JEOL

**Scientific / Metrology Instruments**

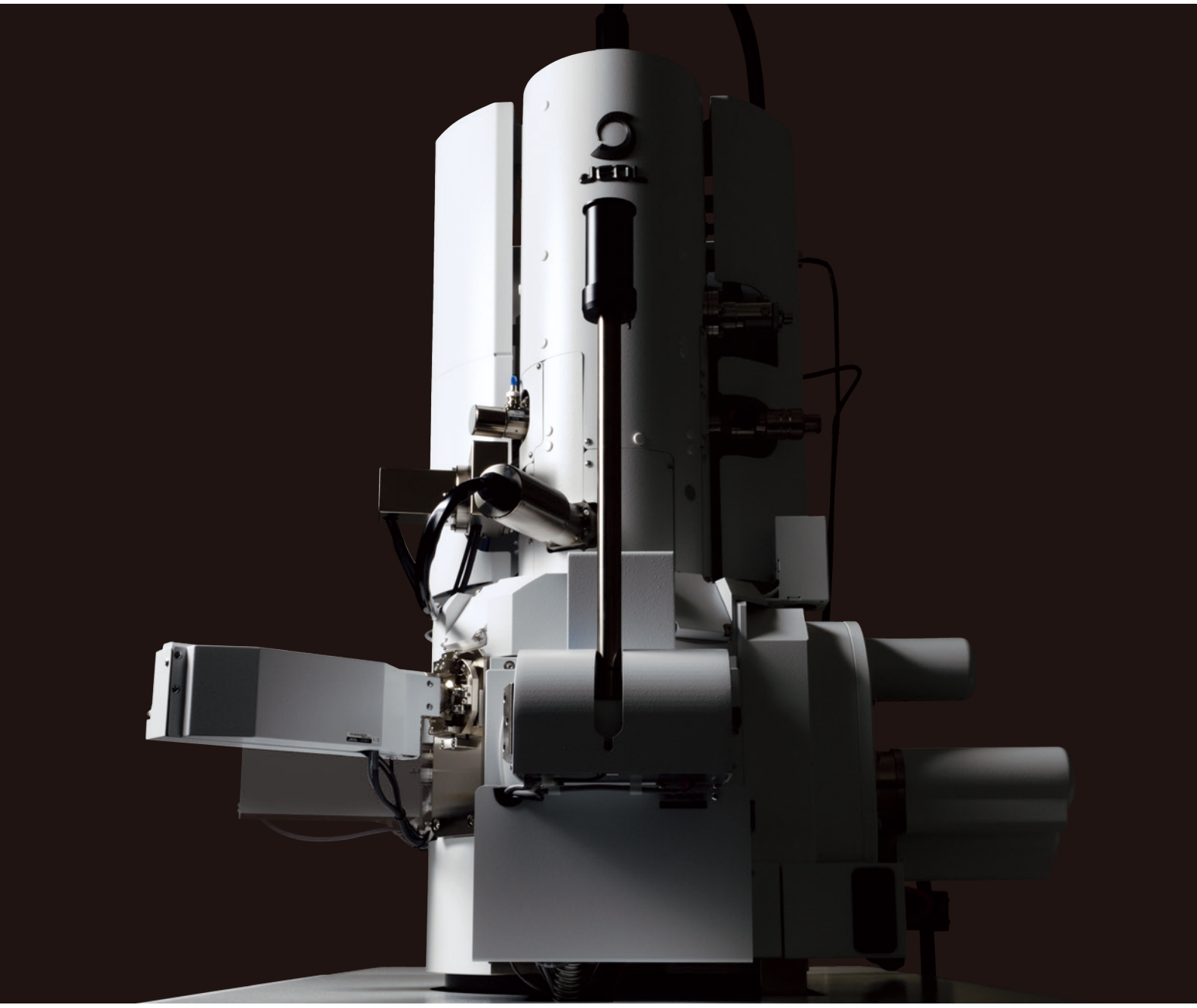
**Schottky Field Emission Scanning Electron Microscope**

Solutions for Innovation

The next level of Intelligence Technology in FE-SEM

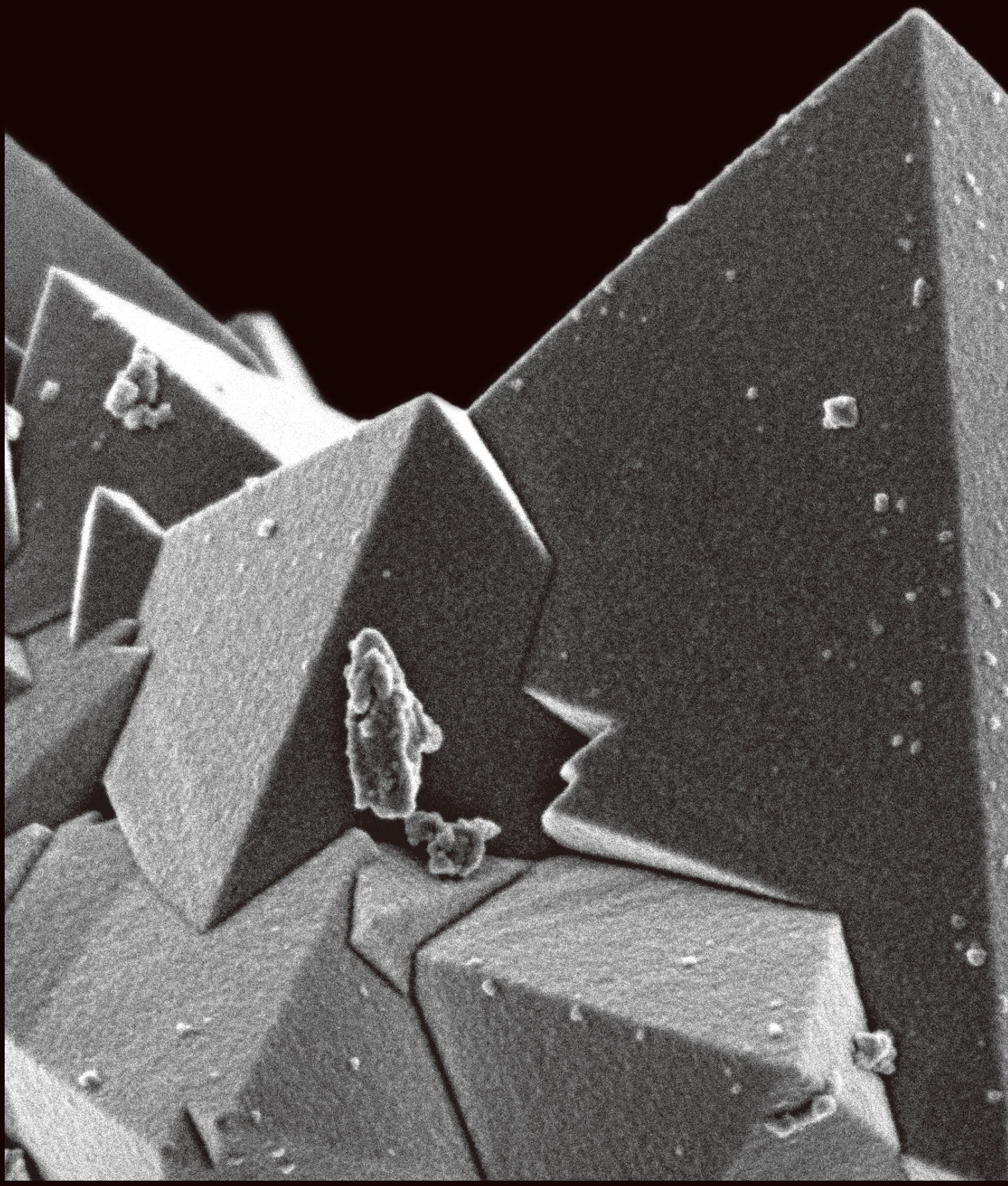
# JSM-IT800

## Super Hybrid Lens 〈SHL〉



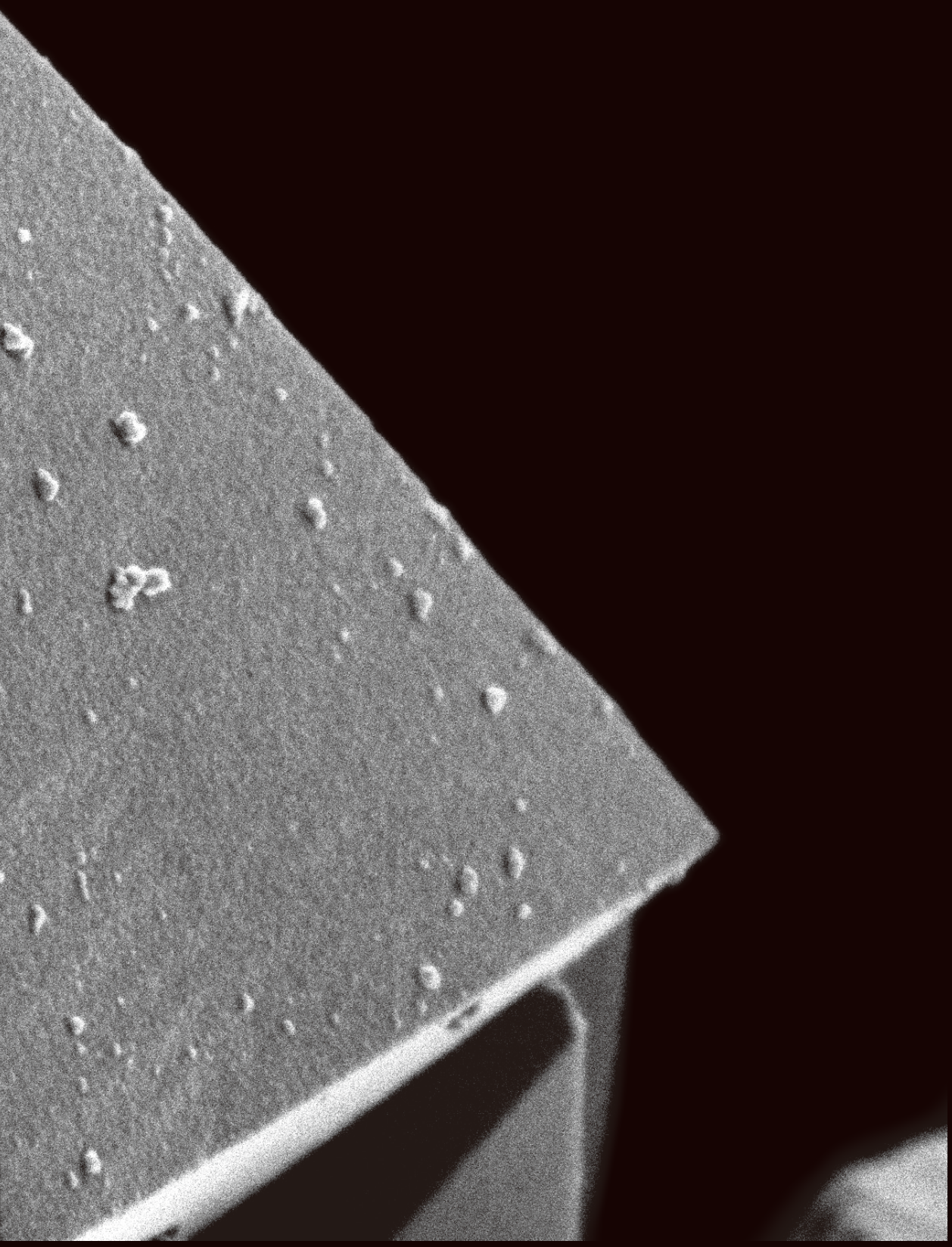
JEOL Ltd.

# Stunnin



# g Images Inspire the Future

JSM-IT800
Super Hybrid Lens



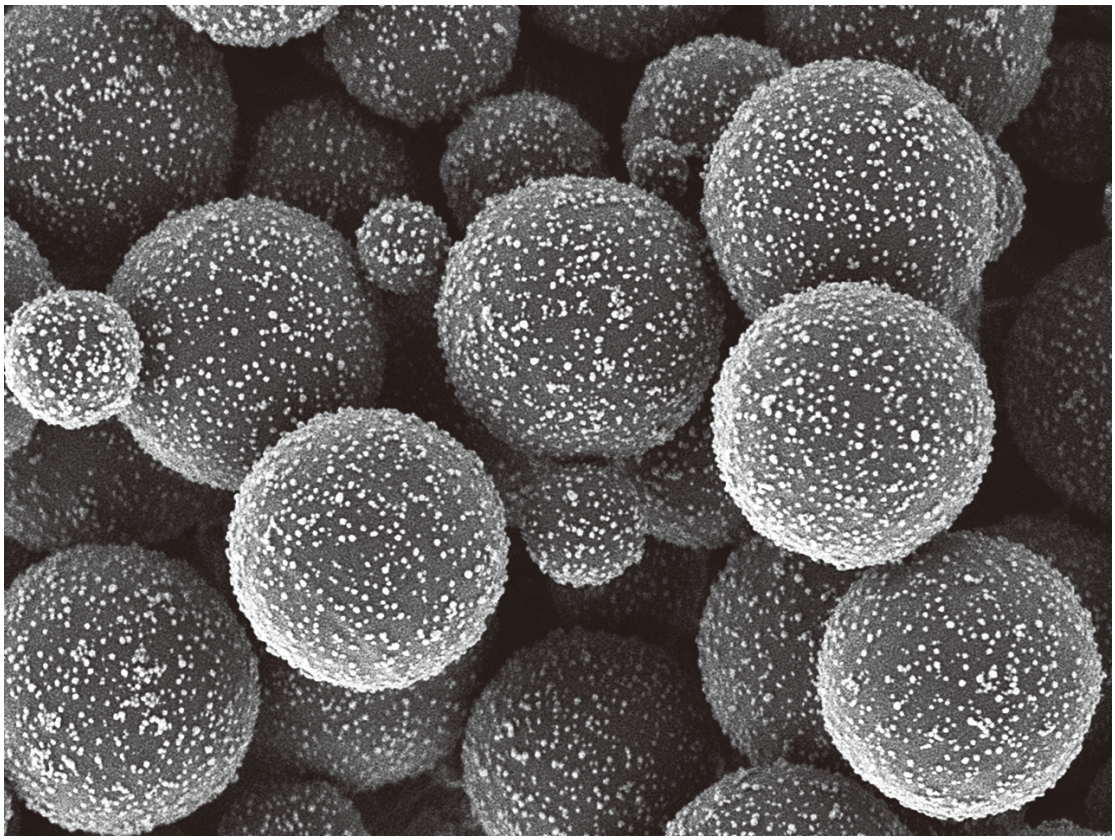
Specimen: Cerium Oxide
Specimen courtesy of
Professor Seiichi Takami
Nagoya University, Japan

100 nm

# Detection System in JSM-IT800〈SHL〉

## UHD (Upper Hybrid Detector)

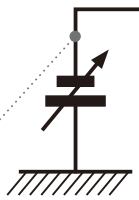
- JSM-IT800〈SHL〉features a new UHD detector.
- Improve the detection to improve the detection efficiency of the electrons generated from the specimen by placing this detector into the objective lens.




Specimen: acrylic particles, Accelerating voltage: 0.7 kV, Observation mode: BD, Detector: UHD

## SHL (Super Hybrid Lens)

- An electromagnetic/electrostatic field superposed objective lens by combining magnetic lens and electrostatic lens.
- A new objective lens design to achieve much higher spatial resolution for observation and analysis by enhancing the Hybrid Lens.

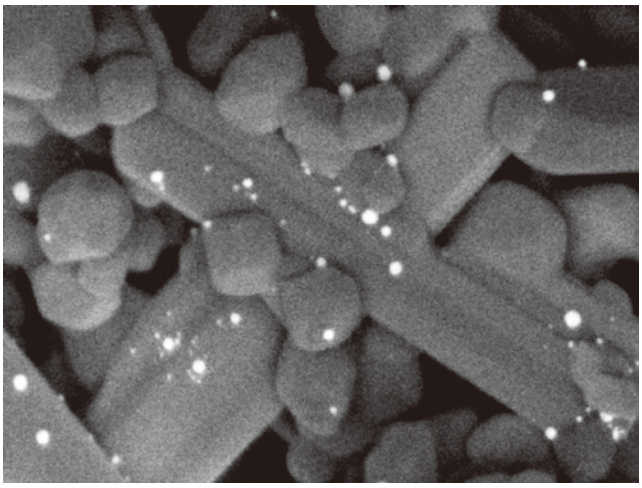


## BD mode (Beam Deceleration: BD)

- Enables deceleration of the beam before it lands on the specimen by applying a bias voltage up to the specimen stage.
- Improves the spatial resolution and S/N significantly even at low accelerating voltage; highly effective in observing the outermost surface of specimen, easily charged or beam damaged specimen.

## UED (Upper Electron Detector)

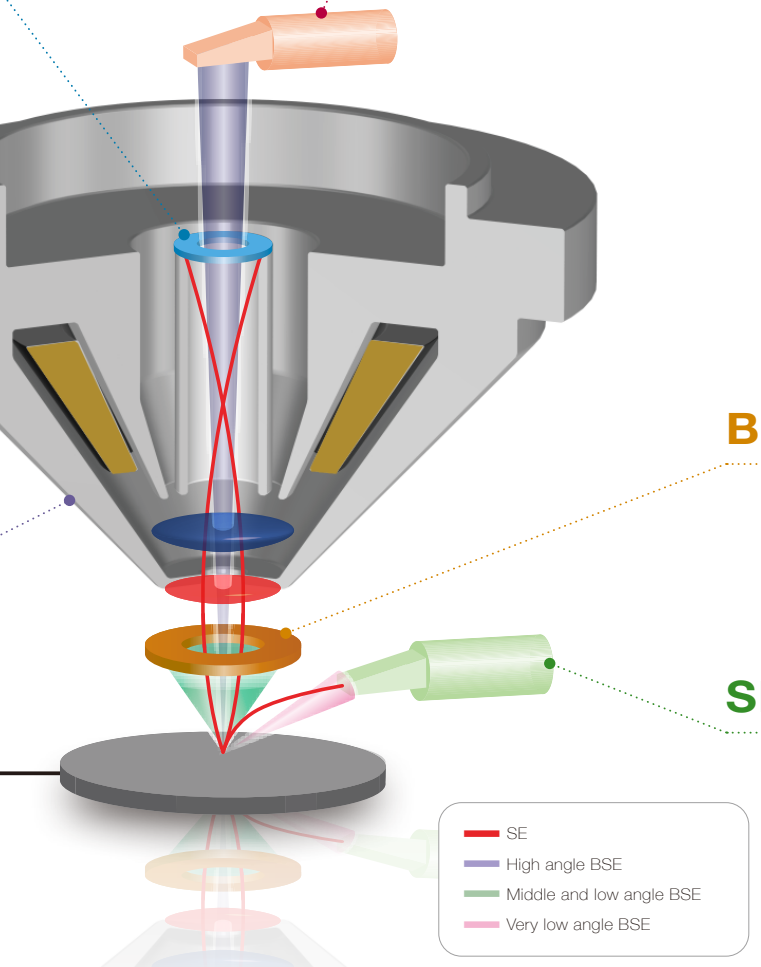
- Collects electrons that are emitted at high angle.
- Enables collection of compositional images by selection of backscattered electrons (BSE).
- Observation of surface morphology when selectively capturing the secondary electrons (SE).



100 nm

Specimen: Ag nanoparticles on the surface of titanium dioxide
Accelerating voltage: 2.0 kV
Observation mode: SHL, Detector: UED

* Obtain the high angle BSE.




## BED (BSE Detector)

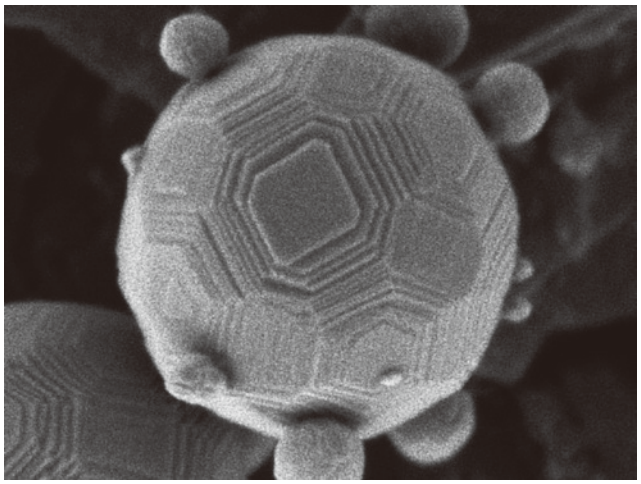
- Suited for obtaining compositional, topographic and channeling contrast.
- Several types of BSE detectors are available to users. (Refer to P. 8).

## SED (SE Detector)

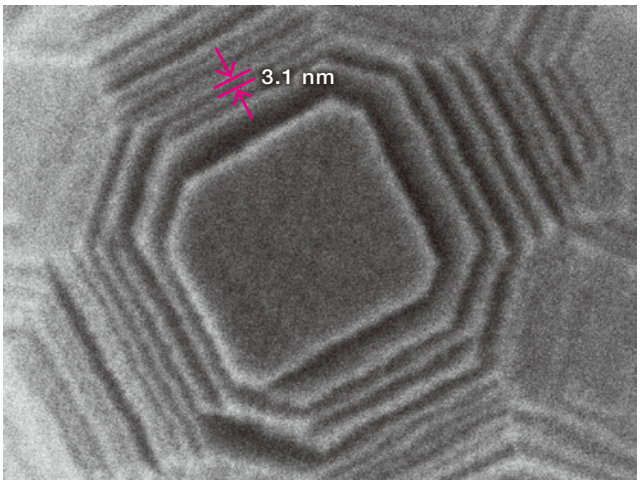
- Detection of the SE and very low angle BSE signals to obtain the topographic information of specimen.

# Examples of High Spatial Resolution Observation Using the UHD

When using the UHD to detect the signals, the SE images with high S/N can be obtained even at very low accelerating voltage. The UHD also can reduce the charging effects; it is suitable for observing the non-conductive specimen with nano-structure and those specimen easily damaged by the electron beam.



50 nm

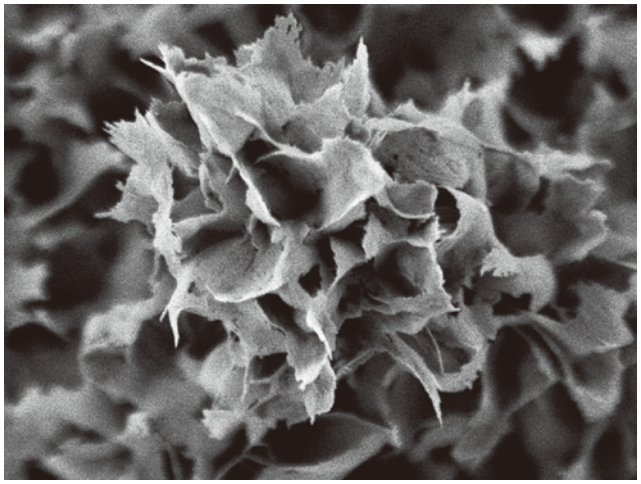



10 nm

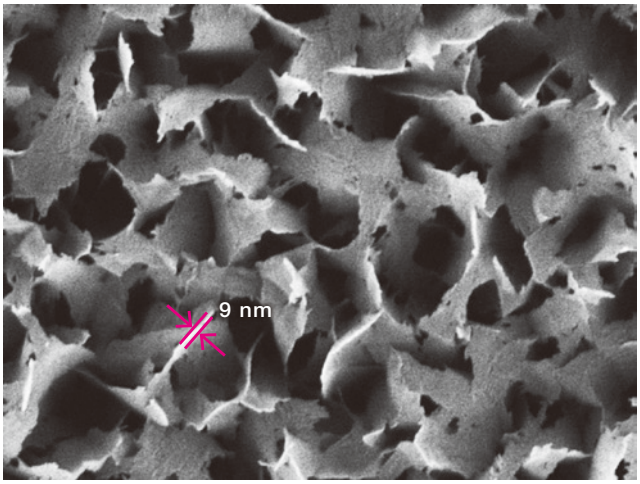
Specimen: Aluminium Oxide particles, Accelerating voltage: 0.5 kV, Observation mode: BD, Detector: UHD

The amazing step-structure on the surface of particles can be observed. Single nm steps are clearly observed on the particle surface.

※ Acquired by the SHL version.



100 nm

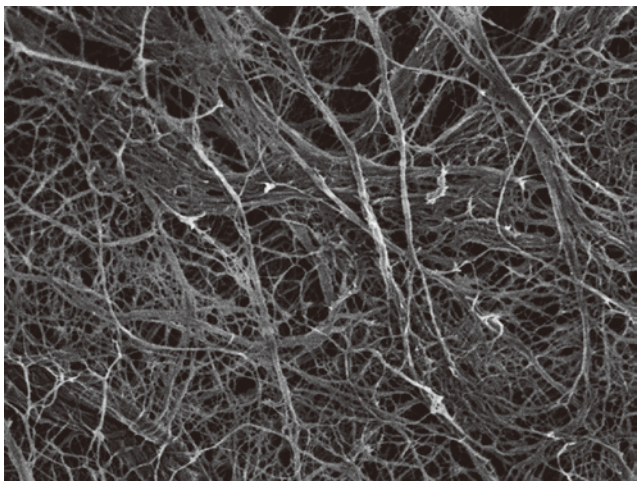



100 nm

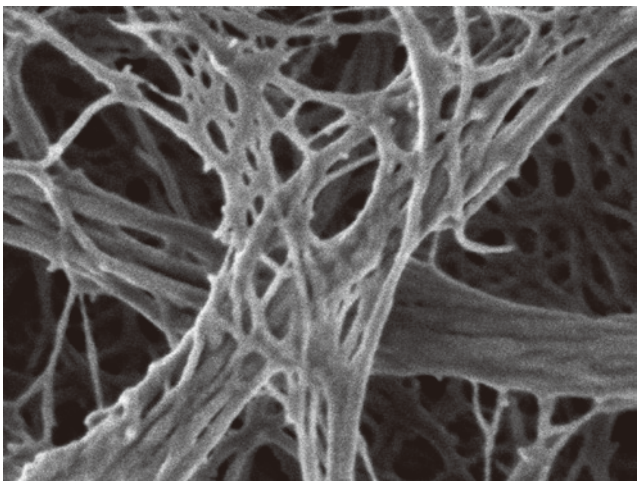
Specimen: Aluminum Boehmite, Accelerating voltage: 0.3 kV, Observation mode: BD, Detector: UHD

The thin nanosheet-structure with less than 10 nm thickness can be clearly observed on the surface of aluminum boehmite.

※ Acquired by the SHL version.



100 nm



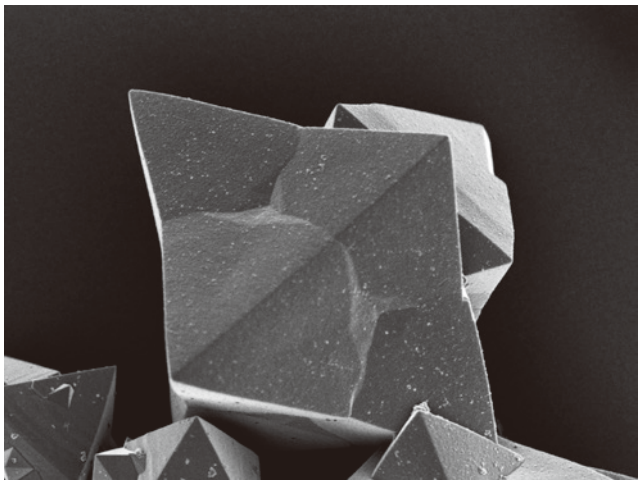
100 nm

Specimen: Cellulose Nanofiber (CNF), Accelerating voltage: 0.2 kV, Observation mode: BD, Detector: UHD+UED (signal addition) Specimen courtesy of Professor Hiroyuki Yano (Research Institute for Sustainable Humanosphere, Kyoto University, Japan)

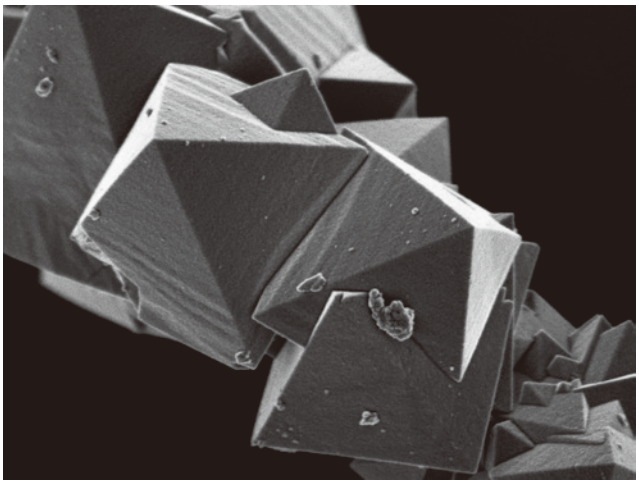
Although the specimen is an organic fiber, the observation is also feasible through controlling the beam damage on the organic fiber.

※ Acquired by the SHL version.

The newly designed UHD combined SHL is appropriate to obtain the stunning SE images with high S/N at low accelerating voltage.



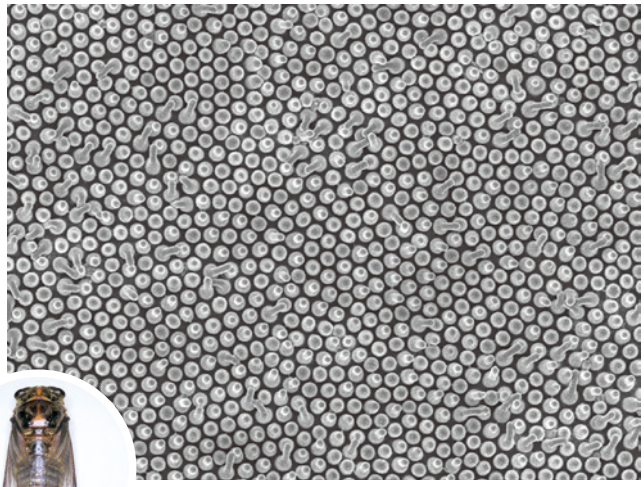
0.5 µm



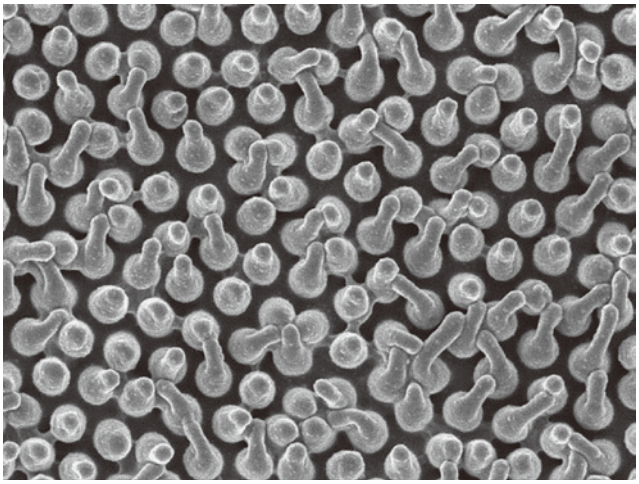
100 nm

Specimen: Cerium Oxide (osmium coating), Accelerating voltage: 1.0 kV (without BD mode), Observation mode: SHL, Detector: UHD Specimen courtesy of Professor Seiichi Takami (Nagoya University, Japan)

The surface structure of cerium oxide crystals can be clearly observed.



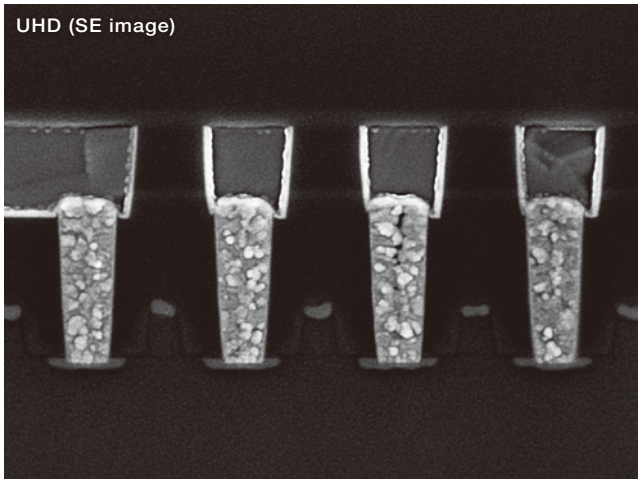
0.5 µm



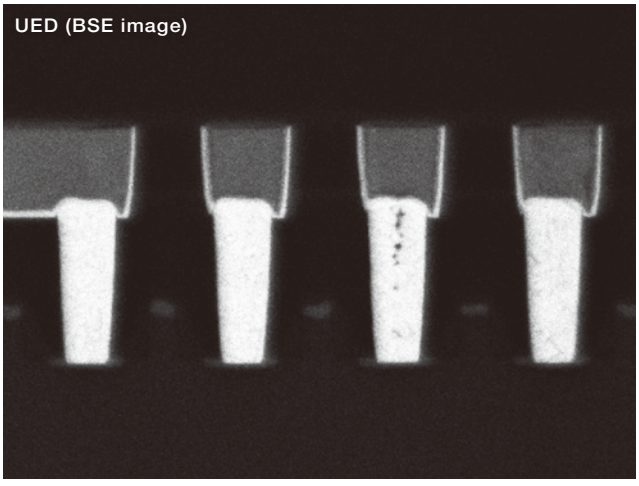
100 nm

Specimen: Cicada wing (osmium coating), Accelerating voltage: 1.0 kV (without BD mode), Observation mode: SHL, Detector: UHD

The surface structure of biological specimen can be clearly observed.




100 nm




100 nm

Specimen: section of IC-chip (surface-etching, osmium coating), Accelerating voltage: 5.0 kV (without BD mode), Observation mode: SHL, Detector: UHD, UED (BSE mode)

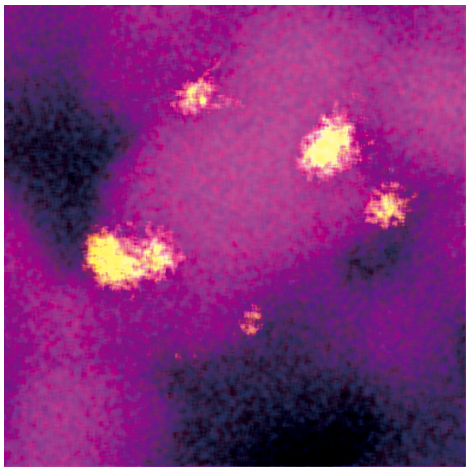
The SE image can be obtained by using the UHD; and the BSE image can be obtained by using the UED.

# EDS Mapping with JSM-IT800〈SHL〉

JSM-IT800〈SHL〉 is equipped with In-lens Schottky Plus field emission electron gun that maintains small probe diameter even at low accelerating voltage or large probe current. Therefore, integrating EDS with FE-SEM can improve the convenience of operating from observation to analysis, and also can obtain the high spatial resolution elemental maps within several minutes.

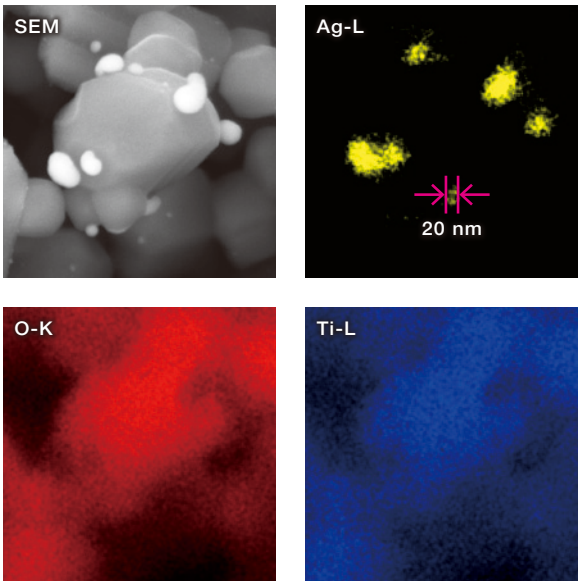
## High spatial resolution EDS maps

EDS mapping reveals tens of nanometer sized Ag nanoparticles.



100 nm

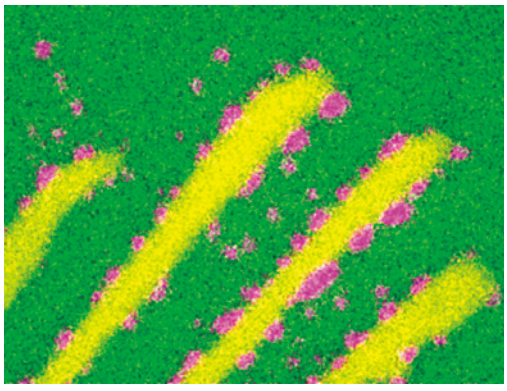
Specimen: Ag nanoparticles on the surface of titanium dioxide
Accelerating voltage: 5.0 kV
Probe current: 2.0 nA
Measurement time: 9 minutes
Detecting area of EDS detector: 100 $mm^2$




100 nm

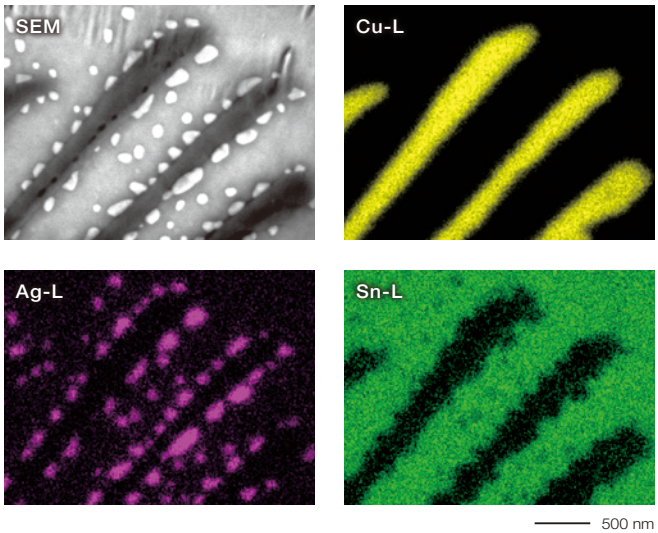
## High speed EDS mapping

The stunning elemental maps can be obtained within 3 minutes under large probe current setting.



500 nm

Specimen: Pb-free solder (Sn-Cu-Ag)
Accelerating voltage: 7.0 kV
Probe current: 11.5 nA
Measurement time: 3 minutes
Detecting area of EDS detector: 100 $mm^2$



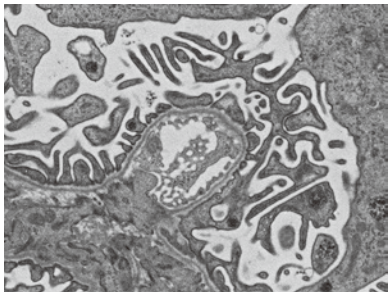

500 nm

# NEW BSE Detectors

In addition to BED (conventional solid state BSE detector), SBED (scintillator BSE detector) and VBED (versatile BSE detector) are also available.

## SBED (Scintillator BSE Detector)

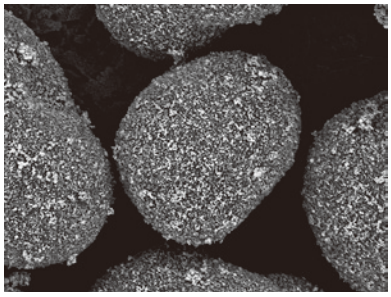
The response and sensitivity of the detector are enhanced when substituting semiconductor elements with scintillator in the detector.



— 0.5 µm

Specimen: ultra thin section of mouse kidney (contrast reversion)
Accelerating voltage: 5.0 kV
Scan speed: 0.04 µsec/pixel (5,120 × 3,840)

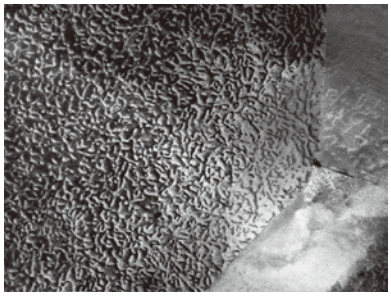
*Observe the biological ultra thin section through high speed scanning*



— 1 µm

Specimen: toner
Accelerating voltage: 1.5 kV

*Obtain the compositional image at low accelerating voltage*



— 100 nm

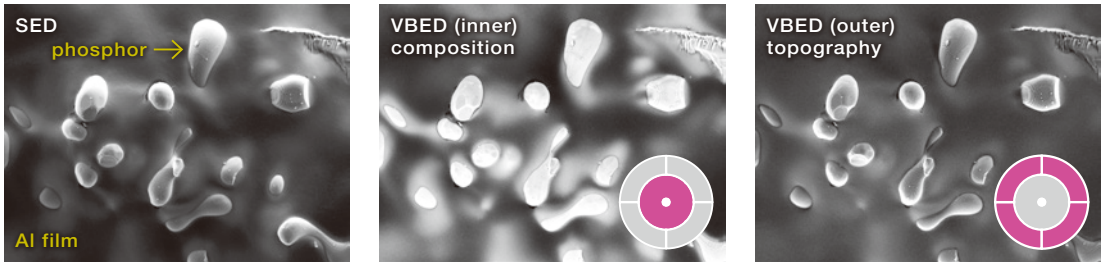
Specimen: steel plate (for observing dislocation)
Accelerating voltage: 25.0 kV

*Obtain the dislocation image at high accelerating voltage*

## VBED (Versatile BSE Detector)

The semiconductor detection elements are divided into 5 sections. According to the purpose of observation, the signals are selectively obtained from different detection area of these 5 sections.

### Angle selection

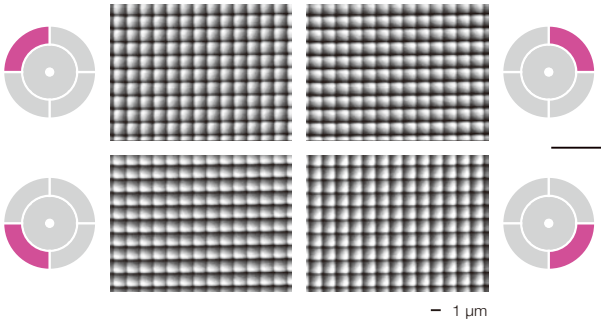



Specimen: phosphor, Accelerating voltage: 3.0 kV

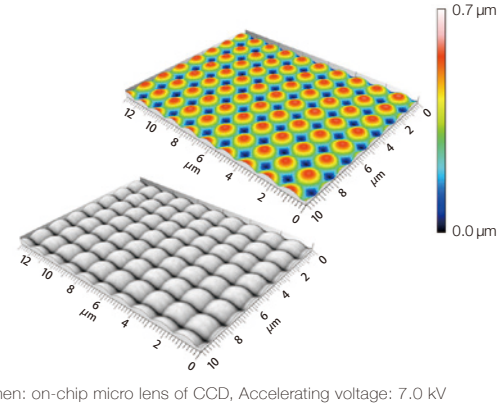
— 1 µm

*According to the different detection angles of BSE, the compositional information is principally obtained through the inner detecting elements of VBED and the topographic information is principally obtained through the outer detecting elements. In addition, it is remarkable that the phosphors under the Al film are bright when using the inner elements of detector to observe.*

### 3-Dimensional Image Reconstruction



— 1 µm




Specimen: on-chip micro lens of CCD, Accelerating voltage: 7.0 kV

*3-dimensional images can be reconstructed by using these 2-dimensional images obtained from 4 directions.*

# Technical DATA

## SEM specifications

| | SHL | SHL Standard (SHLs) |
|---|---|---|
| Resolution | 0.5 nm (15 kV)<br>0.7 nm (1 kV)<br>0.9 nm (500 V)<br>3.0 nm (5 kV, 5 nA, WD 10 mm) | 0.6 nm (15 kV)<br>1.1 nm (1 kV)<br><br>3.0 nm (15 kV, 5 nA, WD 10 mm) |
| Magnification | Photo magnification: ×10 to ×2,000,000 (128 × 96 mm)<br>Display magnification: ×27 to ×5,480,000 (1,280 × 960 pixels) | |
| Accelerating voltage | 0.01 to 30 kV | |
| Probe current | A few pA to 500 nA (30 kV) A few pA to 100 nA (5 kV) | |
| Detector (standard) | Secondary electron detector (SED) Upper hybrid detector (UHD) | |
| Electron gun | In-lens Schottky Plus field emission electron gun | |
| Aperture angle control lens (ACL) | Built-in | |
| Objective lens | Super hybrid lens / SHL | |
| Large Depth Focus (LDF) | Built-in | |
| Specimen exchange chamber | Built-in | Option |
| Vacuum system | SIP × 2, TMP, RP × 1 | |

| Specimen stage | Specimen stage Type1 (standard) | Specimen stage Type2 (option) | Specimen stage Type3 (option) |
|---|---|---|---|
| Type | Full eucentric goniometer stage | | |
| Movement range | X: 70 mm Y: 50 mm<br>Z: 1 to 41 mm<br>Tilt: –5 to 70°<br>Rotation: 360° | X: 100 mm Y: 100 mm<br>Z: 1 to 50 mm<br>Tilt: –5 to 70°<br>Rotation: 360° | X: 140 mm X: 80 mm<br>Z: 1 to 41 mm<br>Tilt: –5 to 70°<br>Rotation: 360° |
| Stage control | Computer-controlled 5-axis motor drive | | |
| Specimen size (draw out) | Maximum diameter: 170 mm<br>Maximum height: 45 mm<br>(WD 5 mm) | Maximum diameter: 200 mm<br>Maximum height: 55 mm<br>(WD 5 mm) | Maximum diameter: 200 mm<br>Maximum height: 45 mm<br>(WD 5 mm) |

| Low Vacuum (option) | |
|---|---|
| Resolution | 1.3 nm (15 kV) |
| Detector | Low vacuum backscattered electron detector (LVBED) |
| Pressure range | 10 Pa to 300 Pa |
| Orifice control | Automatic |
| Introduction gas | Nitrogen |
| Vacuum system | SIP × 2, TMP, RP × 2 |

## Principal Options

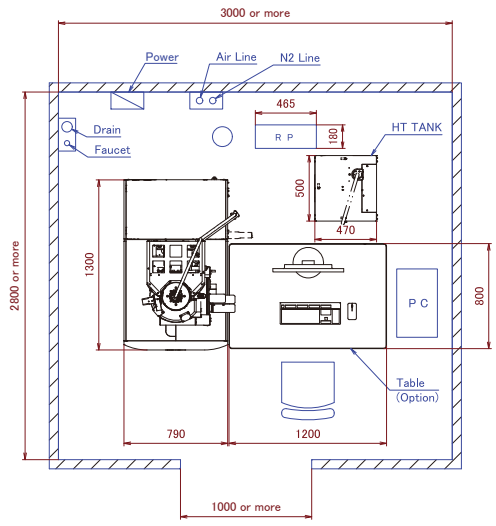
- Upper electron detector (UED)
- Backscattered electron detector (BED)
- Scintillator backscattered electron detector (SBED)
- Versatile backscattered electron detector (VBED)
- Transmission electron detector (TED)
- Low vacuum (included Low vacuum backscattered electron detector (LVBED))
- Low vacuum secondary electron detector (LVSED)
- Electron backscatter diffraction system (EBSD)
- Wavelength dispersive X-ray spectrometer (WDS)
- Soft X-ray emission spectrometer (SXES)
- Probe current detector
- Specimen exchange chamber
- Stage navigation system
- Chamber camera
- Operation table
- Operation panel
- Track ball
- SMILENAVI
- Montage
- LIVE map
- LIVE AI filter
- SMILE VIEW™ Map

## Installation Requirements

| | |
|---|---|
| Power | Single phase100 V, 50/60 Hz, 3 kVA (Max.),<br>Allowable input psower fluctuation: ±10% |
| Grounding terminal | 100 Ω or less, One |
| Cooling water | Flow rate: 0.6 to 1.1 L/min<br>Pressure: 0.05 to 0.25 MPa (gauge pressure) *1<br>Temperature: 20 ± 5 °C |
| Dry nitrogen gas | Pressure: 0.45 to 0.55 MPa |
| Dry compressed air | Pressure: 0.45 to 0.55 MPa |
| Installation room | Room temperature: 20 ± 5 °C<br>Humidity: 60% or less (no condensation)<br>Footprint: 3,000 × 2,800 mm or more<br>Door size: 1,000 (W) × 2,000 mm (H) or more |

*1: Must be provided by the customer

## Installation Figure



## Main Specifications

●: Standard ○: Option

| | | Standard |
|---|---|---|
| SEM integration | Built into the SEM control software | ● |
| | Integrated management of observation & analysis data | ● |
| | Specifying analysis positions on the SEM operation screen (direct analysis on GUI for SEM) | ● |
| | Graphical display of analysis positions | ● |
| Detector | SDD type | Refer to “Details of Dry SD™ detectors” |
| Spectral analysis | Qualitative analysis (peak identification, automatic qualitative analysis) | ● |
| | Visual Peak ID | ● |
| | Standard-less quantitative analysis (ZAF method) | ● |
| | Standard quantitative method (ZAF method) *1 | ● |
| | PHI-RHO-Z (PRZ) method: quantitative correction method | ● |
| | QBase (Quantitative analysis database) | ● |
| Line analysis | Line analysis (paralell & arbitrary direction) | ● |
| Elemental map | Elemental map (map with multiple colors, monochrome, and multiple-color superimposition) | ● |
| | Maximum pixel resolution: 4,096 × 3,072 | ● |
| | Real-time pop-up spectrum | ● |
| | Deconvolution map (net count map, quantitative map) | ● |
| | Real-time net count map | ● |
| | Real-time filter | ● |
| | Line profile display | ● |
| | Probe tracking | ● |
| | Playback analysis | ● |
| Serial analysis | Spectral analysis, line analysis, elemental map | ● |
| | Comprehensive analysis of already-analyzed data (qualitative & quantitative analysis and QBase) | ● |
| Data management function Report generation | SMILE VIEW™ Lab | ● |
| Offline function | Offline software for data analysis | ○ |

### Details of Dry SD™ detectors

| Sensor size | Energy resolution | Detectable elements |
|---|---|---|
| 30 mm² | 129 eV or less | Be to U |
| 60 mm² | 133 eV or less | B to U |
| 100 mm² | 133 eV or less | B to U |

*1: The optional Probe Current Detector (PCD) is required.

Specifications are subject to change without notice.

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*No. 1202D112C Printed in Japan, Kp*