi SU8700
OI INCA x-act	OI X-Max	OI ULTIM MAX	OI ULTIM MAX	OI ULTIM MAX
10 mm^2	80 mm^2	40 mm^2	65 mm^2	170 mm^2

Ultim Max 170 mm² large area



Ultim Extreme 100mm^2 Ultra High Sensitivity Windowless

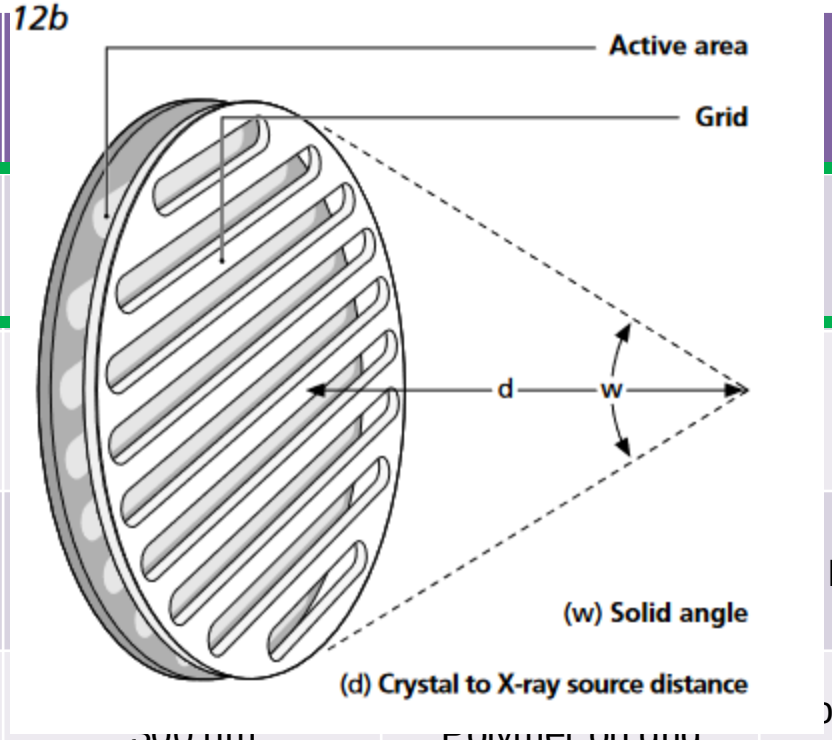


- Light elements (Li+)
- Low kV/high-res (1–7 kV)

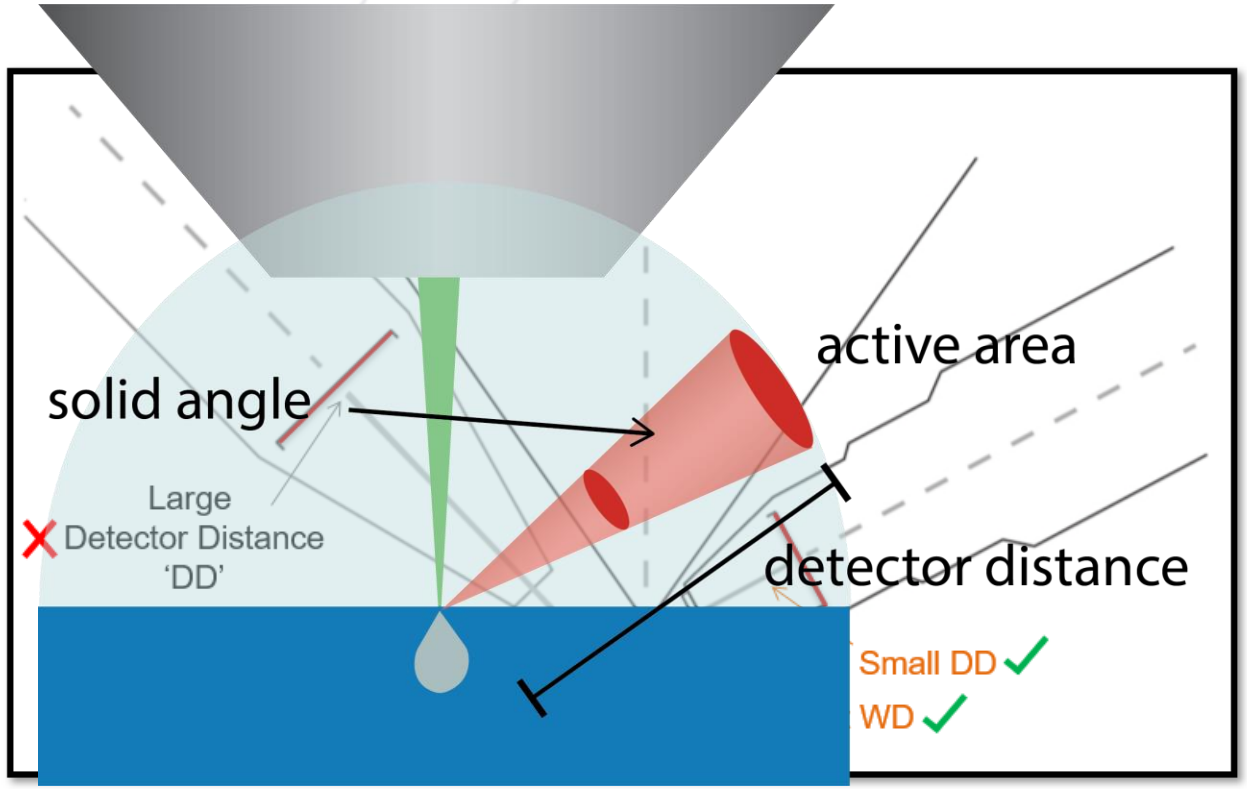
Ultim Extreme 100mm^2 Ultra High Sensitivity Windowless

Type	Name			Advantage	Disadvantage
None	Windowless			No absorption	Contaminates, light artifacts
Be	Beryllium			Robust	Absorption below Na
UTW	Ultra-thin window			Low-absorbing	Breaks easily
ATW	Atmospheric thin window	300 nm	Polymer on grid	ow absorbing and robust	Less effective area (most used)

12b

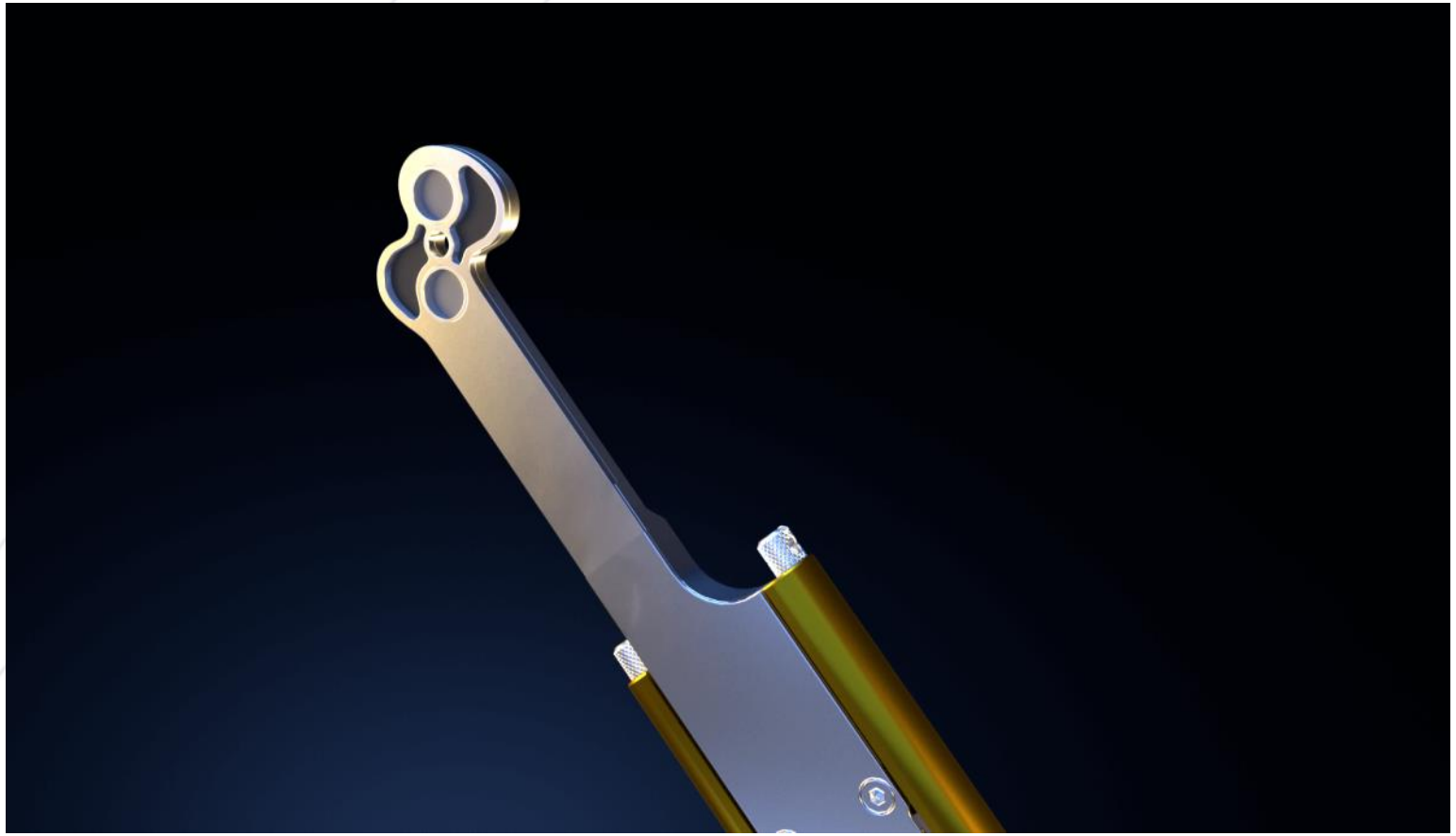


Ultim Extreme 100mm^2 Ultra High Sensitivity Windowless



- Better accuracy/statistics
- Faster
- Easier to use low kV and low beam current
- Better low concentration detection
- Better light element detection:
  Li (4) to Bi (83)
- Shorter working distance

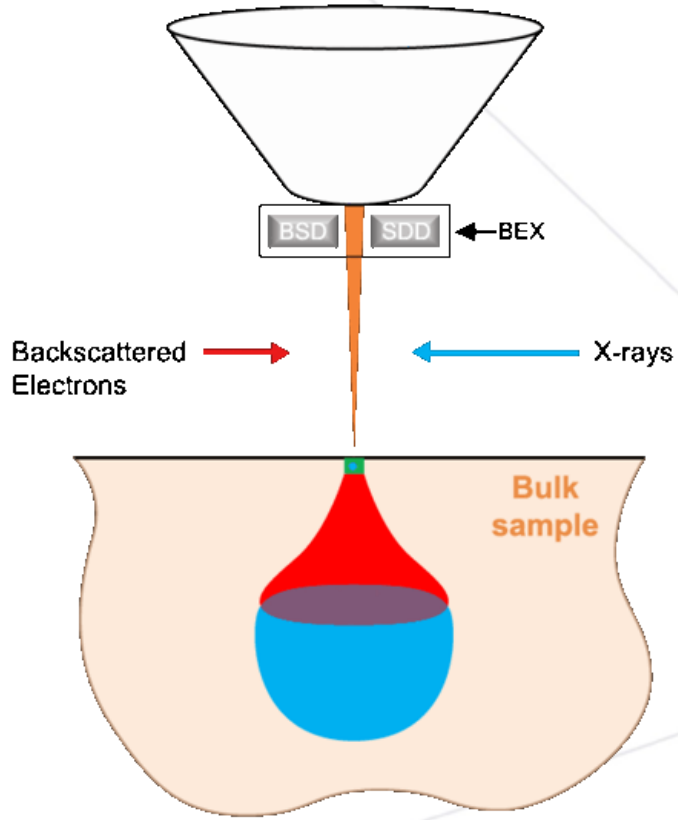
Unity Backscattered Electron and X-ray (BEX) Detector



- Go-to for mapping (EDS +BSE)

Unity Backscattered Electron and X-ray (BEX) Detector

- Wide field of view
- Flexible working distance
- No shadowing
- Best for Na and above
- Mapping at imaging speeds even with normal beam currents (e.g. 1 nA)
- Qualitative
- Works in low-vacuum mode



Unity Backscattered Electron and X-ray (BEX) Imaging Detector

Ultim Max 170

General Qual/Quant
Quant info for BEX
Be +

Ultim Extreme

Light Elements
Low kV (< 7kV)
Li +

Unity BEX

Mapping
Finding ROIs
Na +

EDS

- Ultim Max 170 mm^2 Large Area
- Ultim Extreme Windowless
- Unity BEX

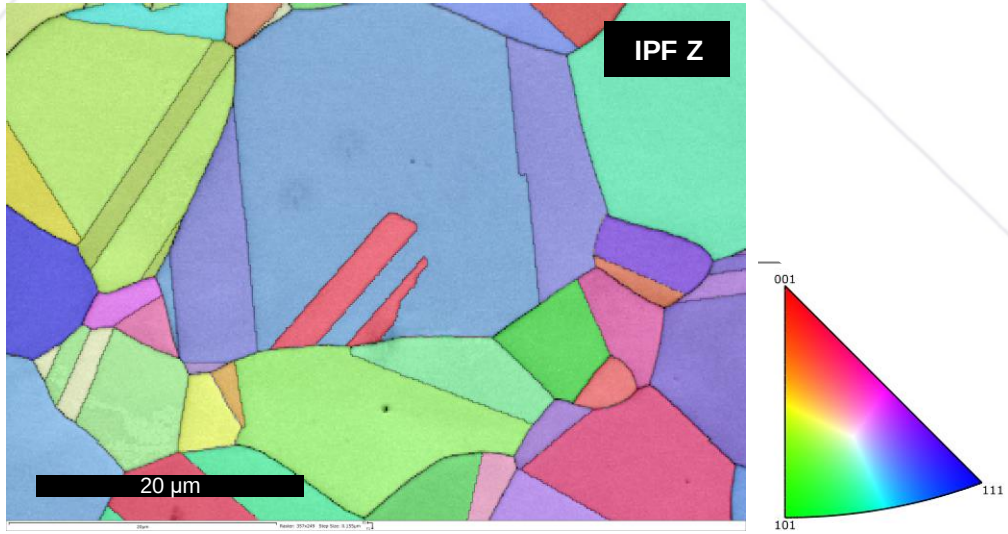
EBSD

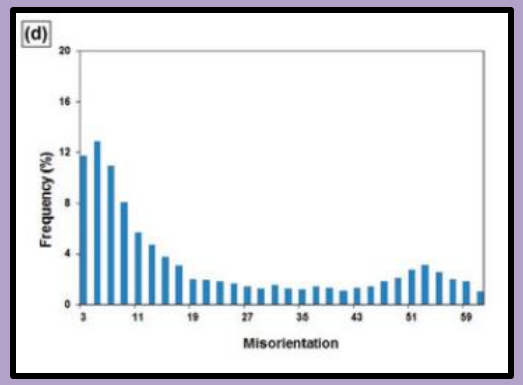
- Symmetry S3

Symmetry S3 EBSD

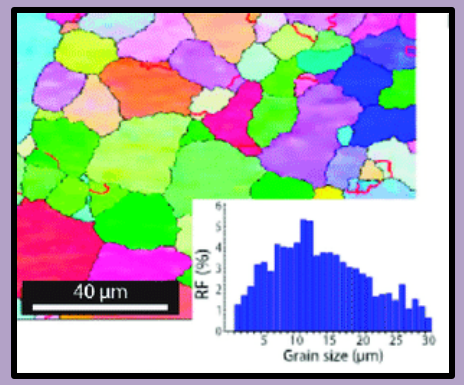
Learn more about EBSD on our YouTube channel

- Enhanced Sensitivity
- Higher Pixel Resolution (1244 x 1024 pixel resolution for high angular resolution (HR) EBSD)
- Faster Data Acquisition (5700 pps at 156 x 128 pixel EBSP)
- Advanced TKD capabilities

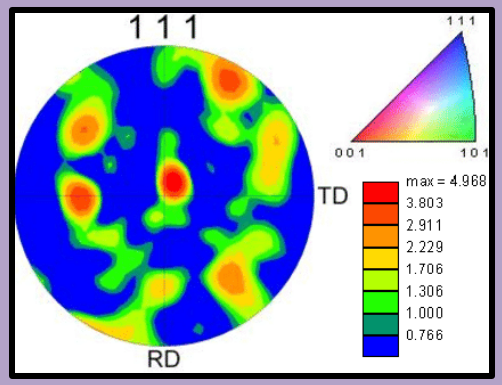




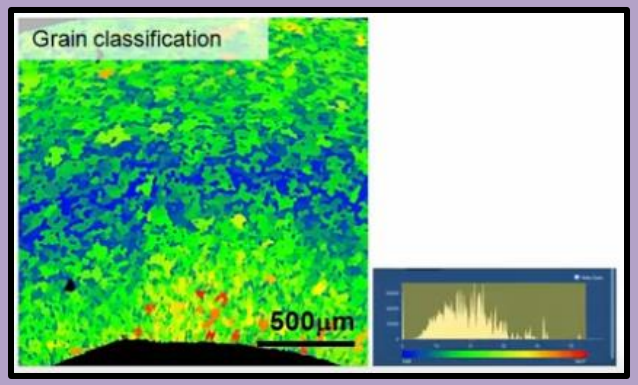
Boundary Characteristics



Grain Size

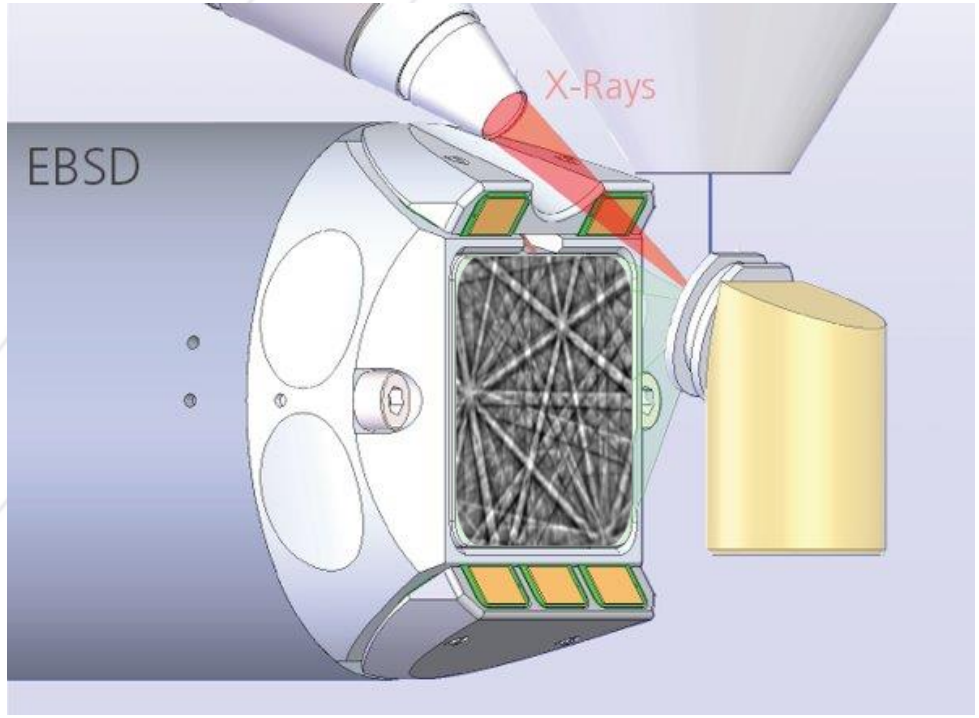


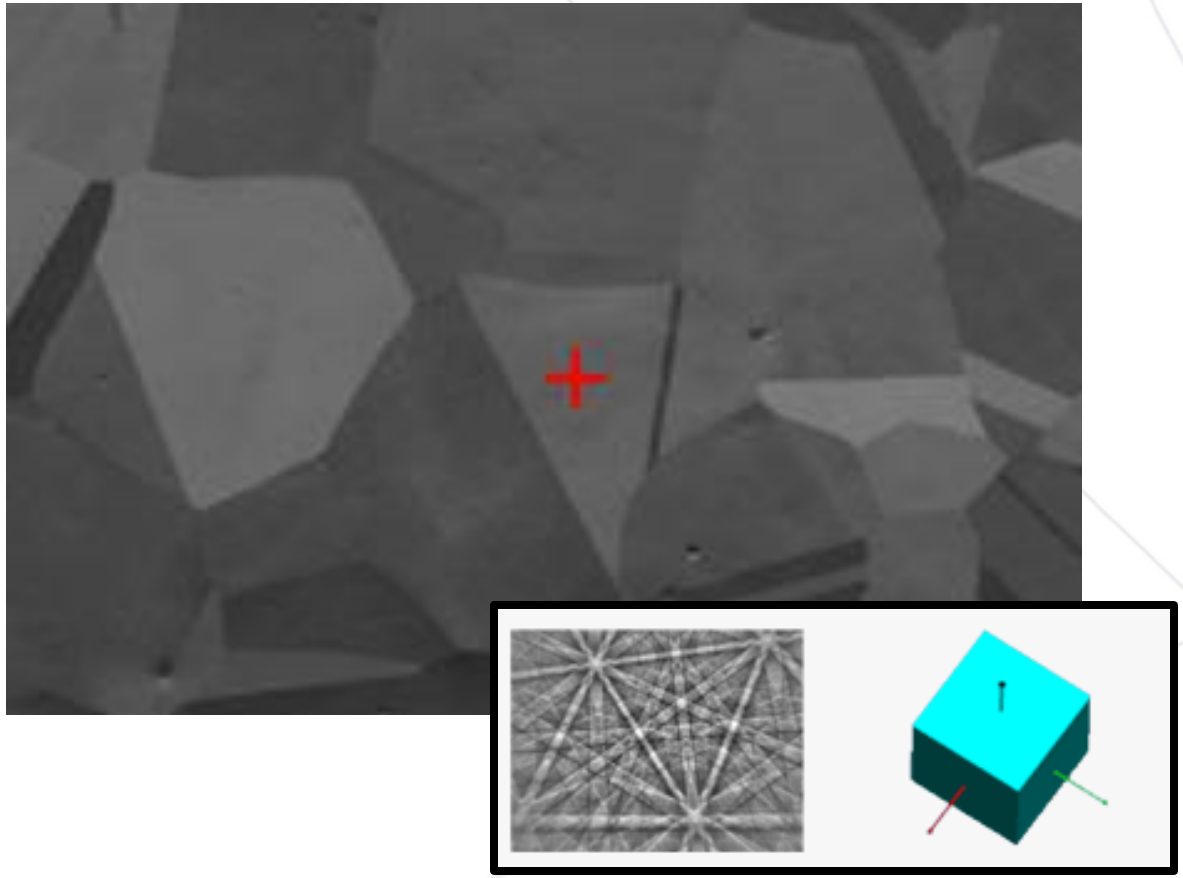
Texture/CPO



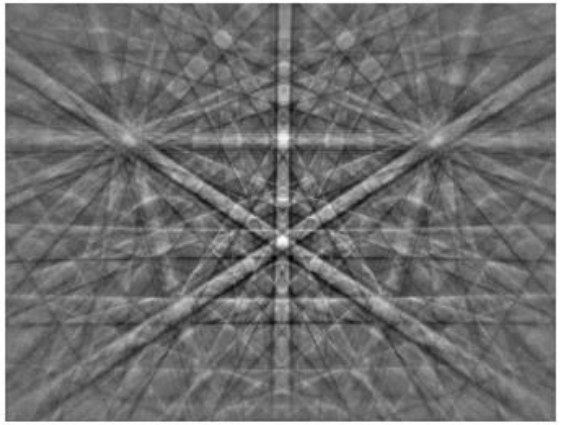
Deformation

Electron Backscatter Diffraction (EBSD)

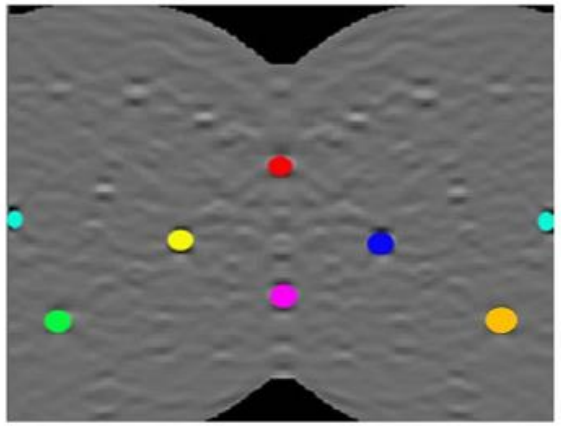




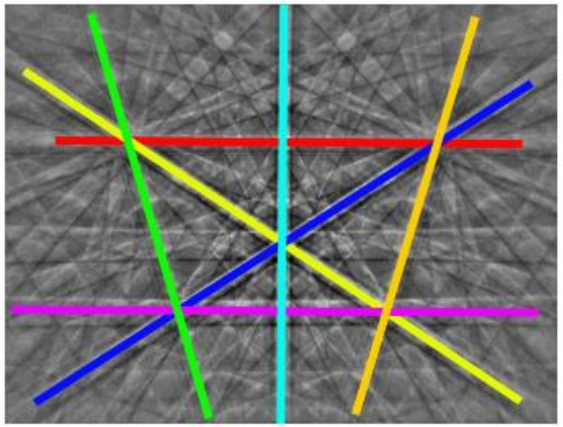
Automated Pattern Indexing



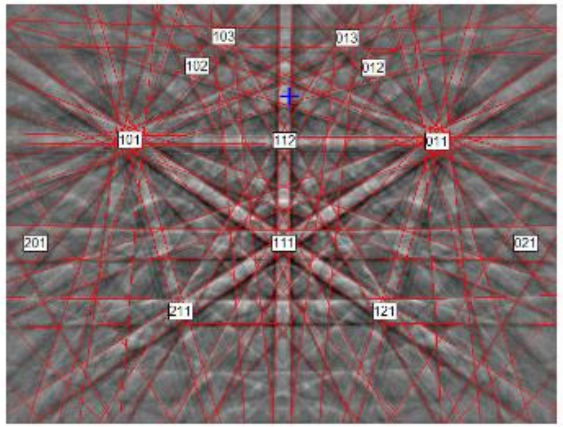
- Collect the pattern for each beam position
  - Silicon at 20 kV
- Transferred to EBSD software



- The Hough transform used to calculate positions of Kikuchi bands

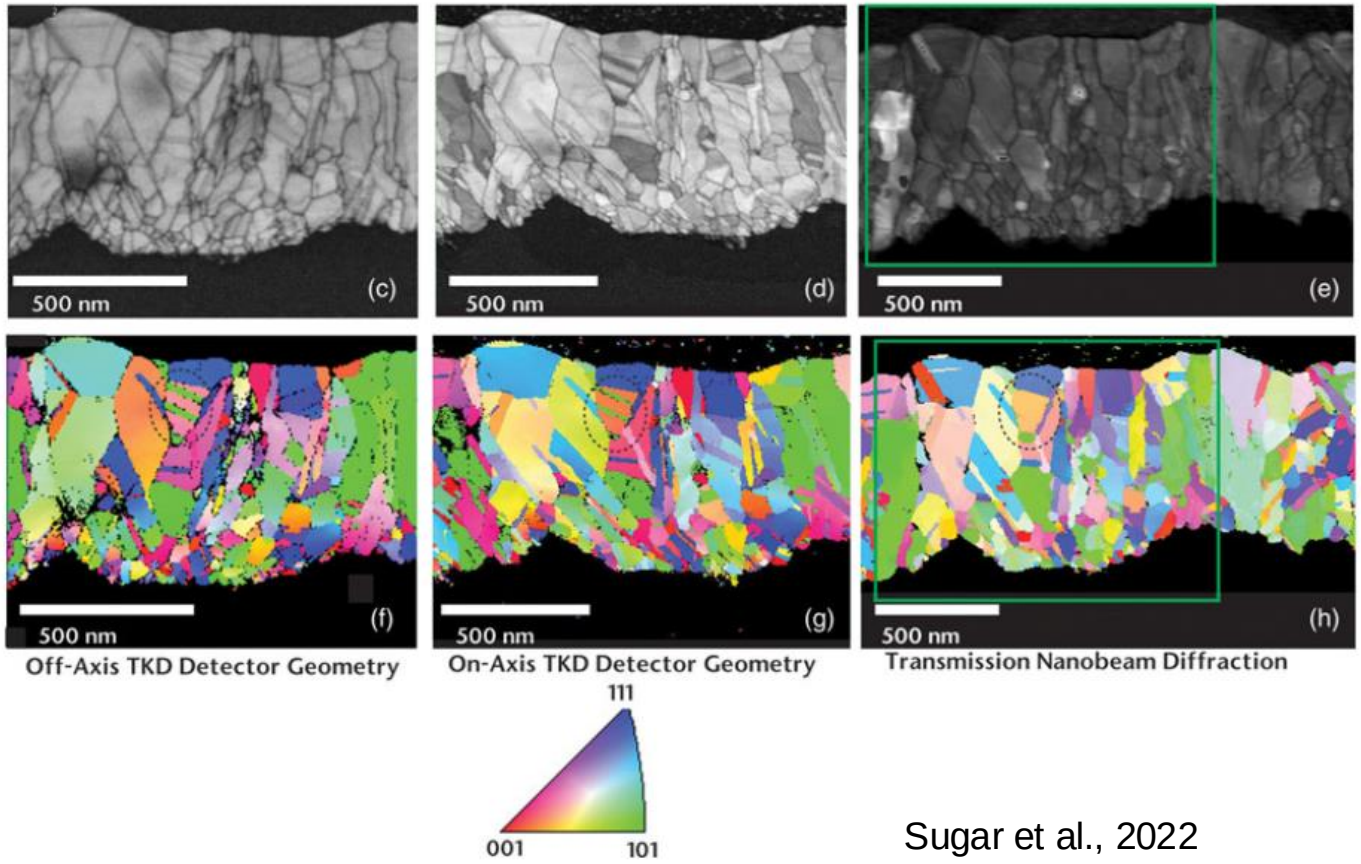


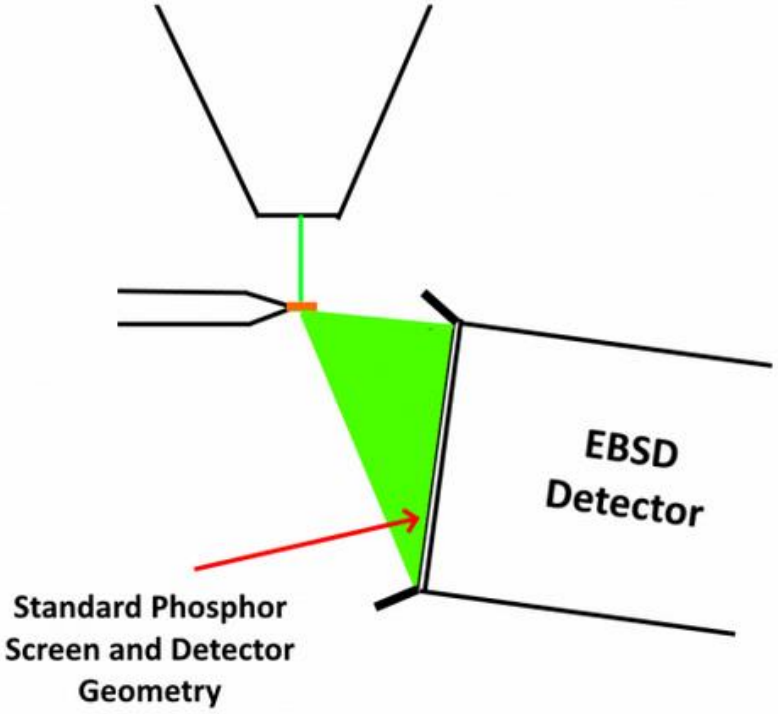
- Bands correspond with peaks found in Hough transform
- Angles between detected bands calculated



- Possible solutions sorted to find best fit
- Orientation matrix calculated
- Indexed diffraction pattern

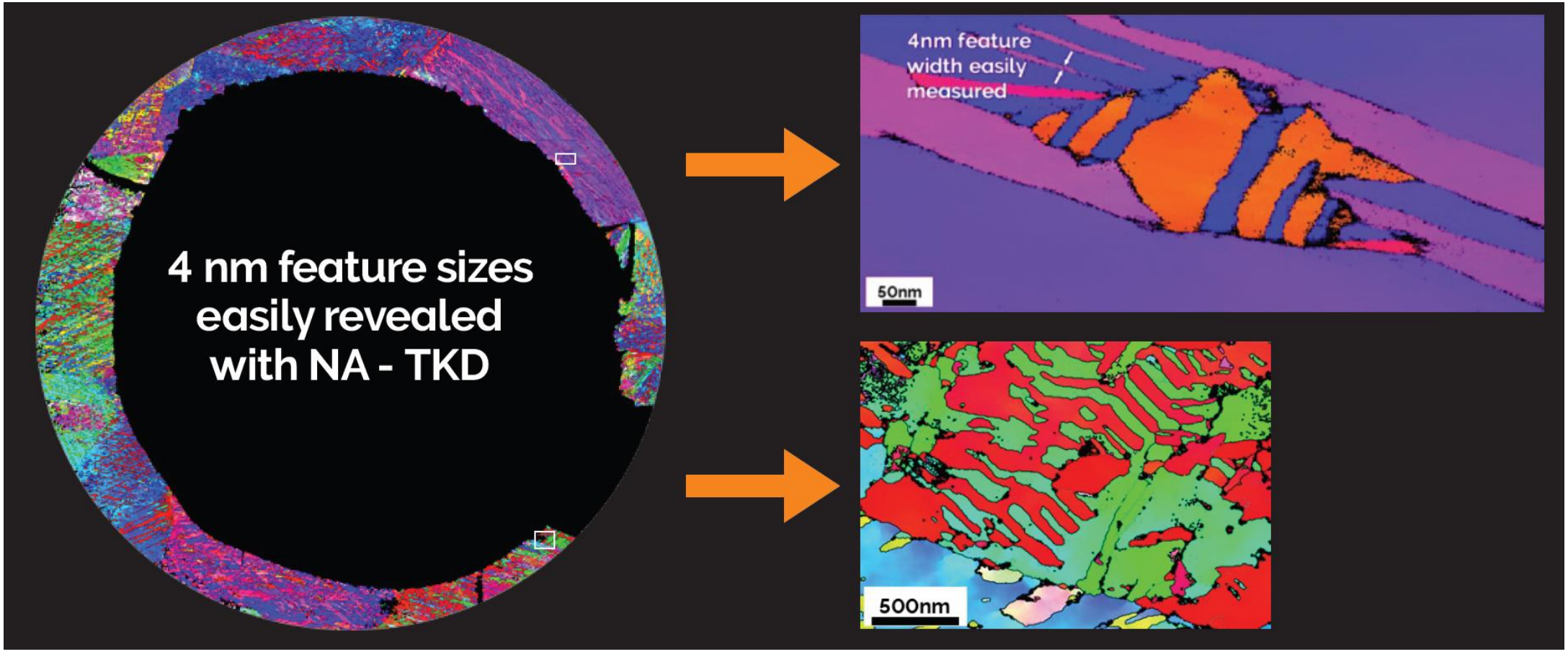
Transmission Kikuchi Diffraction





Sugar et al., 2022

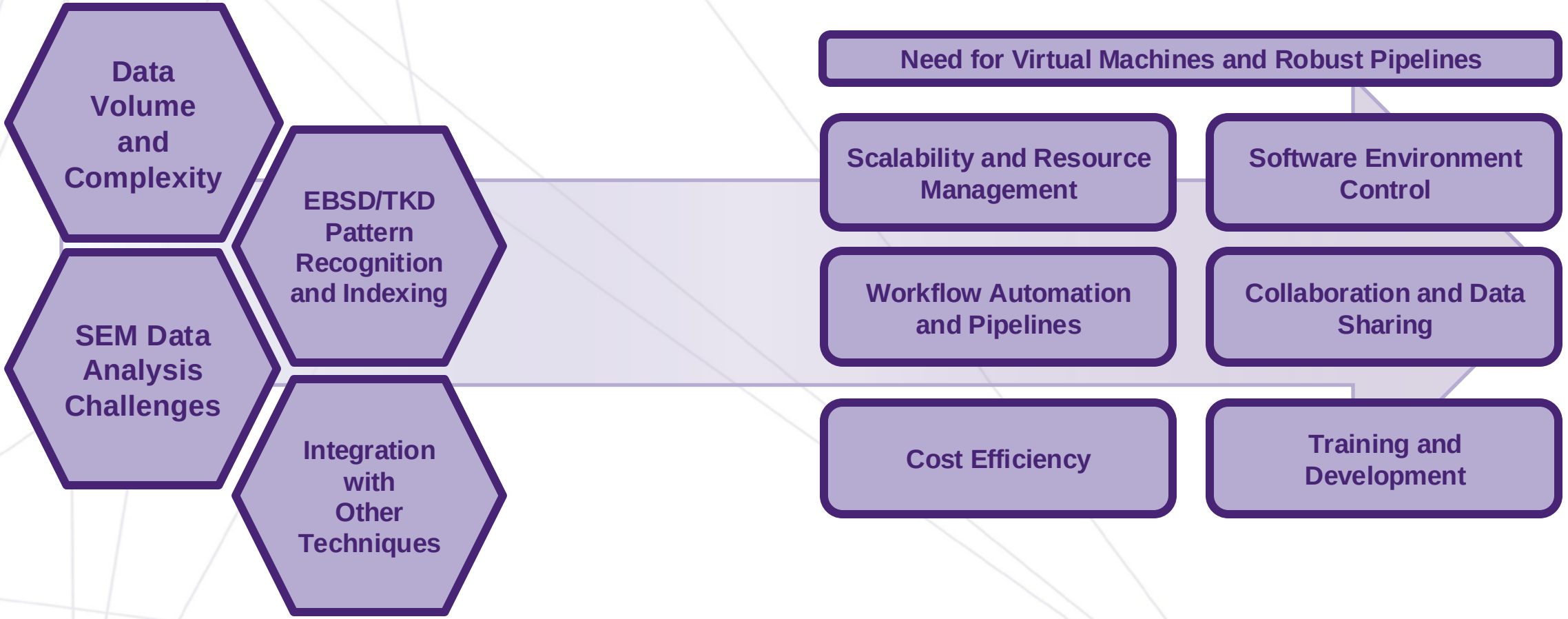
Transmission Kikuchi Diffraction



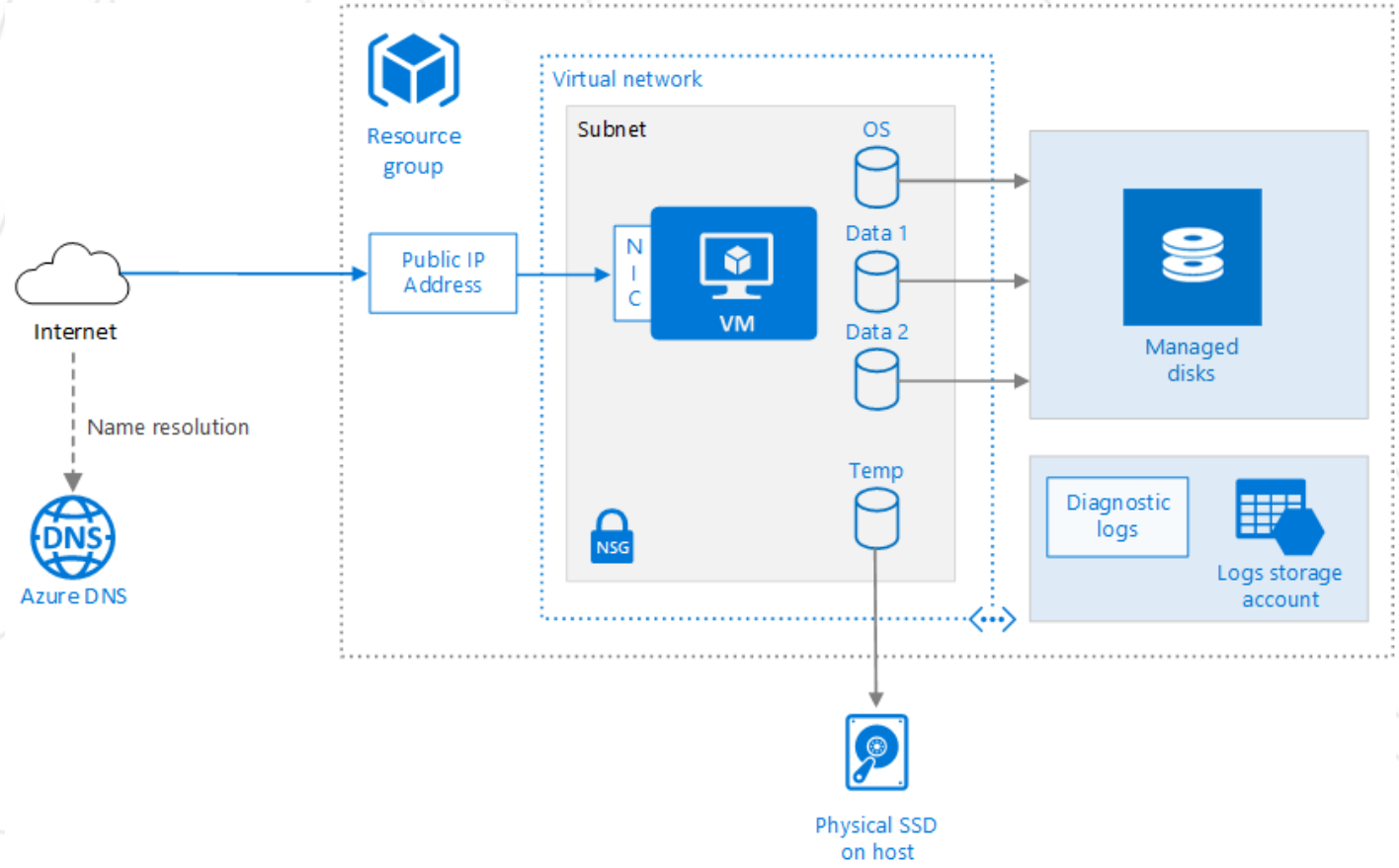
NA–TKD easily reveals 4 nm feature size in 304 Steel. Large area map of TEM foil captured at 50 nm step size. Bottom right: captured using 5 nm step size and Top right: captured using 2 nm step size.

Remote Data Analysis

Remote Data Analysis



Remote Data Analysis



- Secure Remote Access
- Access to data from NUANCE/RDSS via Globus app
- High-Performance Computing Without Local Hardware
- Enhanced collaboration via shared environments

Contact us for more information