



Scientific / Metrology Instruments
Schottky Field Emission Scanning Electron Microscope

Solutions for Innovation

The next level of analytical intelligence in FE-SEM

JSM-F100



JEOL Ltd.

Introducing FE-SEM: Integrating Optical Image,
SEM Image, and EDS Analysis

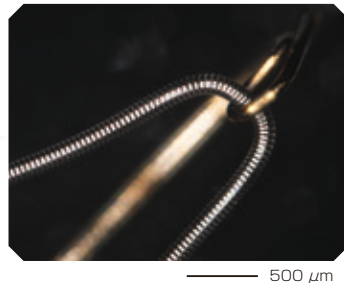
JSM-F100

The JSM-F100

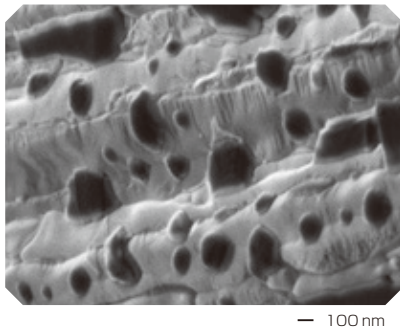
navigates you to the world of unknown nanostructures.



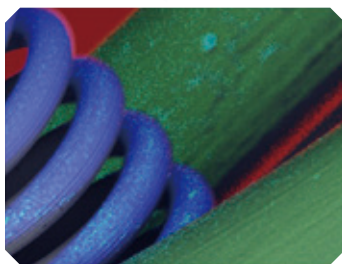
Optical image



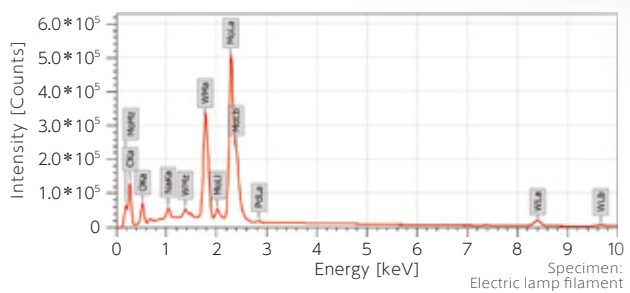
SEM image



EDS analysis



■ C-K ■ Na-K ■ Mo-L ■ W-M



*Use of optical microscope requires an option.

For high throughput in everyday observation and analysis
Highly Innovative



EDS Live Analysis → P10 - 11

Spectrum Monitor enables you to locate the analysis area with automatic live display of the elements in the area. While searching for the target area, Spectrum Monitor automatically makes live display of the elements in the area. This function is useful for screening the object to be measured.

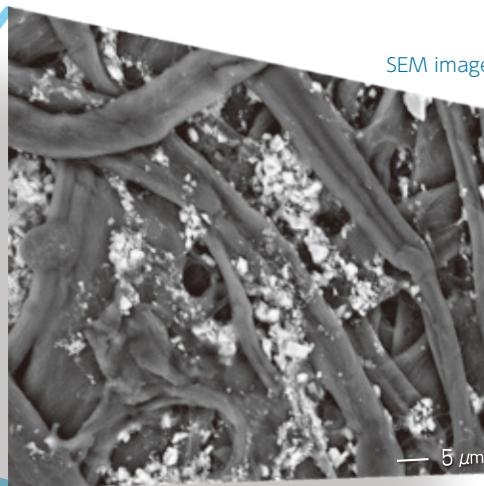
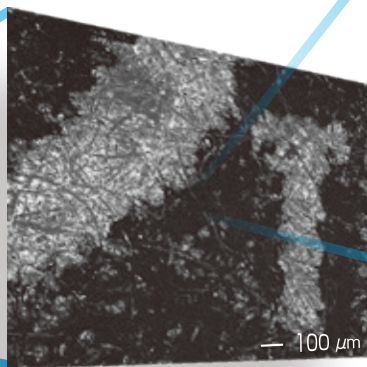
Point analysis, area analysis, mapping or line analysis can be selected from the buttons at the left of the screen. Then, click the target position on the live image to start analysis right away. This simple operation will improve measurement throughput.

Operability

SEM → P5 - 9

Zeromag is incorporated for seamless transition from optical to SEM image. This function is useful for locating the specimen area and for managing acquired data. The JSM-F100 provides not only high operability but also high-resolution images obtained with the FE-SEM.

Report generation

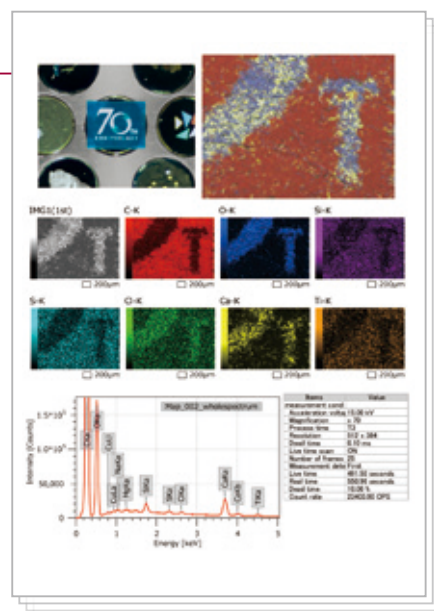
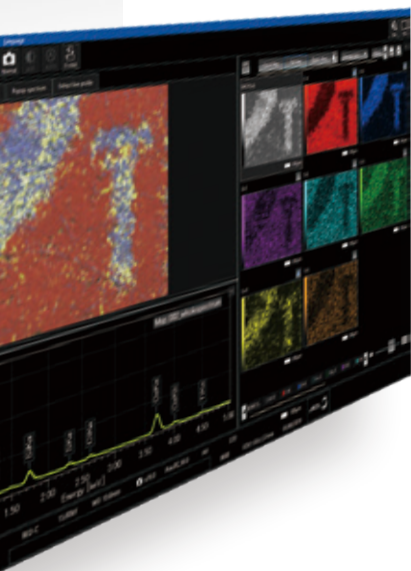


SEM image

Report generation using SMILE VIEW™ Lab

→ P12

The JSM-F100 offers connectivity with SMILE VIEW™ Lab, the new data management system used for JEOL's analytical instruments. It is useful for data management, analysis, and report generation.



*The optional stage navigation system (SNS) is required for use of optical images. → Refer to P.16.

A Variety of Functions for Multi-purpose Analysis

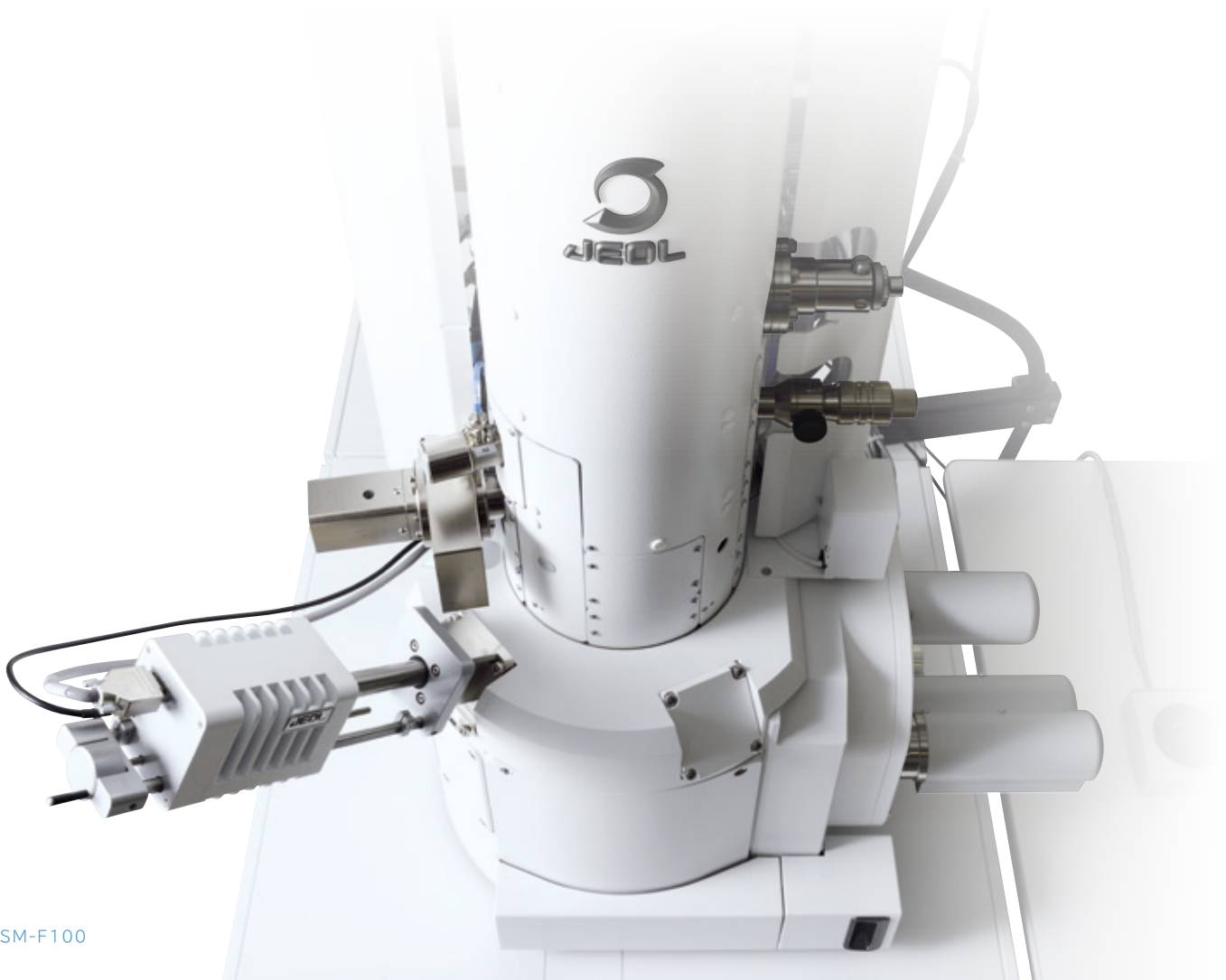
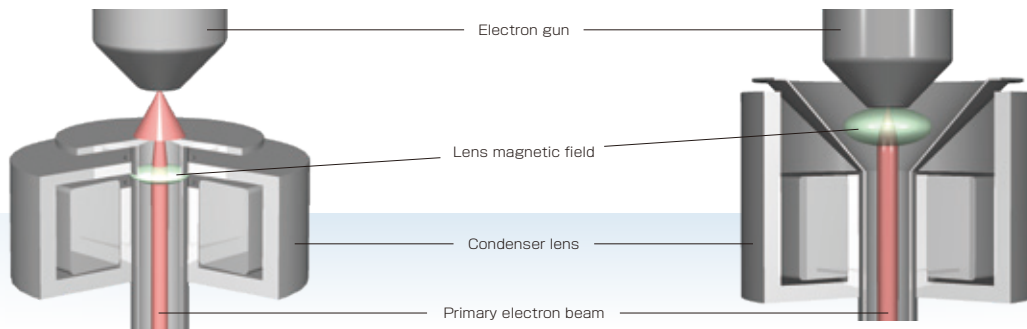
In-lens Schottky Plus Field Emission electron Gun (FEG)

In-Lens Gun

The In-lens Schottky Plus FEG has realized improved brightness as a result of integration of the electron gun and low-aberration condenser lens. With this FEG, generated electrons can be efficiently focused, enabling probe currents on the order of a few pA to several tens of nA even at low accelerating voltages. High-resolution observation is easy: there is no need to switch the objective aperture for tasks from fast elemental mapping to EBSD to SXES (see P15) analyses.

Conventional Schottky FEG

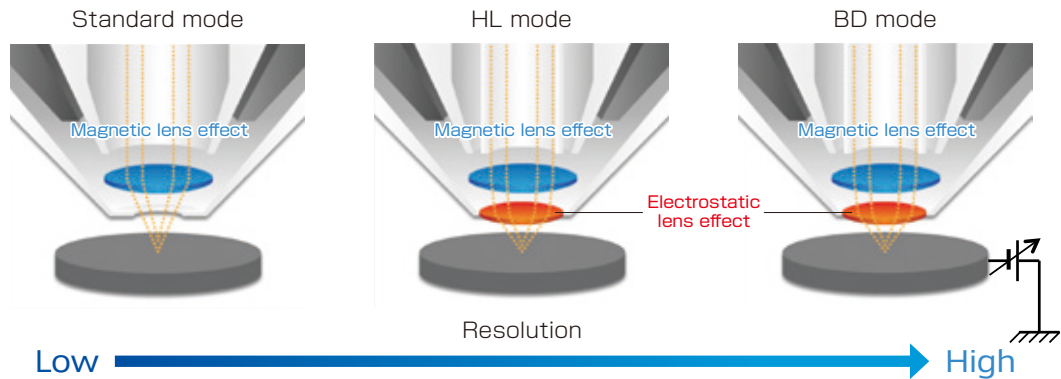
In-lens Schottky Plus FEG



Hybrid Lens (HL)

HL

The JSM-F100 comes with JEOL's electrostatic/Magnetic field superposed objective lens, Hybrid Lens (HL). This powerful lens enables observation and analysis of any specimen, including magnetic and insulating materials at high spatial resolution.



Beam Deceleration (BD) mode

BD

Applying a bias voltage of up to -2 kV to the specimen stage enables deceleration of the incident electron beam just before the specimen. This function improves the spatial resolution and signal-to-noise (S/N) ratio at low accelerating voltage.

Detection system

The JSM-F100 comes with a Secondary Electron Detector (SED) and an Upper Electron Detector (UED, also known as a Through The Lens or TTL detector). In addition, the optional Upper Secondary Electron Detector (USD) and Retractable Backscattered Electron Detector (RBED) can be integrated into the JSM-F100, allowing for signal acquisition with up to four detectors.

→ P7

Aperture angle Control Lens (ACL)

ACL

The aperture angle control lens (ACL), located above the objective lens, automatically optimizes the aperture angle of the objective lens over the whole current range (1 pA to 300 nA). Even when the probe current is increased, the ACL suppresses the spread of the incident electrons to continuously maintain the smallest possible probe size. The ACL enables smooth operation at any level of probe current, from high-resolution observation to analysis requiring a high probe current.

Large Depth of Focus (LDF) mode

In LDF mode, you can focus using the ACL instead of the objective lens. A low-magnification image can be acquired with low image distortion, enabling observation of large areas. In addition, this mode allows you to obtain a larger depth of focus compared with standard mode, making it suitable for observing taller specimens.

Low Vacuum function

*Option

LV

The Low Vacuum function allows simple observation and analysis with no conductive coating for insulating materials.

LIVE-AI filter (Live Image Visual Enhancer –AI: LIVE-AI)

*Option

AI filter

For the first time, a newly developed artificial intelligence (AI) filter has been incorporated into a (Schottky) FE-SEM for higher-quality live images. Unlike image integration processing, the AI filter can display a seamless moving live image with no residual image. This unique feature is very effective for searching for an observation area.

→ P8

Neo Engine

The JSM-F100 is equipped with a next-generation electron optical control system. Neo Engine (New Electron Optical Engine) builds upon JEOL's superb electron optical technologies. Owing to this system, stable imaging can be done under various observation conditions. Neo Engine also offers much greater ease of operation for automatic functions.

Enhanced auto functions

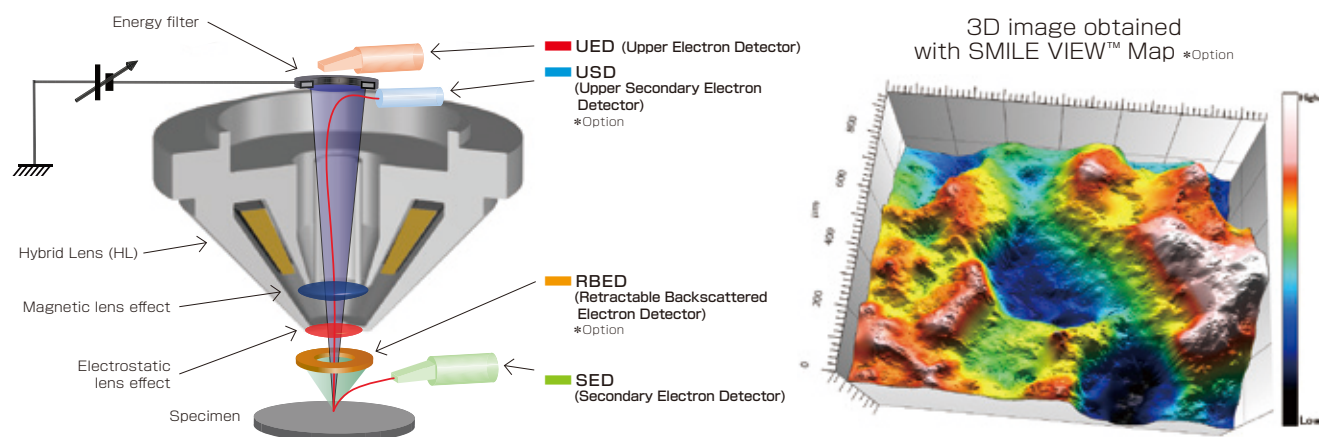
The JSM-F100 is the first JEOL FE-SEM to incorporate an advanced auto beam alignment (ABA) function. This feature automatically aligns the beam, in addition to focus, stigma, and brightness.

Acquiring various information for multiple purposes

Detector System

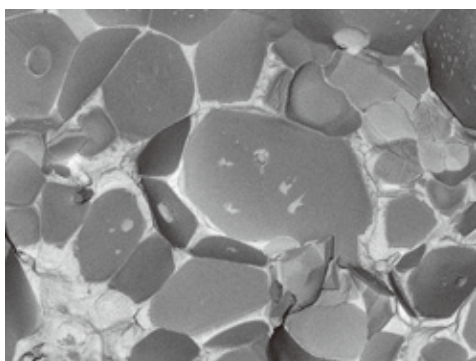
The JSM-F100 accommodates four detectors, enabling you to simultaneously observe various SEM images uniquely formed by each detector. Like the general-purpose SEM, the JSM-F100 offers a Secondary Electron Detector (SED) and a Retractable Backscattered Electron Detector (RBED). In addition, this FE-SEM is configured with two Through The Lens (TTL) detectors: the Upper Electron Detector (UED) and the Upper Secondary Electron Detector (USD).

* RBED and USD are optional



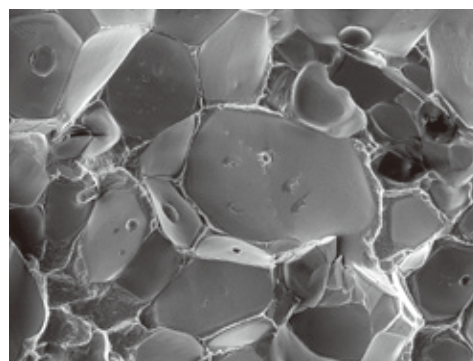
UED: High-angle backscattered electrons
(compositional & crystalline information)

HL



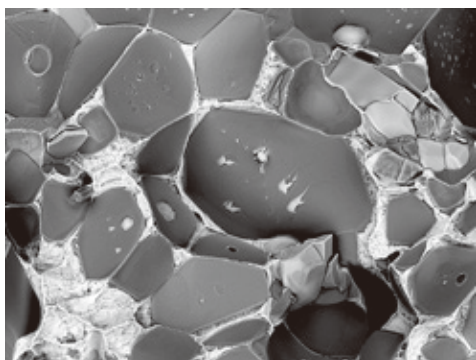
— 1 μm

USD: Secondary electrons
(surface morphological information)



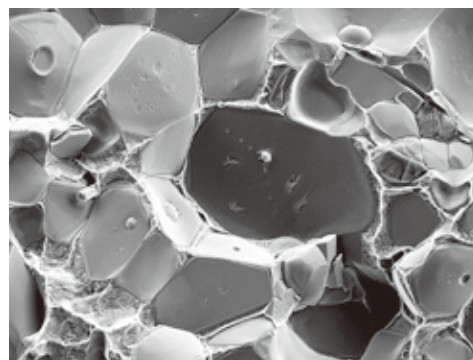
— 1 μm

RBED: Backscattered electrons
(compositional, crystalline, and topographic information)



— 1 μm

SED: Secondary and backscattered electrons
(topographic information)



— 1 μm

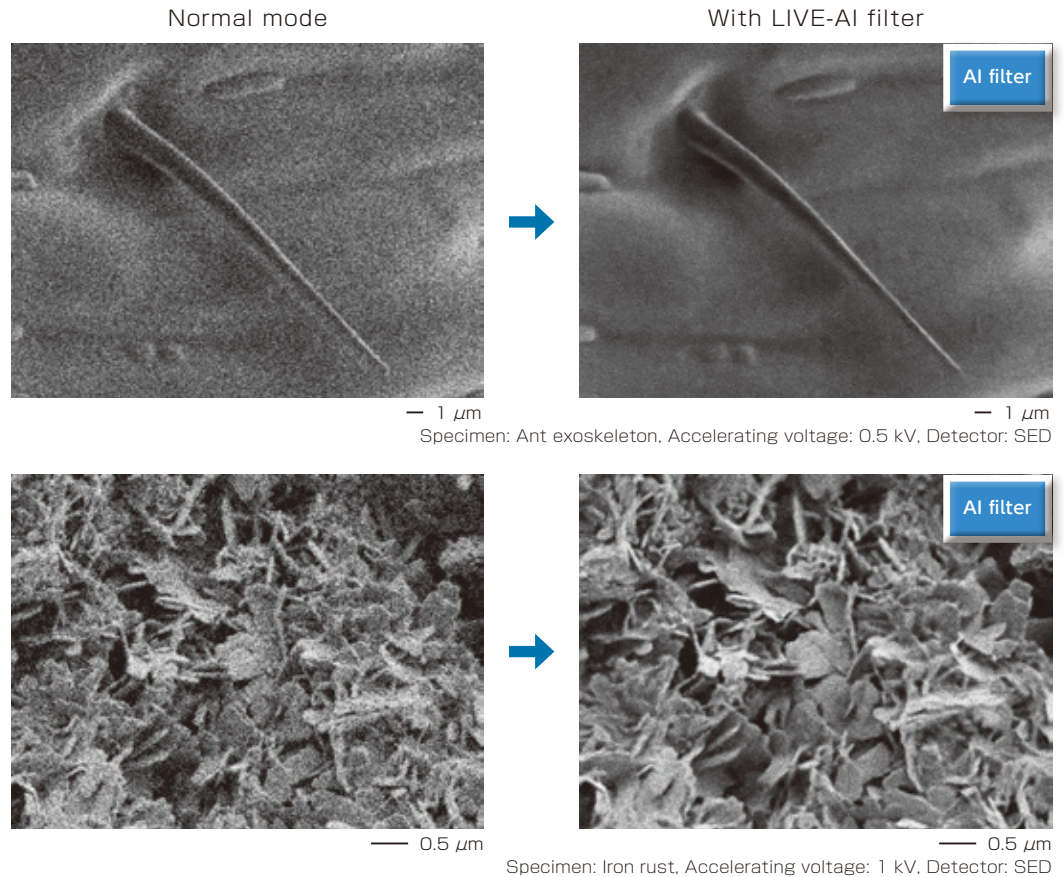
Specimen: Sintered material of Nd-Fe-B. Accelerating voltage: 5 kV, WD: 4 mm. Observation mode: HL. Energy filter: -300 V

In-built AI for SEM

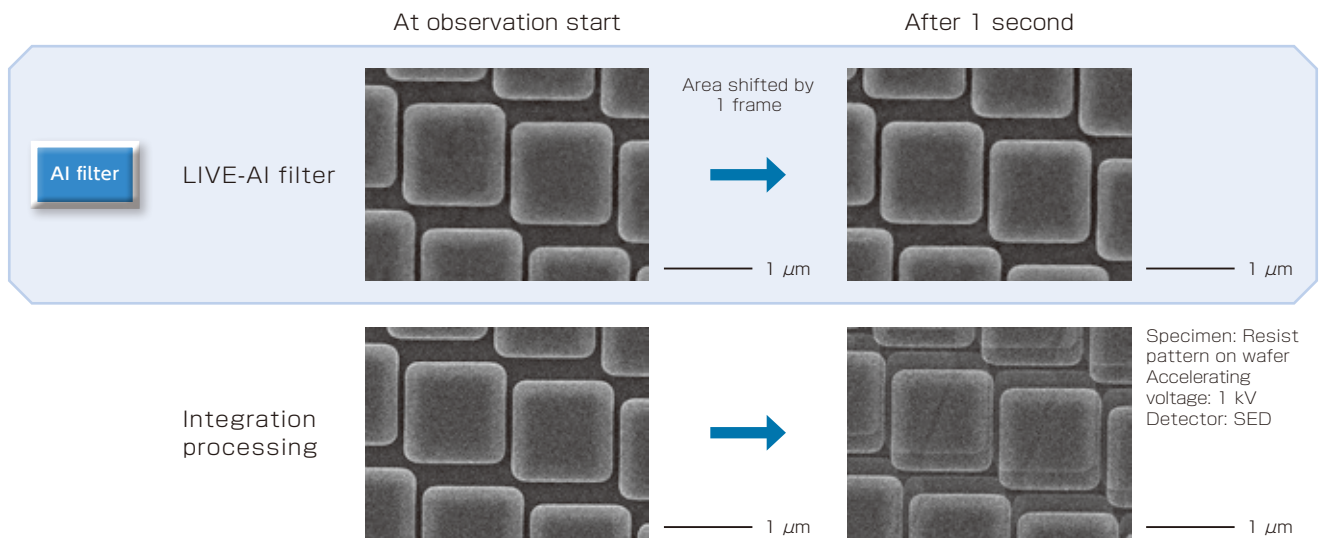
LIVE-AI Filter

JEOL has incorporated the LIVE-AI (Artificial Intelligence) filter for higher quality of live images. Unlike image integration processing, the LIVE-AI filter can display a seamless moving live image with no residual image. This unique feature is very effective in searching for the observation area and for focus and astigmatism correction.

Comparison of normal mode and LIVE-AI filter



Comparison of seamless movement between images with area shifted at a constant speed

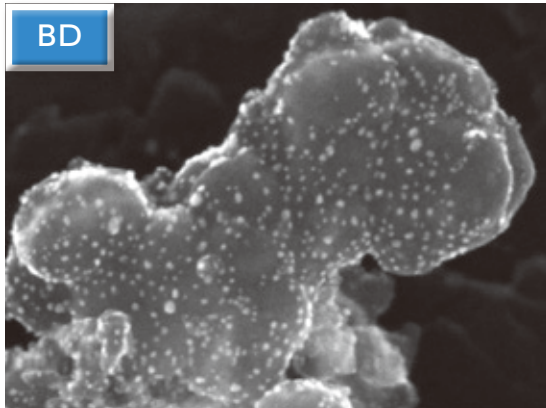


* LIVE-AI filter is an option. * Images obtained with LIVE-AI filter may differ from a normal SEM image.

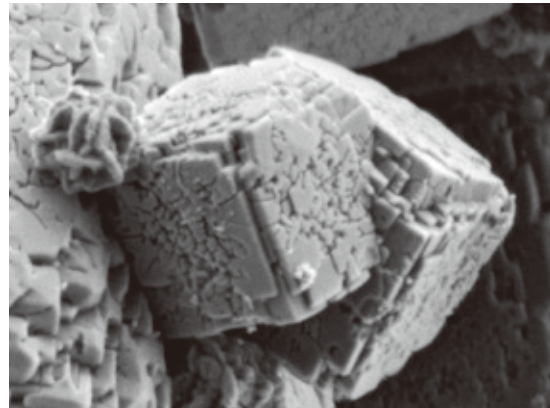
Capable of nanostructure observation

Examples of High-spatial-resolution Images

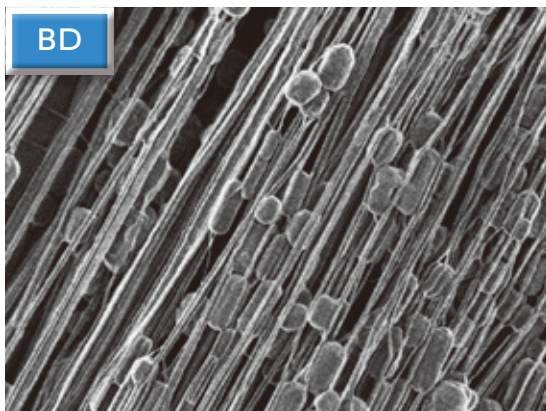
The JSM-F100 FE-SEM permits observation of nanostructures. Selecting observation conditions and detectors suitable for your applications enables you to acquire characteristic SEM images from a variety of specimens.



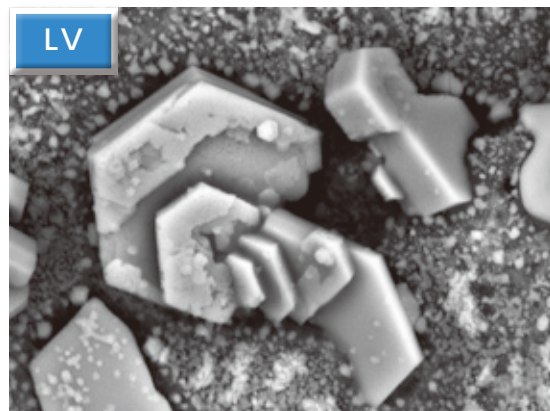
BD
Specimen: Pt nanoparticles on carbon.
Accelerating voltage: 20 kV, WD: 2 mm,
Observation mode: BD, Detector: UED
— 10 nm



Specimen: Zeolite.
Accelerating voltage: 1 kV, WD: 3 mm,
Observation mode: STD, Detector: SED
— 100 nm



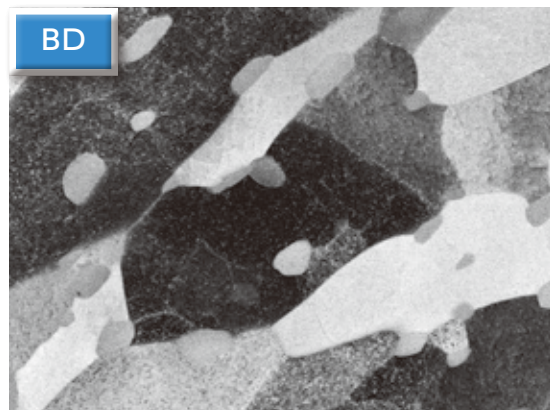
BD
Specimen: Seal tape.
Accelerating voltage: 0.5 kV, WD: 2 mm,
Observation mode: BD, Detector: UED
— 100 nm



LV
Specimen: Electric lamp lead.
Accelerating voltage: 10 kV, WD: 6 mm,
Observation mode: LV, Detector: LVBED
— 0.5 μm



BD
Specimen: Ultra-thin section of mouse glomerulus.
Accelerating voltage: 5 kV, WD: 4 mm,
Observation mode: BD, Detector: RBED (contrast reversal)
— 100 nm



BD
Specimen: Cross section of cast iron.
Accelerating voltage: 25 kV, WD: 4 mm,
Observation mode: BD, Detector: RBED
— 100 nm

*LV, LVBED, and RBED are optional.

Immediate elemental analysis of observation areas EDS Integration

With next-generation operability realized, you can transition seamlessly from SEM imaging to elemental analysis by EDS. Preselect area, mapping, line, or another type of analysis directly on the observation screen to begin analyzing your specimen immediately.

Observation screen

① Select analysis type.

② Specify analysis position.

Check the analysis position using Live Analysis.

③ Analysis starts.
*Preselect analysis positions on multiple areas; each analysis will begin automatically, enabling you to obtain multiple measurements.

Specimen: Cross section of cast iron.



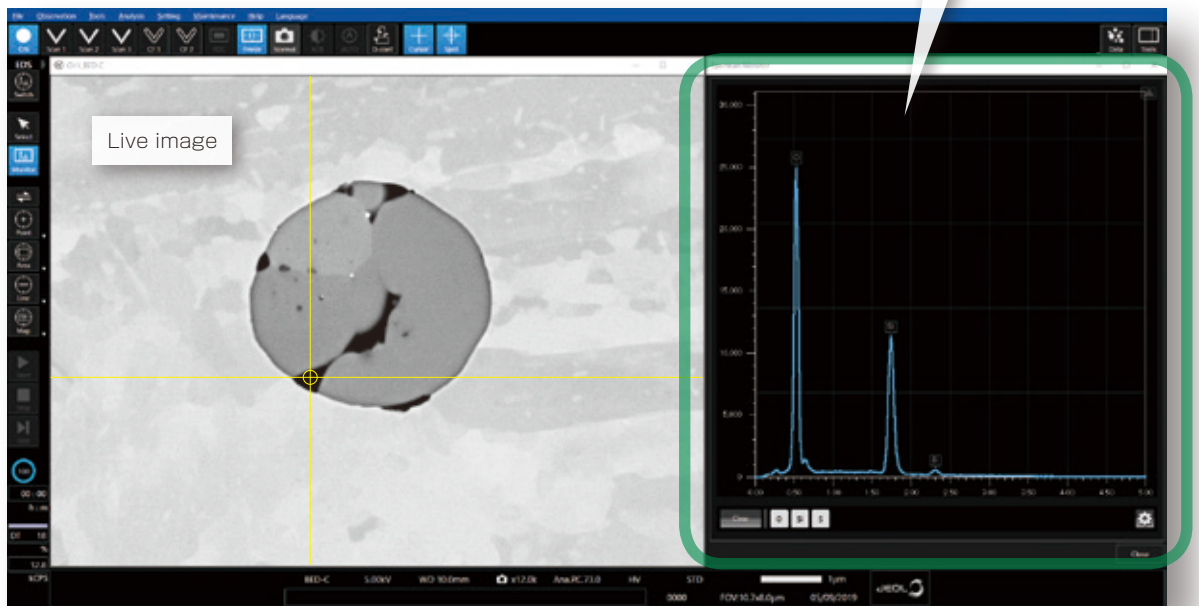
EDS analysis starts immediately after 3 clicks on the observation screen.

Analysis Detail display screen

In-Lens Gun

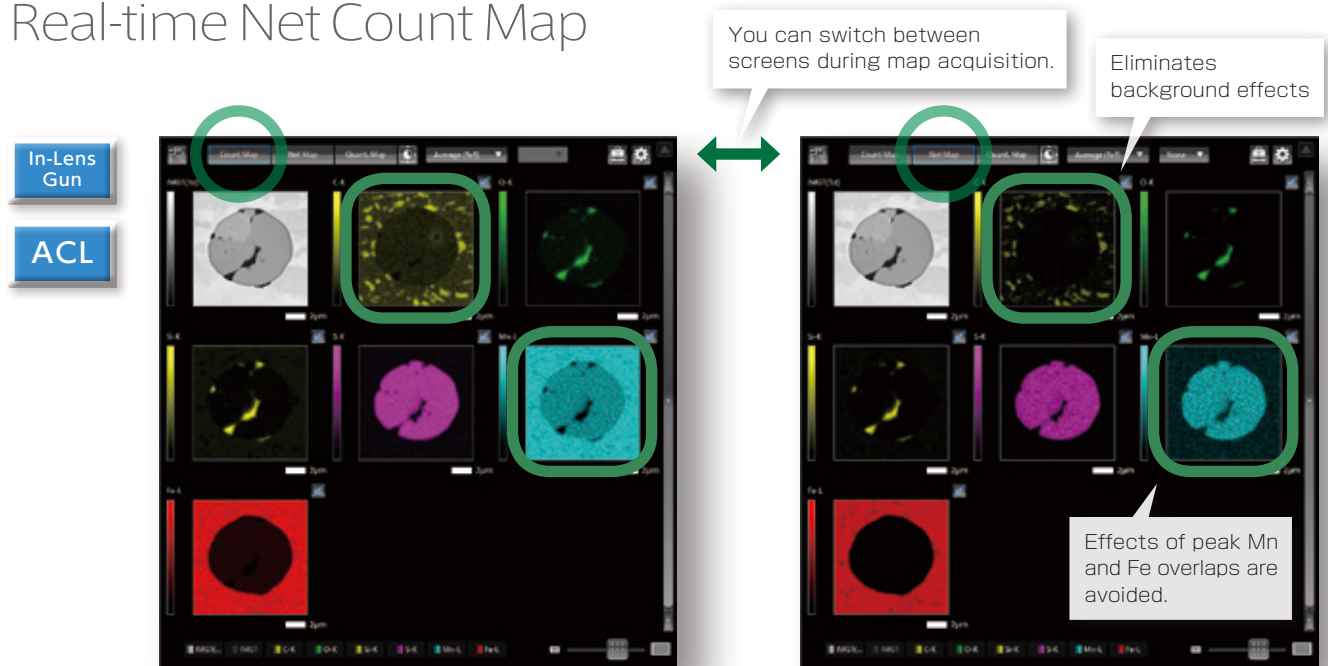
ACL

Elemental screening for EDS analysis always available Live Analysis



Specimen: Cross section of cast iron.

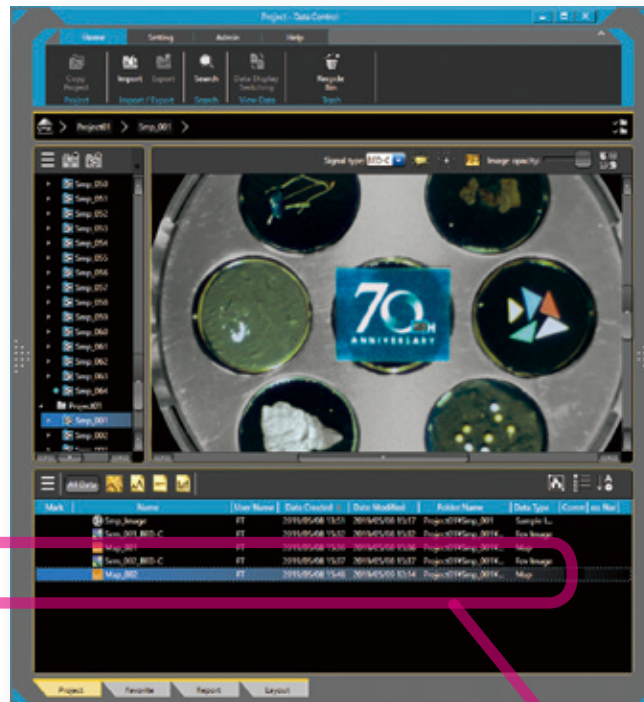
For reducing errors in analysis during acquisition Real-time Net Count Map



Net count map: Reflects analysis results with automatic background removal and peak deconvoluted maps. Useful when the spectrum contains peak overlaps or very small peaks.

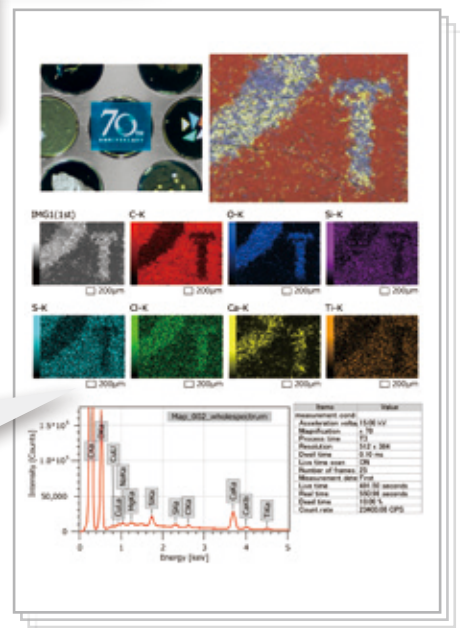
Automatic linkage of optical and SEM images and EDS results Data Management & Report Generation

For fast and simple report generation
SMILE VIEW™ Lab

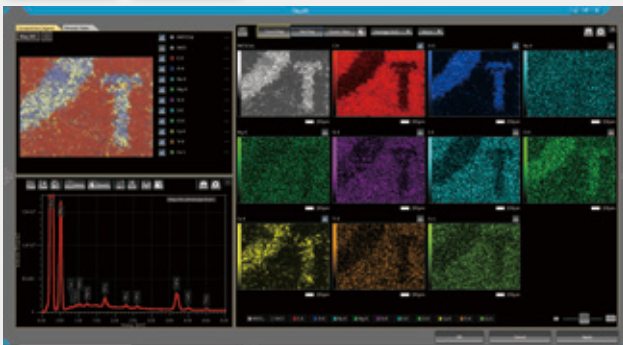


Simply select items from the data list.

A report compiling the optical and SEM images and EDS analysis results can be created with a single click.



In-Lens Gun ACL

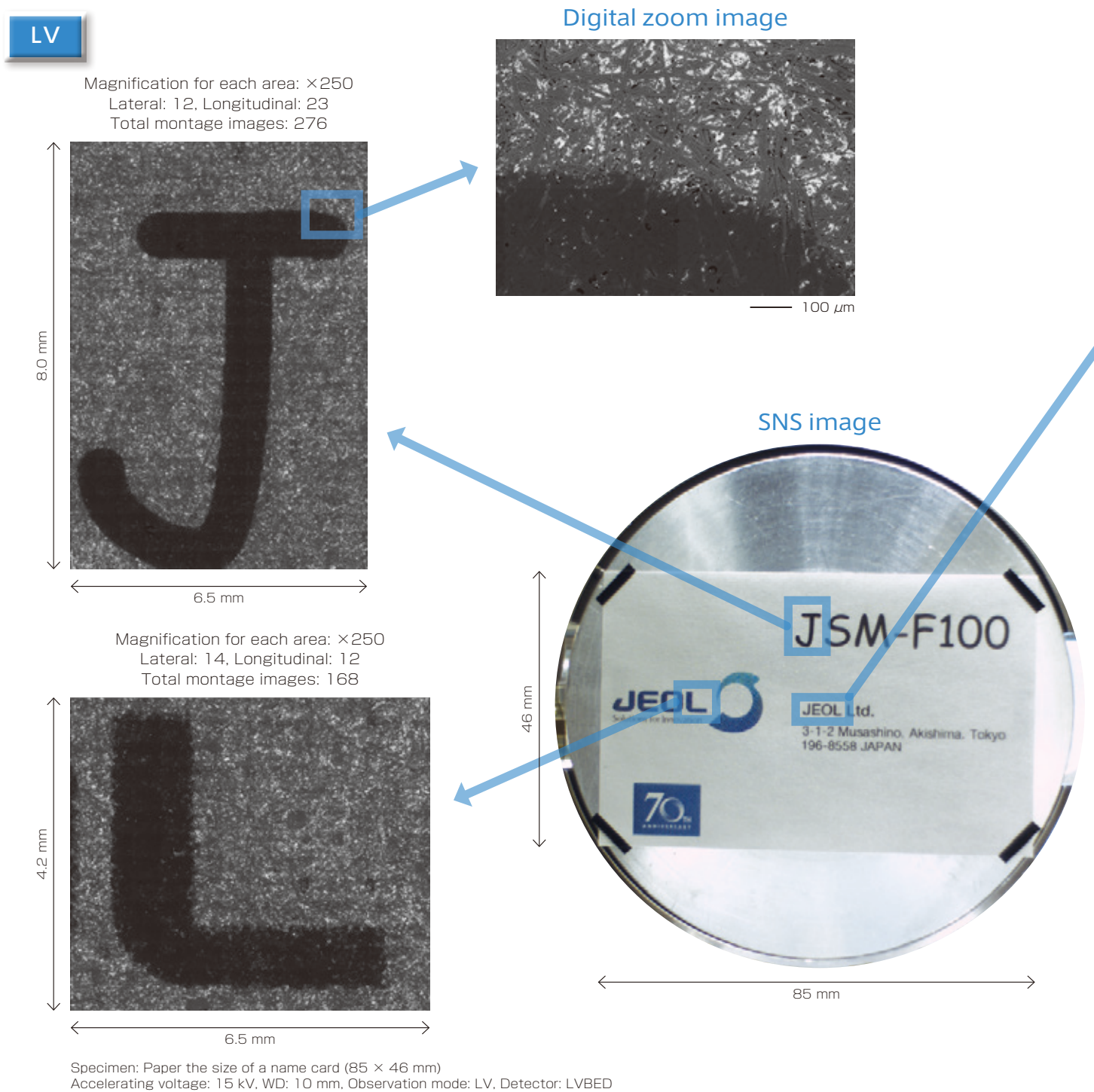


You can easily edit and reanalyze the report: its data are linked to the original data acquisition, observation, and analysis results.

*The optional stage navigation system (SNS) is required for use of optical images. → Refer to P.16.

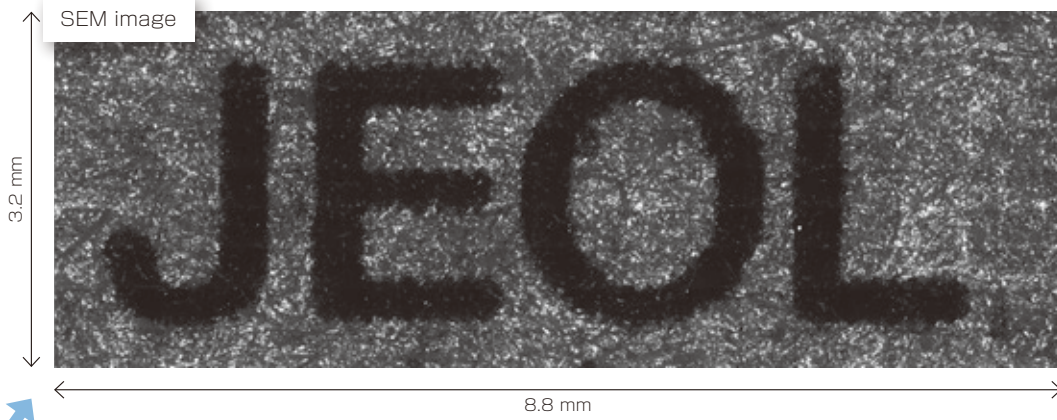
Automatic large area acquisition Montage

Montage images, which cover large areas with automatic acquisition of each area and correction of positional area shift, can be acquired simply by specifying the areas and acquisition conditions. Applying digital zoom to the acquired montage images displays detailed information about the specimen. In addition, montage elemental maps using EDS can simultaneously be obtained, enabling automatic acquisition of a great deal of information without the help of an operator. Montage results shown on this page were acquired in one automatic analysis from three pre-specified areas on a paper the size of a name card (85 mm × 46 mm) using the Zeromag function. With the Montage function, both SEM montage images and EDS montage elemental maps were acquired simultaneously.



*The optional stage navigation system (SNS) is required for use of optical images. → Refer to P.16.
*LV and LVBED are optional

Magnification for each area: $\times 250$, Lateral: 19, Longitudinal: 9
Total montage images: 171



Simultaneously acquired montage elemental maps

C K



In-Lens
Gun

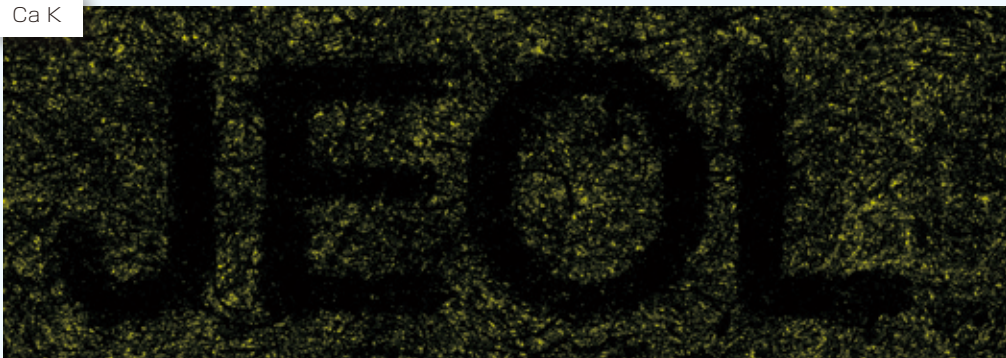
ACL

LV

O K



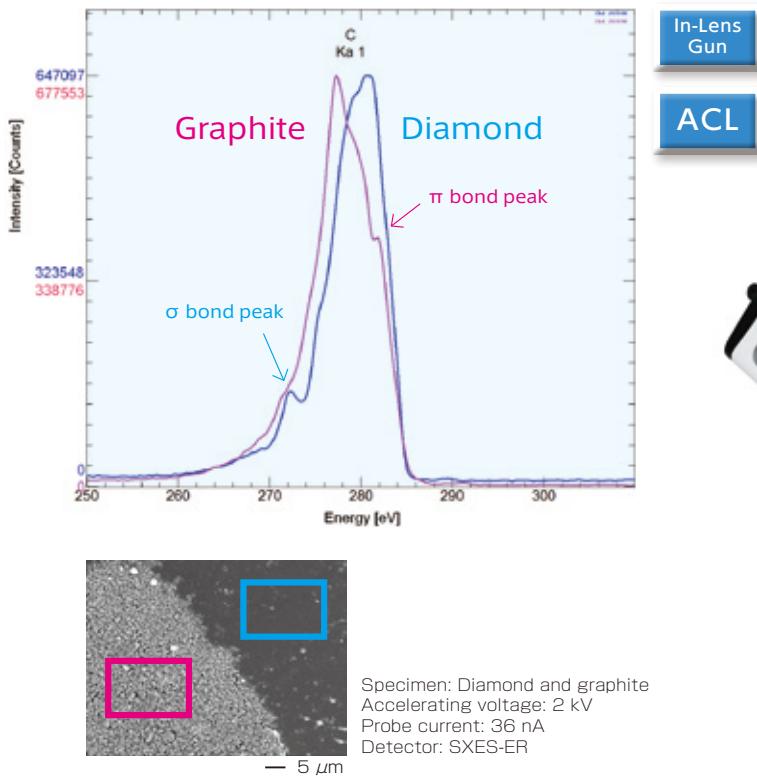
Ca K



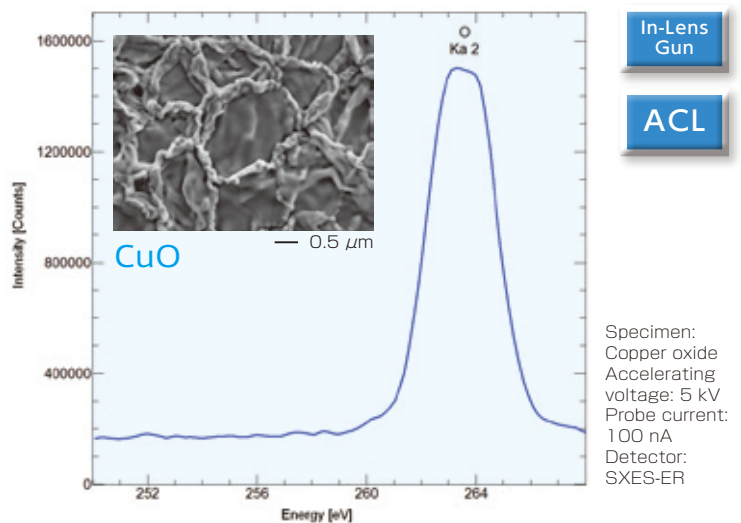
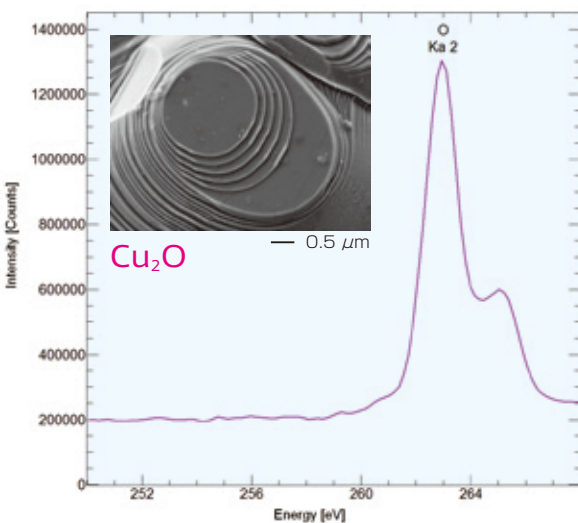
New X-ray analysis applications

Soft X-ray Emission Spectrometer (SXES)

The Soft X-ray Emission Spectrometer (SXES) delivers extremely high sensitivity and energy resolution, allowing for chemical-state analysis, as well as elemental analysis. Incorporation of the SXES in the FE-SEM makes it possible to analyze local areas at high probe current.



Comparison of diamond and graphite spectra. At C-C single bond (σ bond) and C-C double bond (π bond), peak top shifts and different shoulder peaks were confirmed in the C-K α first-order line spectra. The use of SXES reveals the difference in spectral shapes originating from chemical shift, even when the two spectra are acquired from the same type of carbon.



Comparison of monovalent Cu_2O and bivalent CuO spectra. Due to the difference in electronic structure, the difference in spectral shapes in the O-K α second-order line spectra was confirmed.

*SXES is an optional

Applicable to specimens of all sizes, as well as optical imaging Specimen Exchange System

Draw-out system suitable for large-specimen exchange

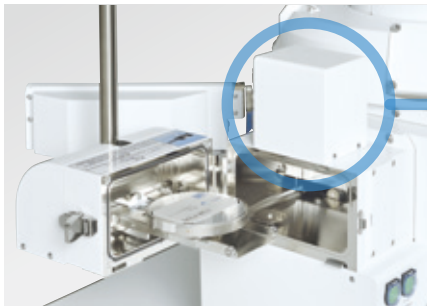


With draw-out system
Max. specimen size:
170 mm diameter
Vacuum evacuation:
3 to 5 minutes
Optical image area:
120 mm × 120 mm



Optical image acquisition supports both specimen exchange systems

Specimen exchange chamber enabling fast and clean specimen loading/unloading



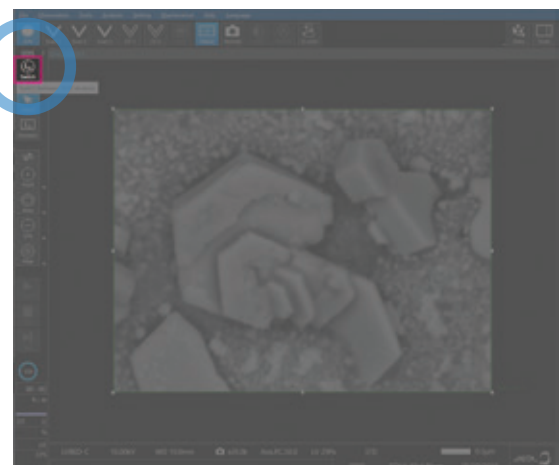
With pre-evacuation chamber
Max. specimen size:
100 mm diameter
Vacuum evacuation:
60 s or less
Optical image area:
70 mm × 70 mm



- * Evacuation and venting times change depending on specimen or installation environments.
- * The optional stage navigation system (SNS) is required for use of optical images.
- * The specimen exchange chamber is an option.

Support learning of operation steps SMILENAVI

SMILENAVI is an assistant tool designed for beginners to allow smooth basic SEM operations. When the operator clicks the appropriate button as indicated by the SMILENAVI flowchart, the SEM GUI is linked to the click operation for operator guidance. Since the GUI displays operation steps and button locations, operators will be able to operate the SEM without using SMILENAVI.



Linkage

*SMILENAVI is an optional

SEM Specifications

	Standard	Low Vacuum
Resolution (1 kV)	1.3 nm	
Resolution (20 kV)	0.9 nm	
Magnification	Direct magnification: ×10 to 1,000,000 (128 mm × 96 mm) Display magnification: ×27 to 2,740,000 (Display panel 23.8 inch (Number of pixels 1,920 × 1,080))	
Accelerating voltage	0.01 to 30 kV	
Probe current	A few pA to 300 nA (30 kV), a few pA to 100 nA (5 kV)	
Standard detector	Upper Electron Detector (UED), Secondary Electron Detector (SED)	
Electron gun	In-lens Schottky Plus field emission electron gun (FEG)	
Aperture angle control lens (ACL)	Built-in	
Objective lens	Hybrid Lens (HL)	
Specimen stage	Full eucentric goniometer stage	
Specimen movement	X: 70 mm, Y: 50 mm, Z: 2 to 41 mm, Tilt: -5 to 70°, Rotation: 360°	
Motor control	5-axis motor control	
Specimen size (Draw-out)	Maximum diameter: 170 mm, maximum height: 45 mm (WD 5 mm)	
Long Depth of Focus (LDF)	Built-in	
Standard detector (low vacuum)	—	Low Vacuum Backscattered Electron Detector (LVBED)
Resolution (low vacuum)	—	1.8 nm (30 kV)
Pressure range (low vacuum)	—	10 Pa to 300 Pa
Differential-pumping orifice control	—	Automatic
Introduction gas	—	Nitrogen
Vacuum system	SIP × 2, TMP, RP × 1	SIP × 2, TMP, RP × 2

Principal Options

Low Vacuum function
 Retractable Backscattered Electron Detector (RBED)
 Upper Secondary Electron Detector (USD)
 Low Vacuum Secondary Electron Detector (LVSED)
 Scanning Transmission Electron Detector (STEM)
 Electron Backscatter Diffraction System (EBSD)
 Wavelength Dispersive X-ray Spectrometer (WDS)
 Soft X-ray Emission Spectrometer (SXES)
 Cathodoluminescence Detector (CL)
 Specimen exchange chamber
 Stage navigation system (SNS)
 Chamber camera
 Operation table
 Operation panel
 Trackball
 SMILENAVI
 LIVE-AI filter
 SMILE VIEW™ Map

Installation Requirements*

Power	Single phase 100 V, 50/60 Hz, 3 kVA (max.) Allowable input power fluctuation: ± 10%
Grounding terminal	100 Ω or less, One
Cooling water	Flow rate: 0.6 to 1.1 L/min
	Pressure: 0.05 to 0.25 MPa (gauge pressure)
	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
	Humidity: 60% or less (no condensation)
	Footprint: 3,000 mm × 2,800 mm or more
	Door size: 1,000 mm (W) × 2,000 mm (H) or more

* Must be provided by the customer.

EDS 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 DrySD™ detectors"
Spectral analysis	Qualitative analysis (peak identification, automatic qualitative analysis)	●
	Visual Peak ID	●
	Standard-less quantitative analysis (ZAF method)	●
	Standard quantitative analysis (ZAF method) *	●
	PHI-RHO-Z (PRZ) method: quantitative correction method	●
	QBase (Quantitative analysis database)	●
Line analysis	Line analysis (horizontal & arbitrary directions)	●
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 DrySD™ detectors

Detection area	Energy resolution	Detectable elements
30 mm ²	129 eV or less	Be to U
60 mm ²	133 eV or less	B to U
100 mm ²	133 eV or less	B to U

* The optional Probe Current Detector (PCD) is required.
Specifications are subject to change without notice.

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