



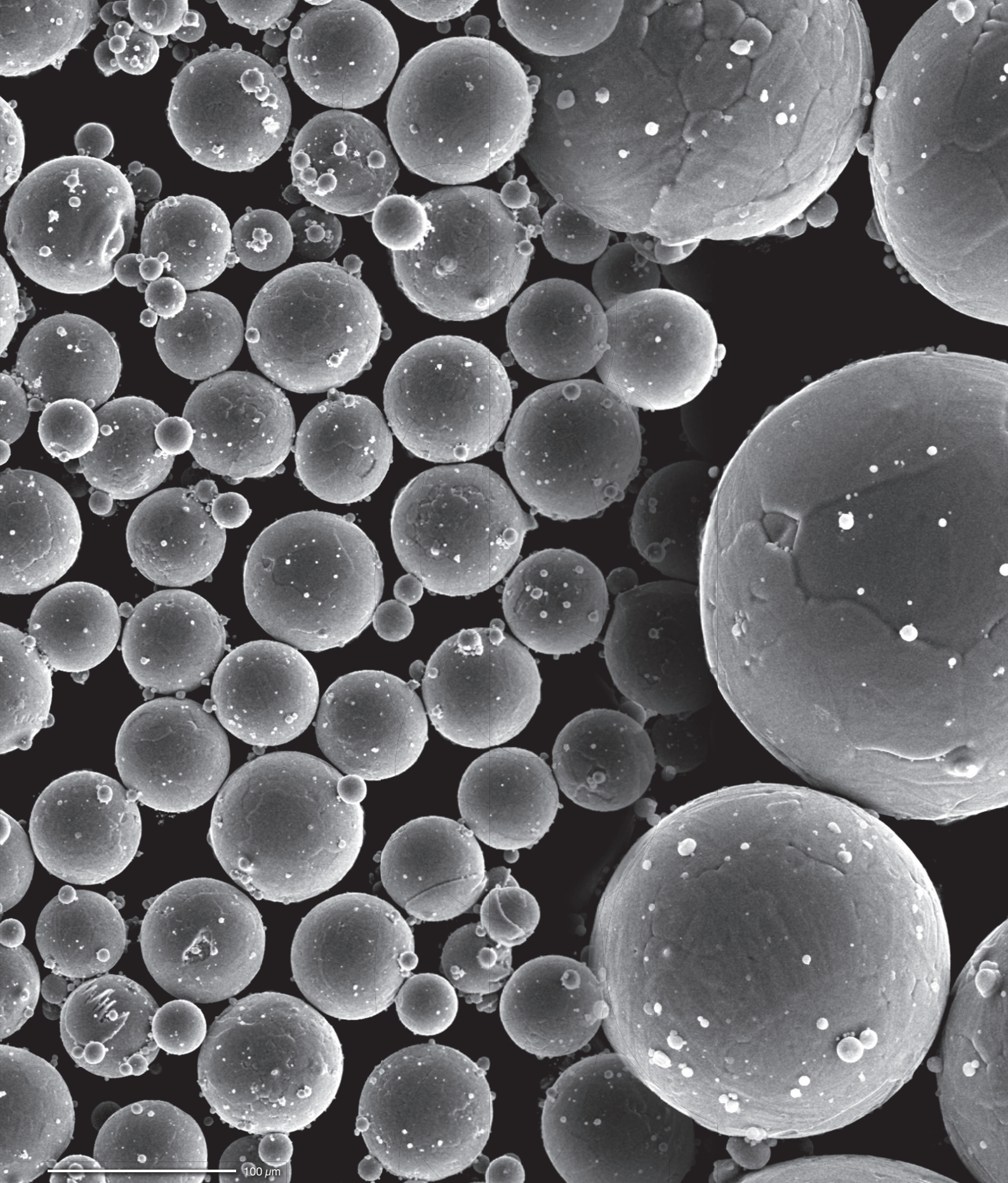
Scientific / Metrology Instruments  
Scanning Electron Microscope

Solutions for Innovation

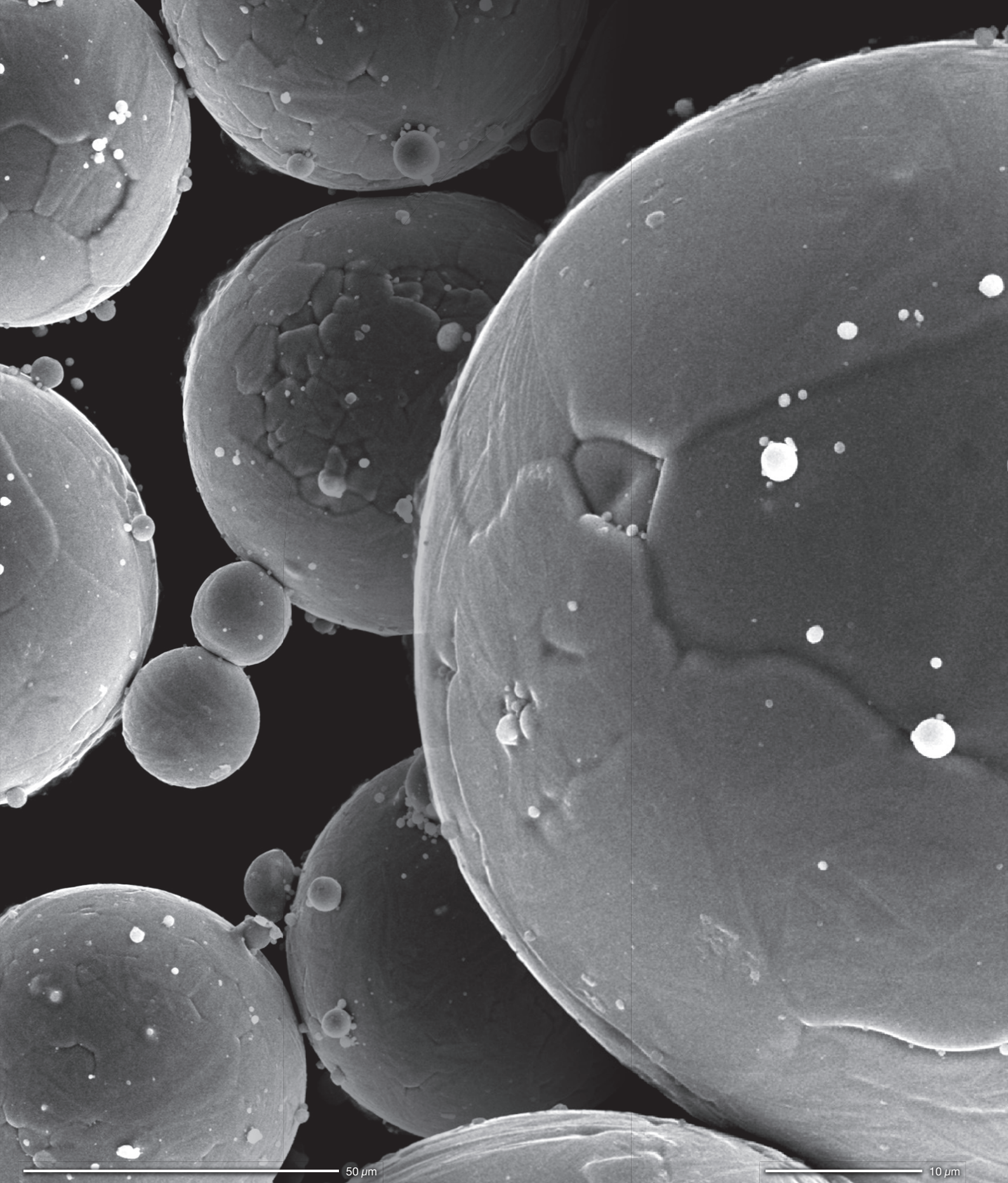
# JSM-IT510



JEOL Ltd.

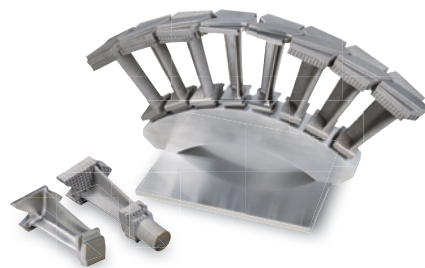


*Titanium alloy Ti-6Al-4V is a popular material for metal 3D printing. It is very important to control the size and shape.*



Specimen: Titanium alloy powder (Ti-6Al-4V) Accelerating voltage: 20 kV Signal: Secondary electron (SE)

*Model of gas turbine prepared by a metal 3D printer  
(Electron beam metal AM machine JAM-5200EBM).*

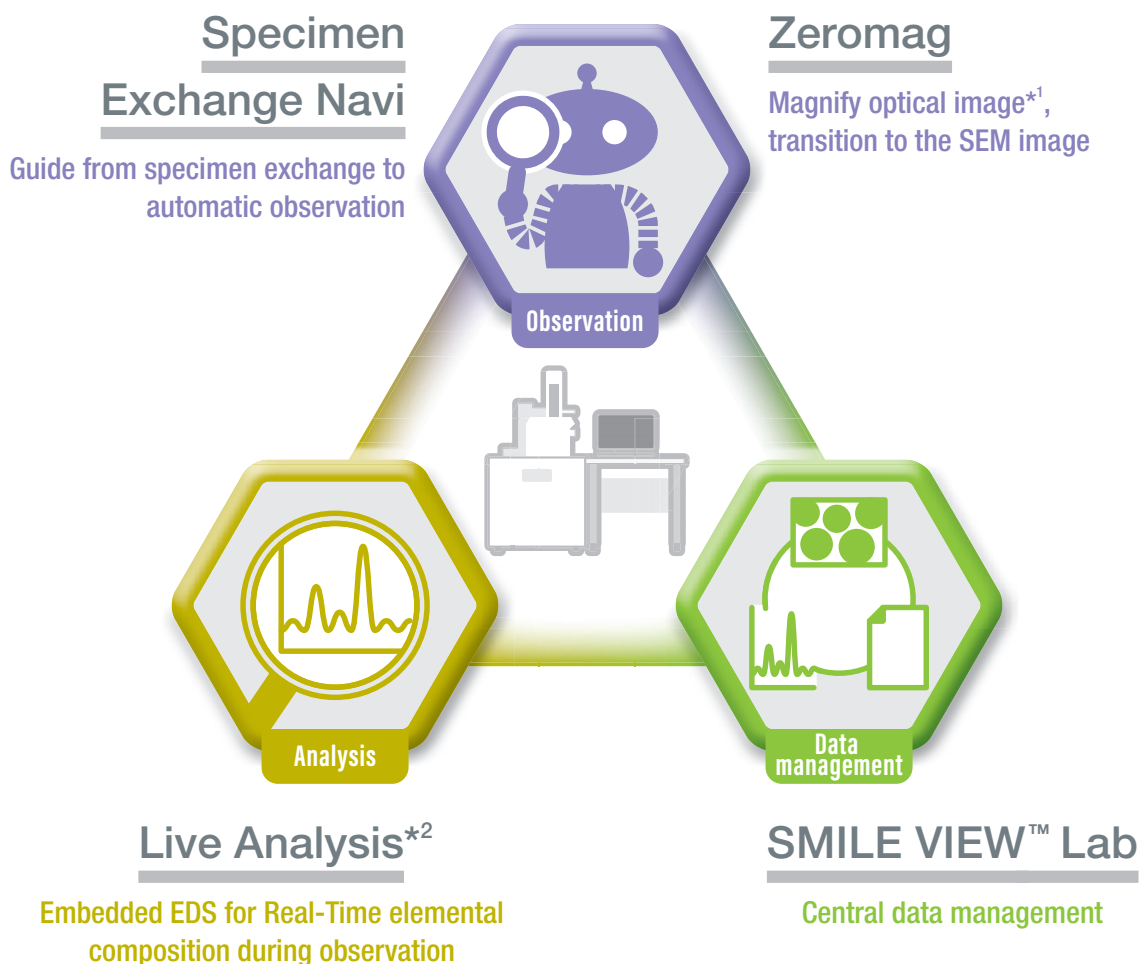


# Easy to acquire data

NEW

## Simple SEM

Automate daily routine work



\*1 SNS (Stage Navigation System) is necessary to display an optical image.  
\*2 Live Analysis is applied in A (Analysis), LA (Low Vacuum & Analysis).

*for all specimen types*



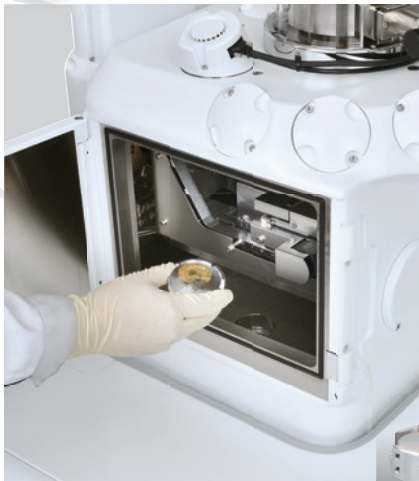


# Guide from specimen exchange to au

## Specimen Exchange Navi

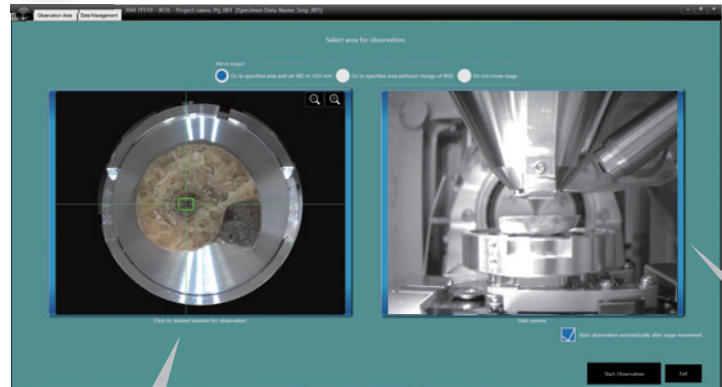
### Safe and simple! Specimen Exchange Navi

1 Follow the Navi guide to set specimen



Specimen height scale

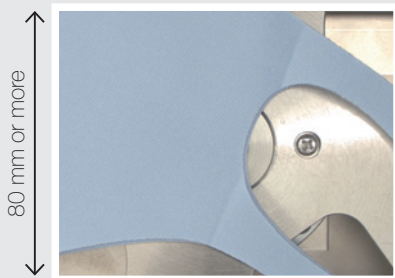
2 Prepare for observation during evacuation



### Easy to find the target area

Navigate from an image as large as 200 mm in diameter.

### Stage Navigation System (SNS)\*<sup>1</sup>

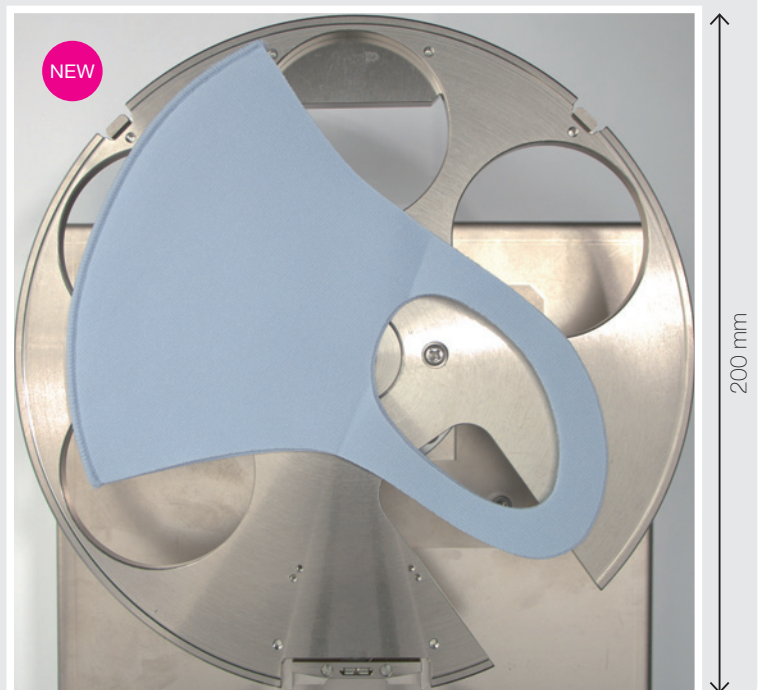


80 mm or more

100 mm or more

Specimen: Mask

### Stage Navigation System Large Sample (SNSLS)\*<sup>2</sup>



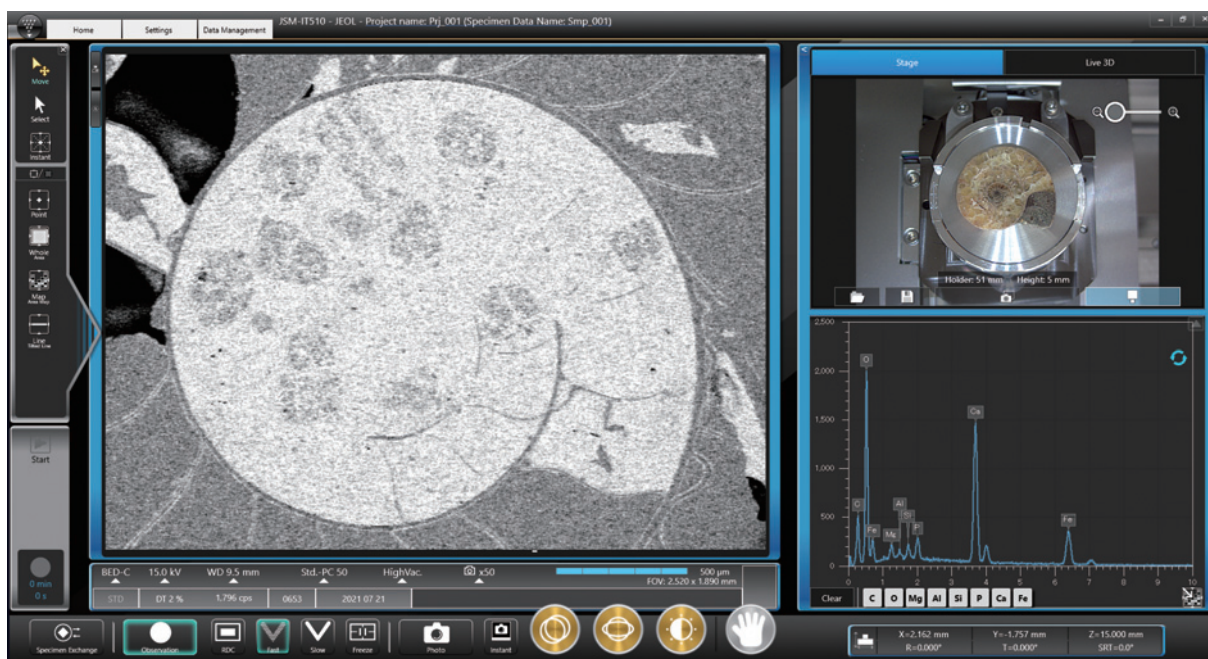
200 mm

200 mm

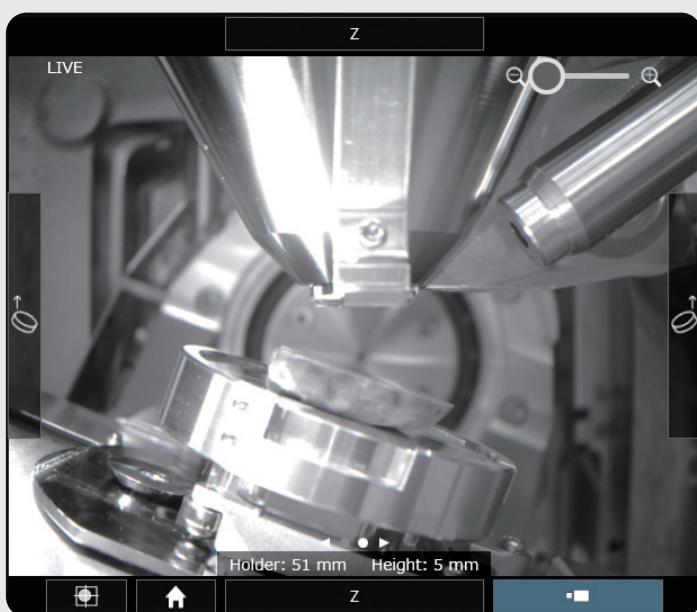
# Automatic observation

## 3 Start observation automatically

Automatic image formation after evacuation.



## Display the inside of chamber



Tilt to 20°

## Chamber Scope (CS)\*3

High resolution camera with digital zoom for viewing specimen position. Operations like tilting or rotation, are safe because movements in the chamber is visible.

\*1 State Navigation System (SNS) is an option.

\*2 SNS Large Sample (SNSLS) is an option. Compatible with SNS.

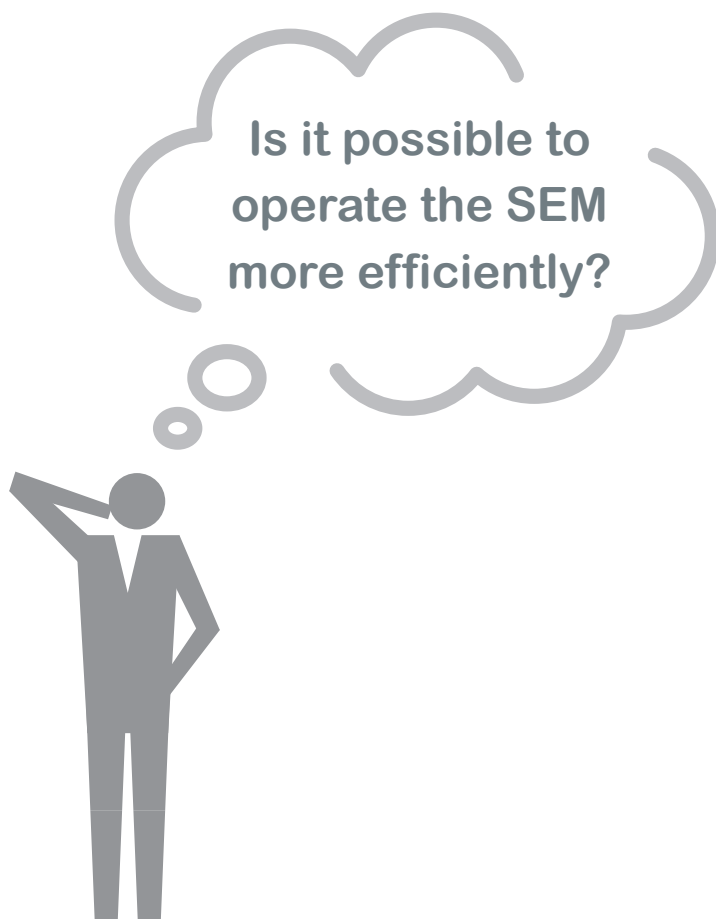
\*3 Chamber Scope (CS) is an option.



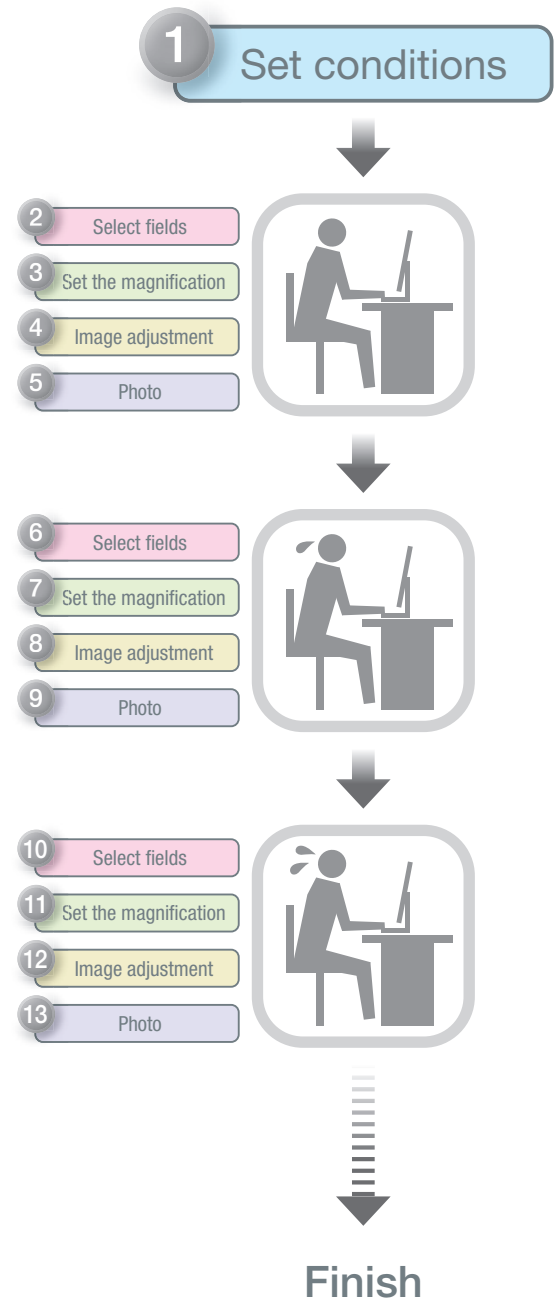
# Automate daily routine work

As an important characterization method in R&D, SEM observation depends on manual operation.

With advancements in SEM, it has become an important tool for quality assurance and manufacturing. As a part of inspection, the same observation is performed repeatedly. The observation speed is important for improving the efficiency of routine work.



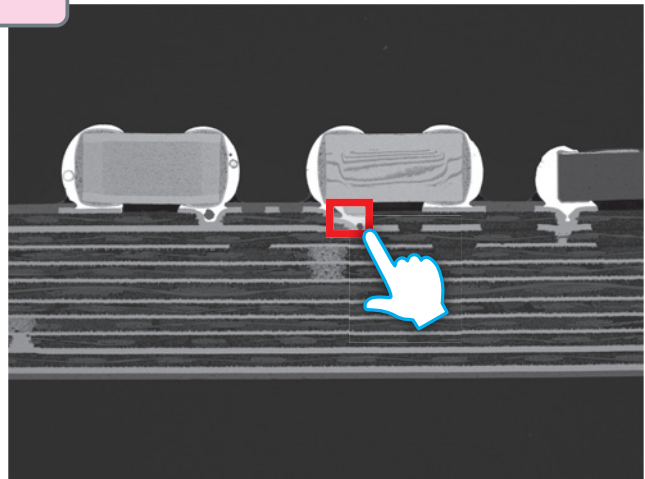
## Example





Select the observation field at low magnification

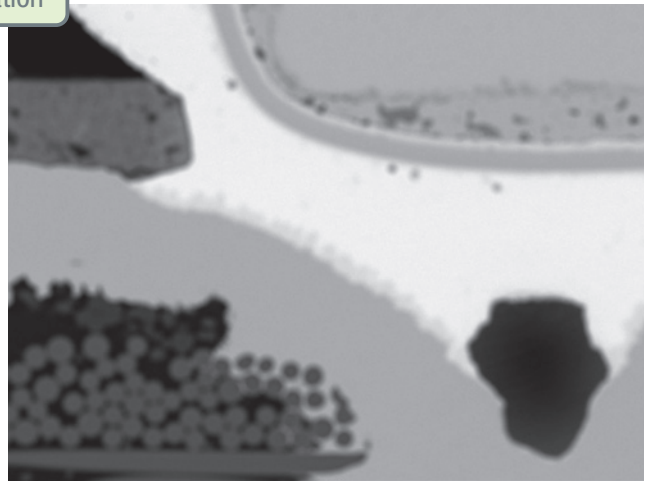
Select fields



Magnification: x50

500  $\mu\text{m}$

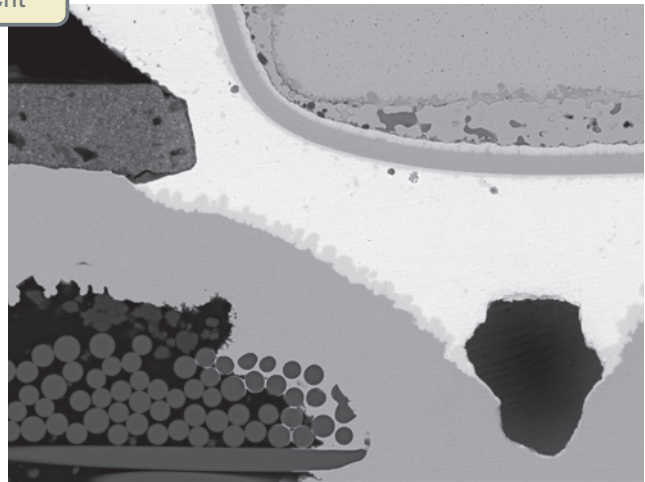
Set the magnification



Magnification: x1,000

10  $\mu\text{m}$

Image adjustment



Specimen: Electronic device Accelerating voltage: 15 kV  
Magnification: x1,000 Signal: Backscattered electron (BE)

10  $\mu\text{m}$

Photo

Routine work



NEW



# Just select the target field

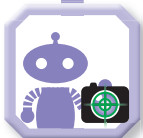
## Simple SEM

Simple SEM supports daily routine work.

Simple SEM

Simple SEM

- 1 Set conditions
- 2 Select fields
- 3 Simple SEM start



Finish



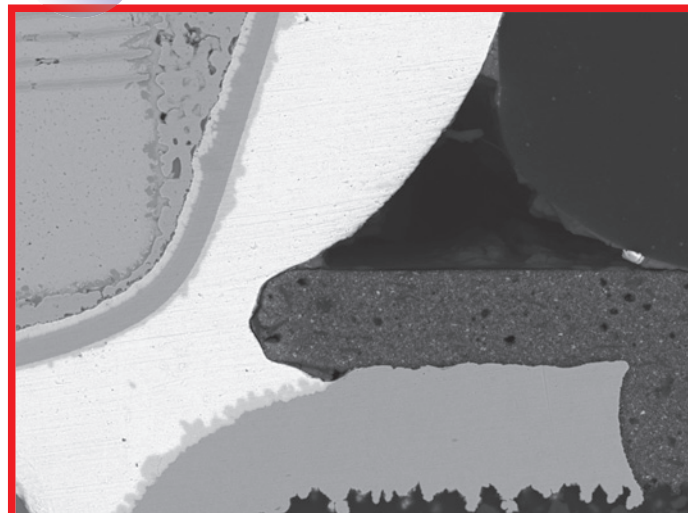
Simple SEM  
Efficient and  
reliable!

Automate image  
collection!

Automatic photo !



×1,000

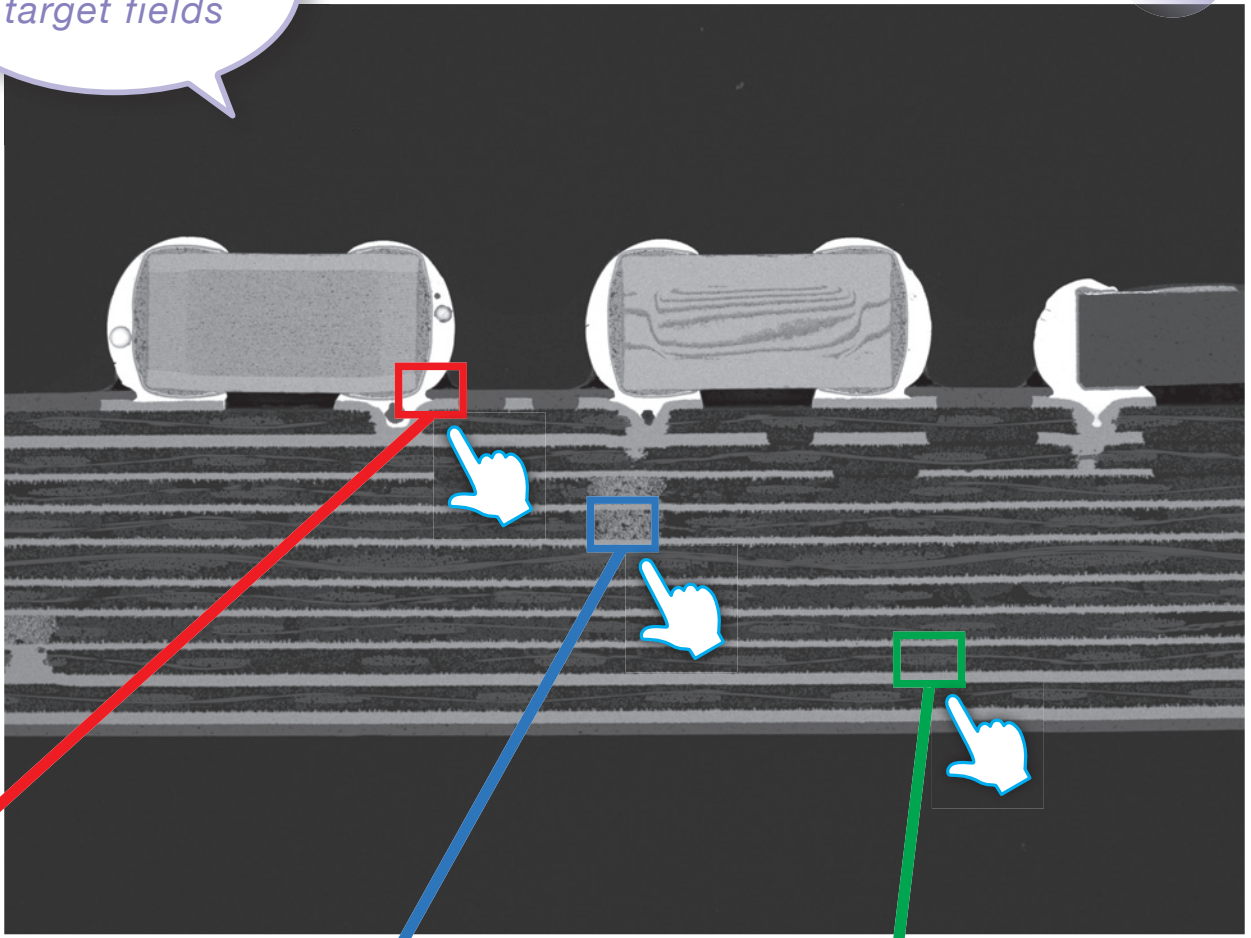


Magnification: ×1,000

10 μm

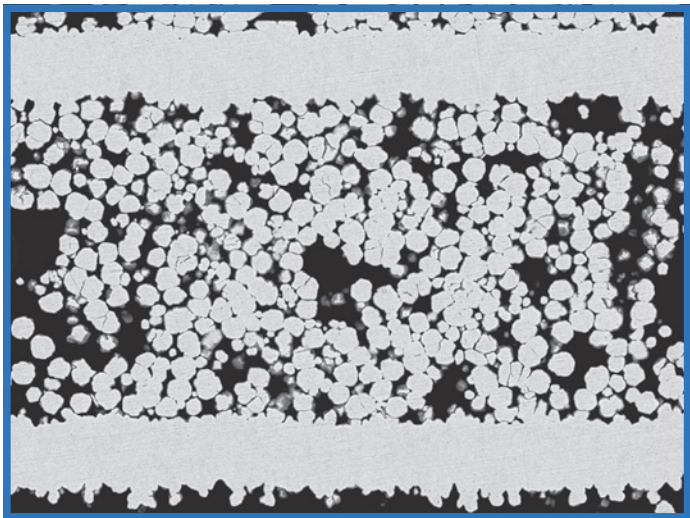
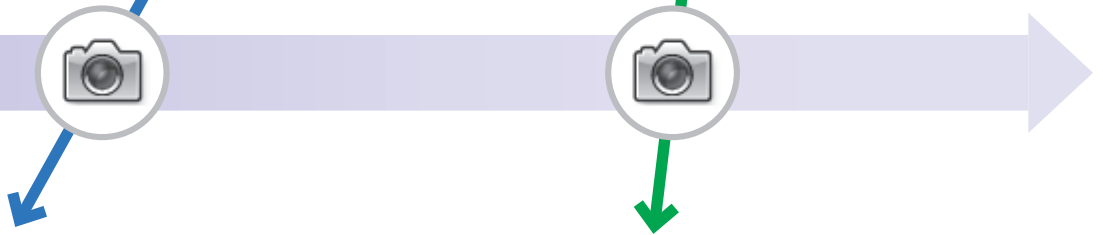
Select the target fields

x50



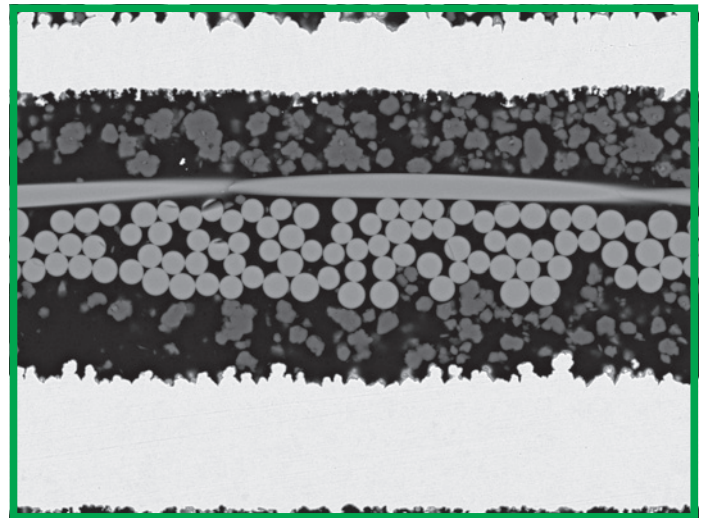
Specimen: Electronic device  
Accelerating voltage: 15 kV Magnification: x50  
Signal: BE

500 μm



Magnification: x1,000

10 μm



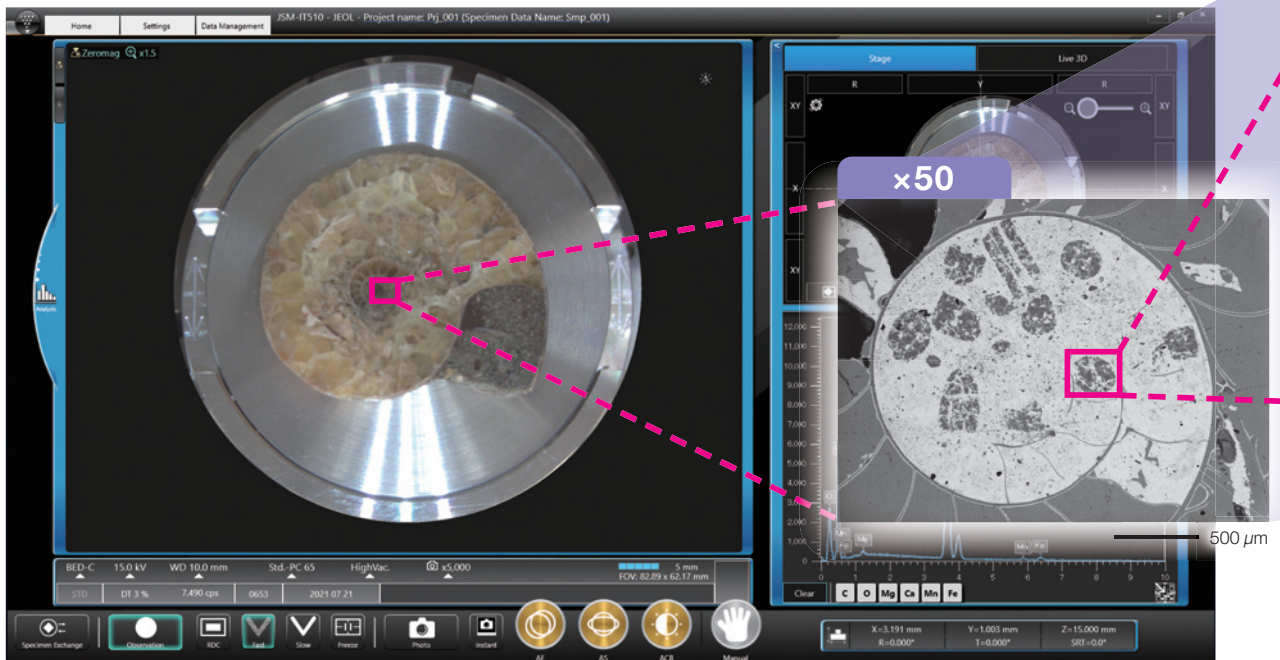
Magnification: x1,000

10 μm



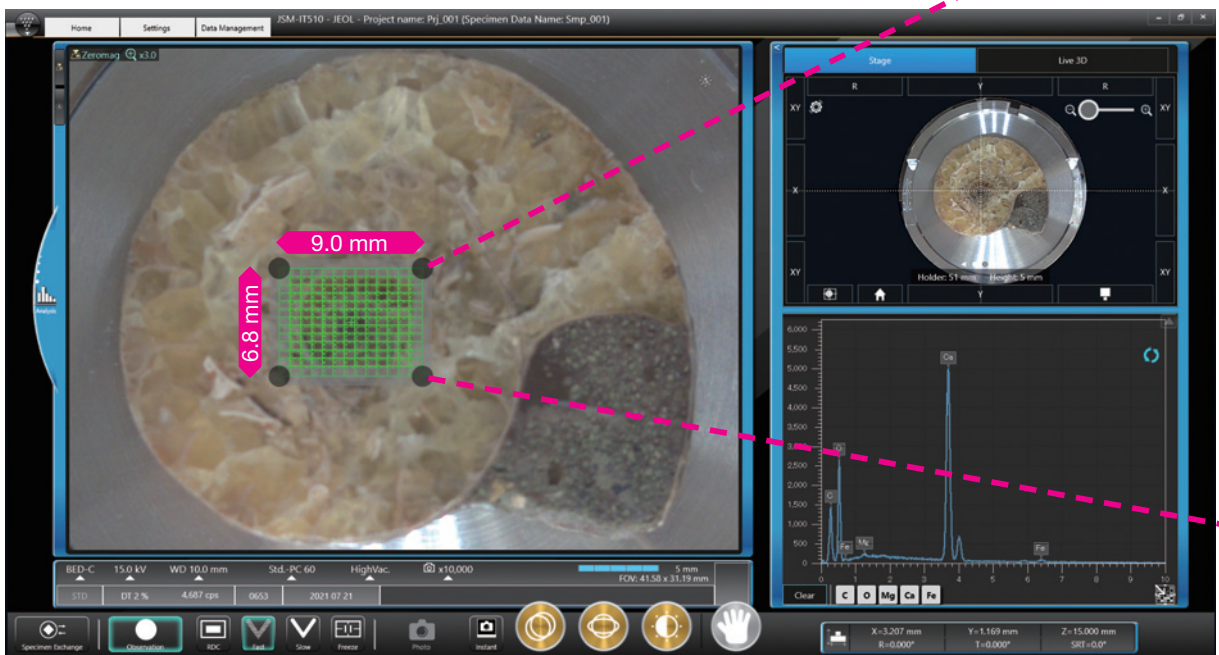
# Magnify the optical image, transition to Zeromag

The Zeromag function simplifies navigation providing a seamless transition from the optical to SEM image. The SEM, optical image and holder graphic are all linked for a global view of analysis locations.

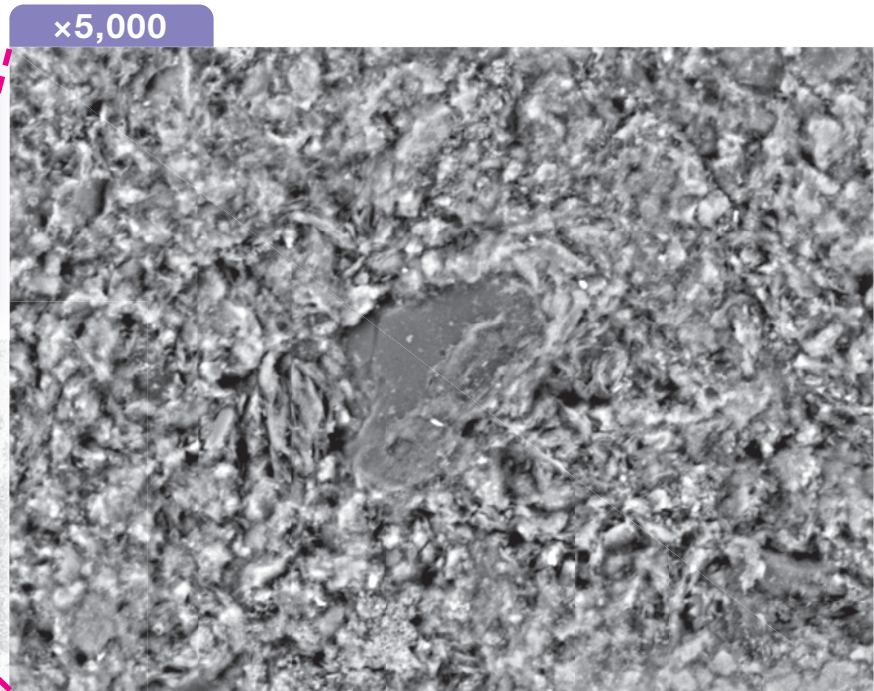
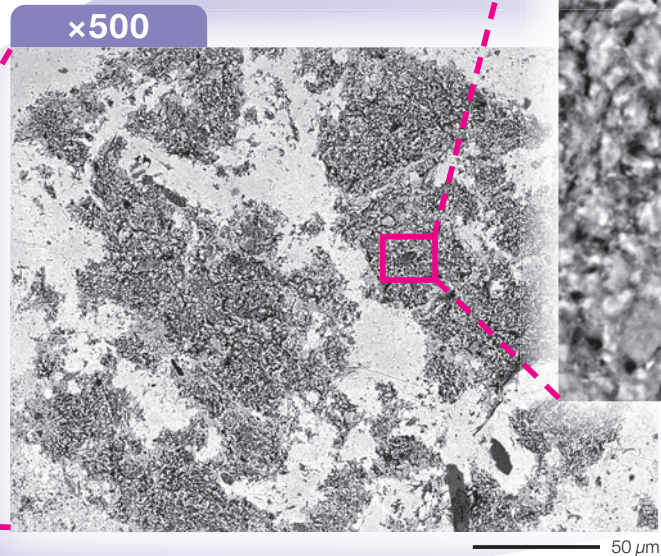


## Montage

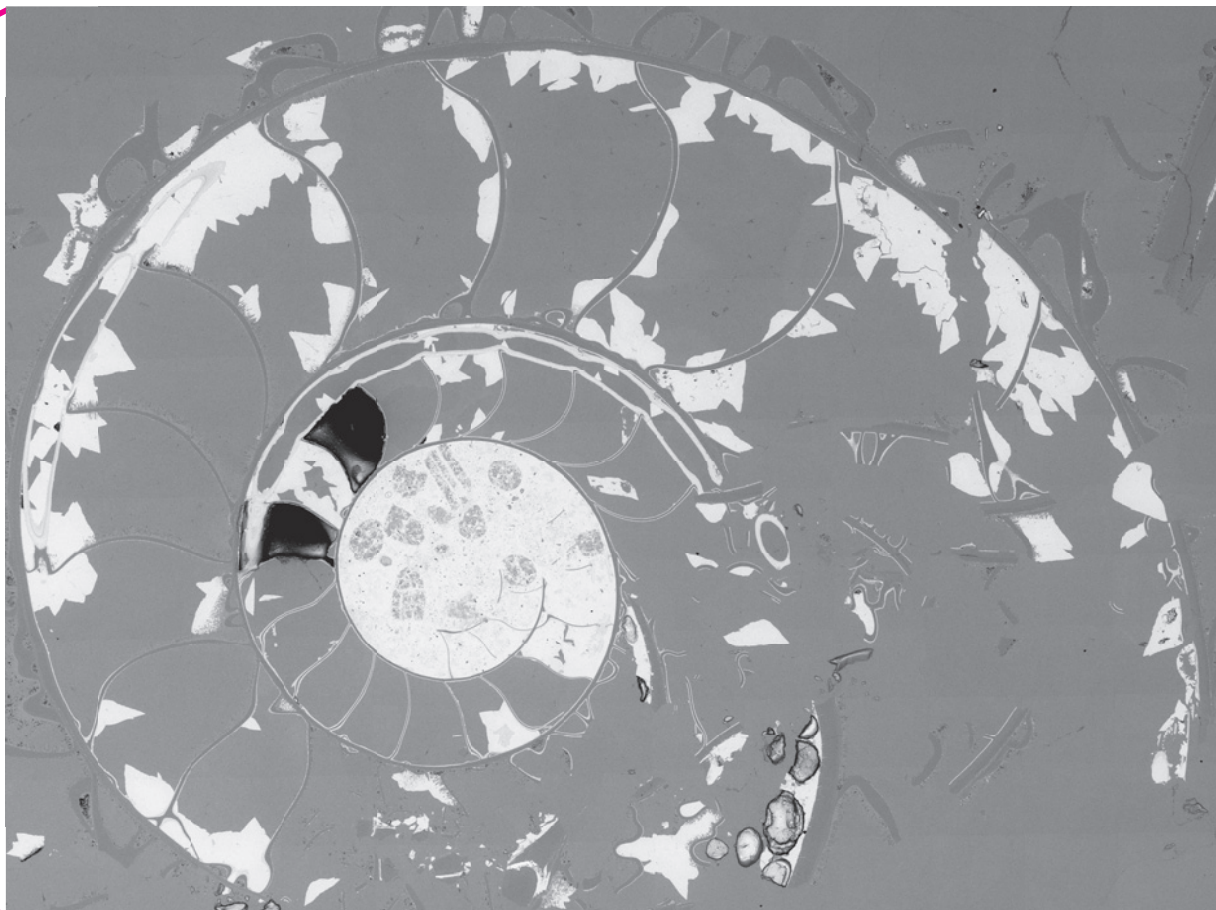
Montage function automates large area image collection and stitching of these images into a composite image.



# SEM image



Specimen: Fossil of ammonite  
Accelerating voltage: 7 kV Signal: BE



Specimen: Fossil of ammonite Accelerating voltage: 15 kV Signal: BE Number of field: 13 x13 Magnification: x150

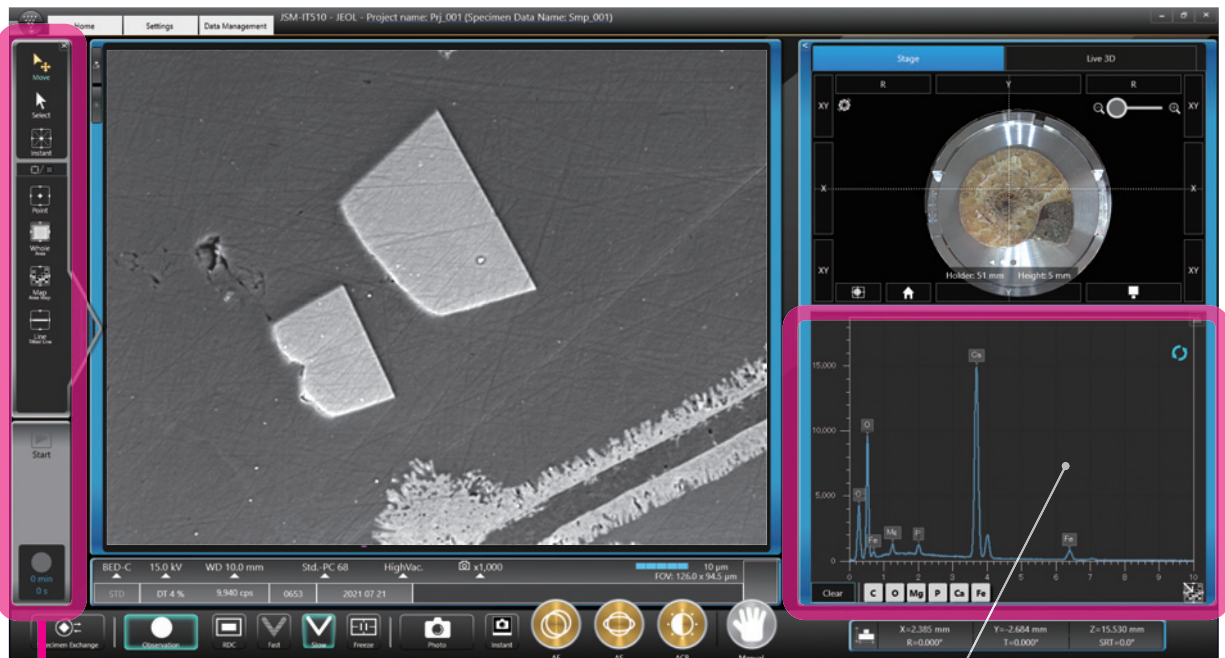
\* Stage Navigation System (SNS) is needed to display the optical image.



# Embedded EDS for Real-Time element Live Analysis\*

Live Analysis is a function which displays the EDS spectrum or element maps in Real-Time during image observation. This function can support searching and provide an alert for target elements.

Live Analysis

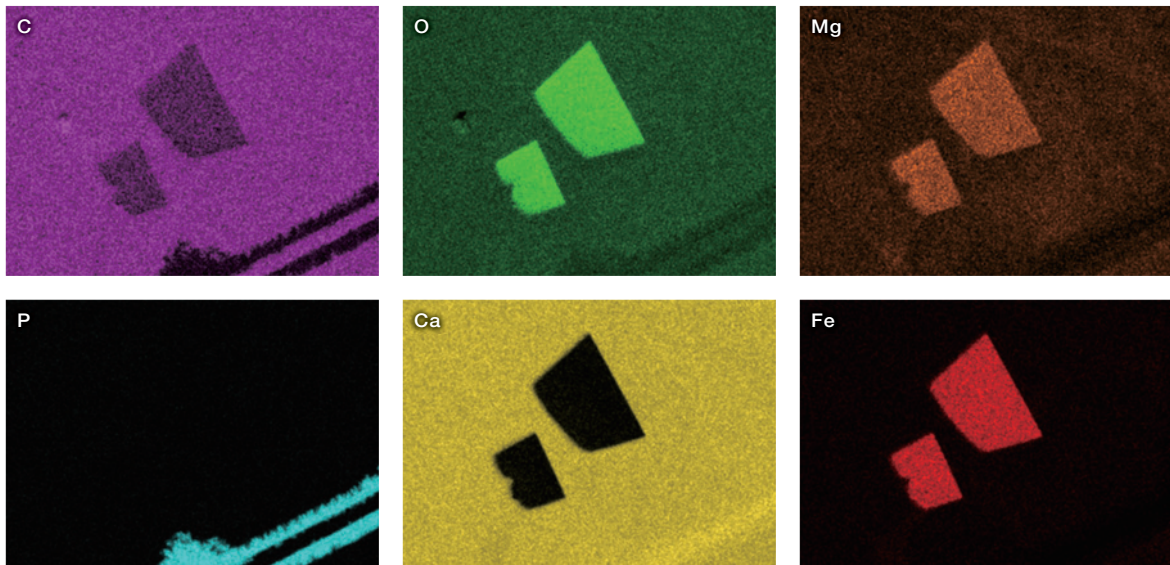


The spectra of elements detected from the observation screen and automatic qualitative results are displayed in Real-Time.



## Simple analysis

The EDS analysis can be started within 3 clicks.

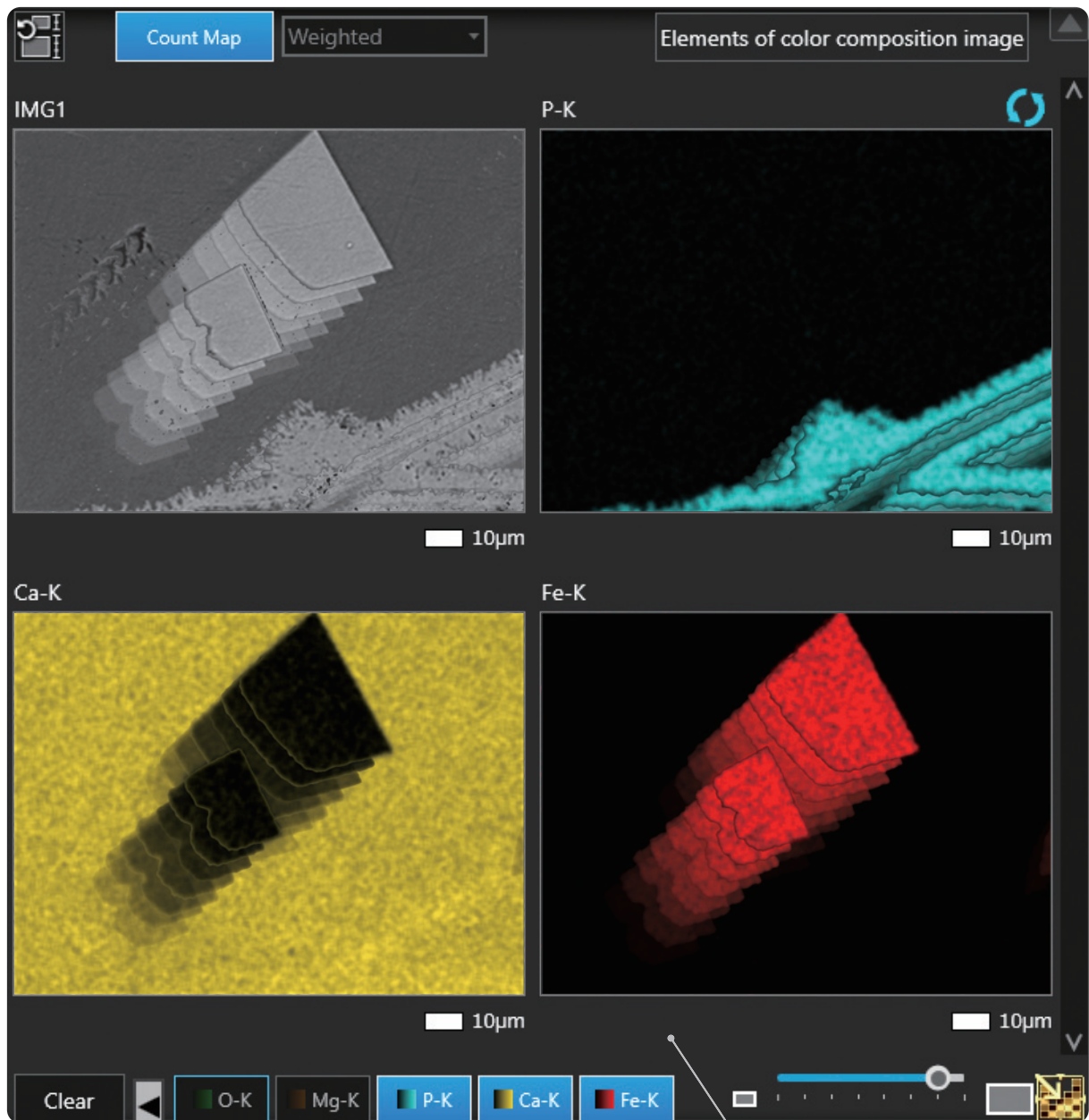
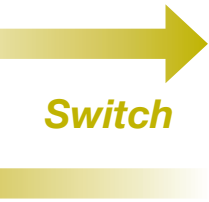


Specimen : Fossil of ammonite Accelerating voltage: 15 kV Magnification: x1,000

10  $\mu$ m

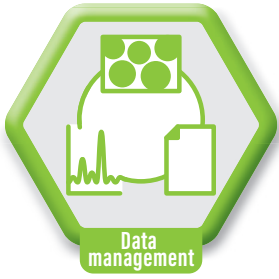
# Elemental composition during observation

## Live Map



The Live Map displayed.

\* Live Analysis is a standard for A (Analysis) / LA (Low Vacuum & Analysis).

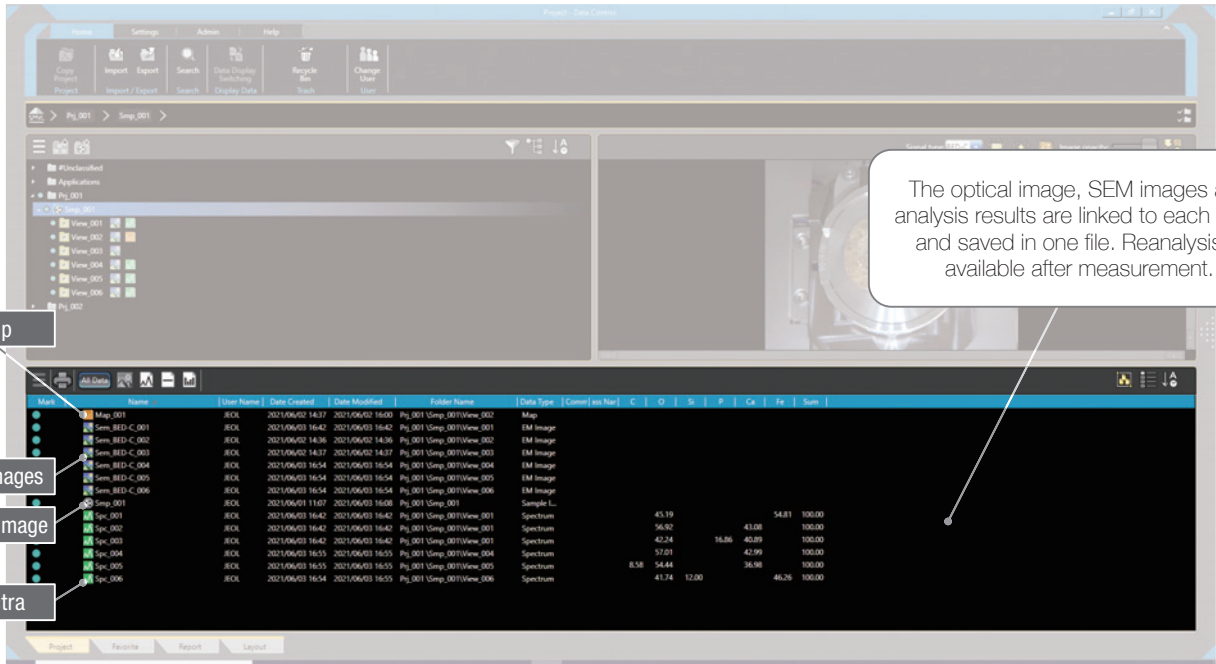


# Central data management

## SMILE VIEW™ Lab

SMILE VIEW™ Lab is JEOL software that links the optical image, SEM images and EDS analysis results. Install an off-line version\* to another computer to free the instrument for data collection and work with your data offline.

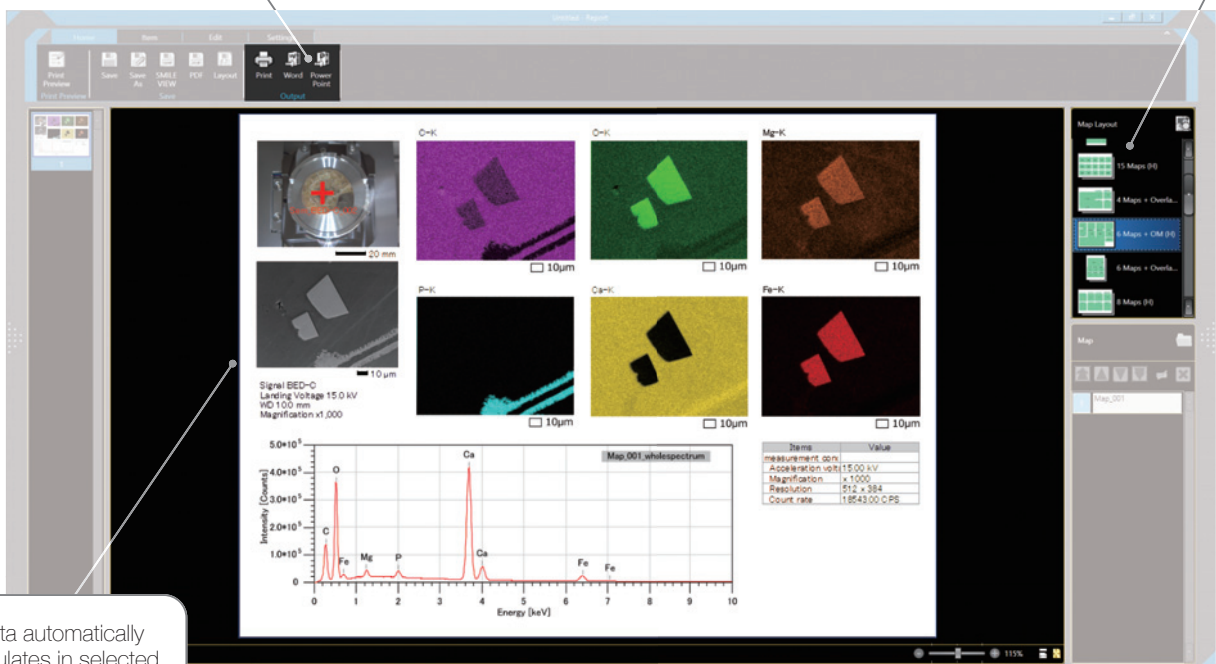
SVL



Make a report easily

3 Output as Word or PowerPoint file

1 Select layout



\* Off-line data analysis software (option) is required.

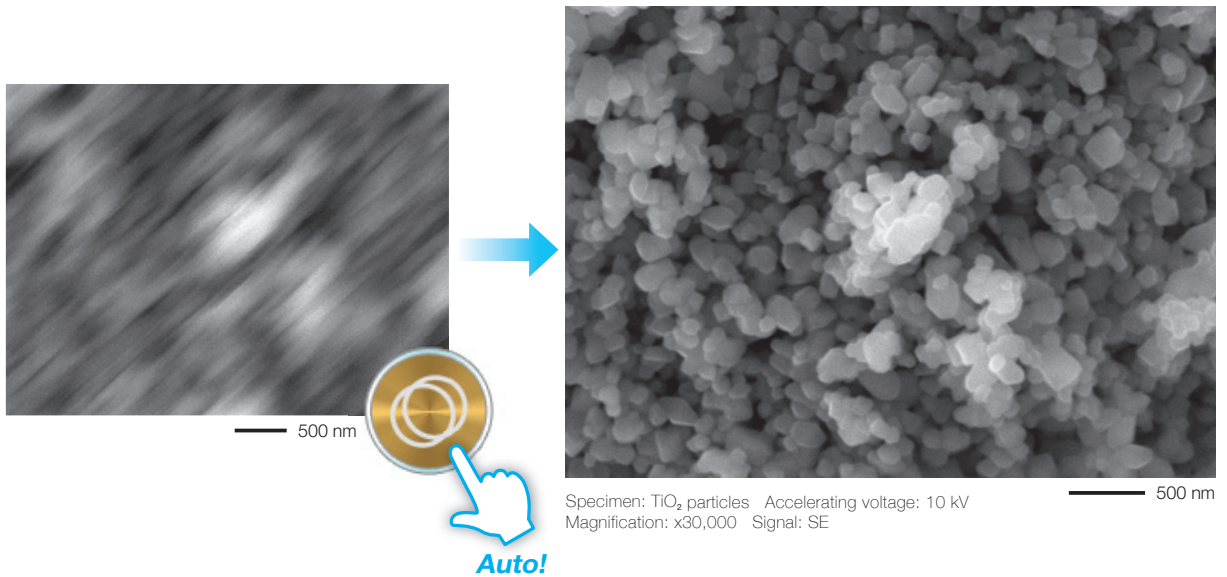




## Tools for speed

### Auto functions

In order to obtain a clear image, operators need to adjust stigma, beam alignment and focus carefully. Advanced auto functions complete all these adjustments.

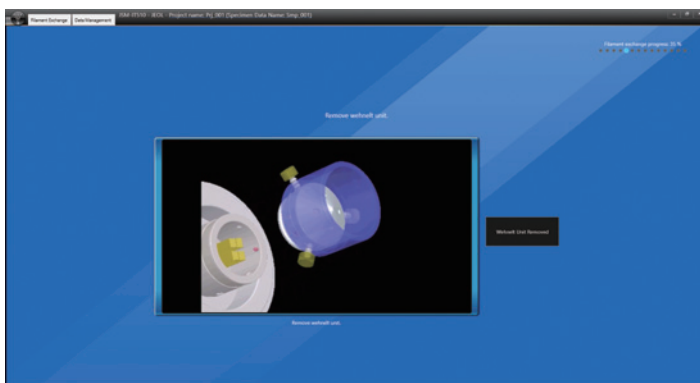


### Display the depth of signal

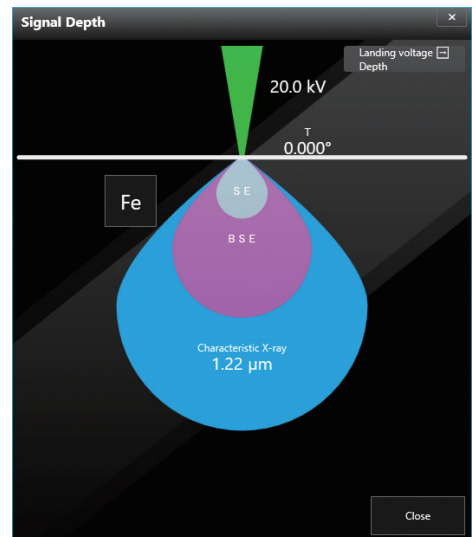
This function displays the analysis depth (approx.) in the specimen.  
For element analysis, it is very useful.

### Maintenance

Following the Help guide, anybody can exchange the filament.



Guide for exchanging filament





# Variety of advanced options

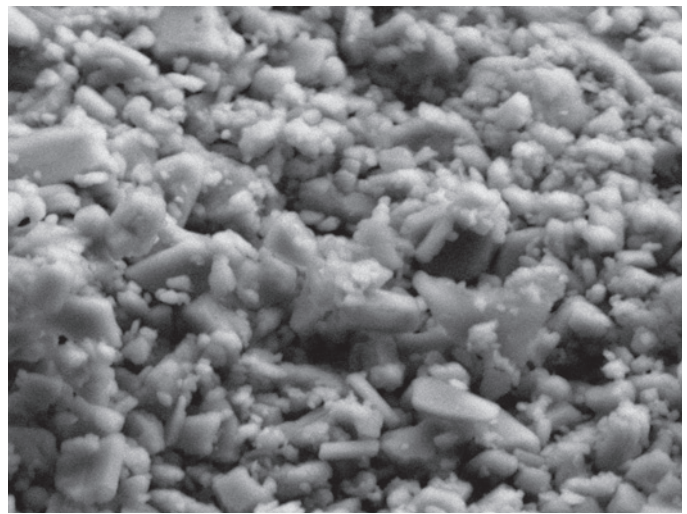
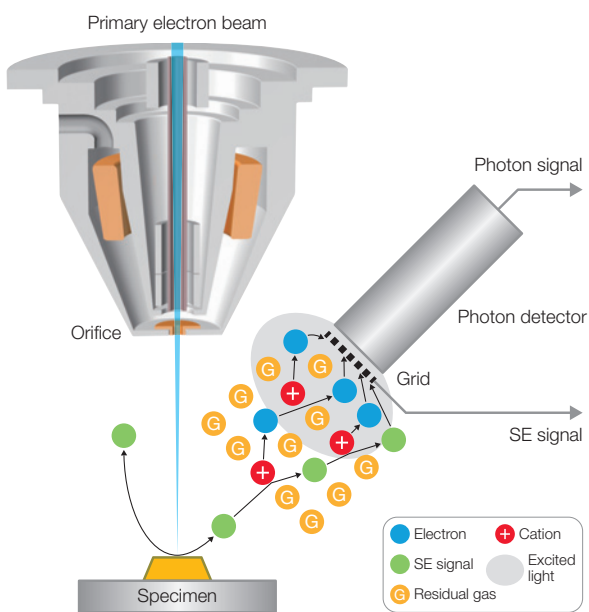
NEW

**LV**

## Low-vacuum Hybrid Secondary Electron Detector (LHSED)\*

This new detector collects both electron and photon signals providing an image with high S/N and enhanced topographic information.

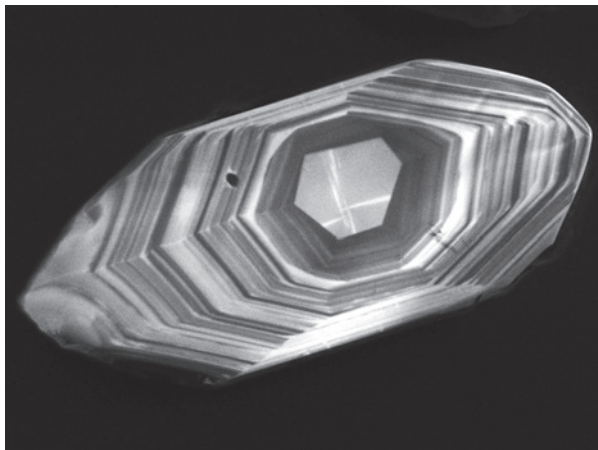
### The mechanism of LHSED



Specimen: Plaster Accelerating voltage: 7 kV Magnification: x10,000 Signal: LV SE

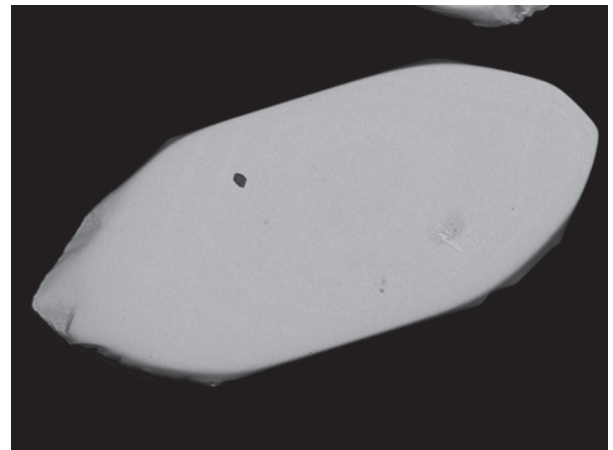
Some mineral and oxides will produce light when irradiated by an electron beam. LHSE PD (Photon Detector) can capture this light emission. LHSED in PD mode captures the signals originally from cathodoluminescence (CL).

LHSE PD image



Specimen: Zircon Accelerating voltage: 10 kV Magnification: x800

BE image



20 μm

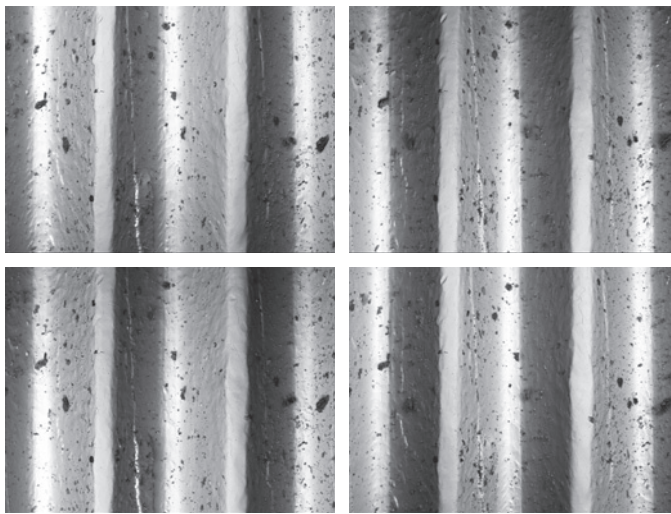
\* LHSED is an option. And LV (Low Vacuum) or LA (Low Vacuum & Analysis) is also required.

NEW

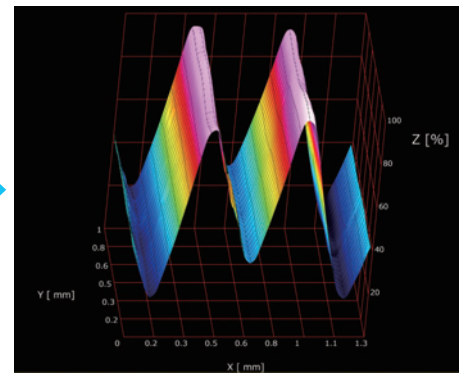
## 3D Live 3D\*<sup>1</sup>

The images obtained by a new quadrant BE detector\*<sup>1</sup> can be displayed as a live 3D image. 3D images can clearly represent the shape of a specimen, even for those with subtle topographic information.

The 4 images obtained by a quadrant BE detector



3D image



— 100 μm

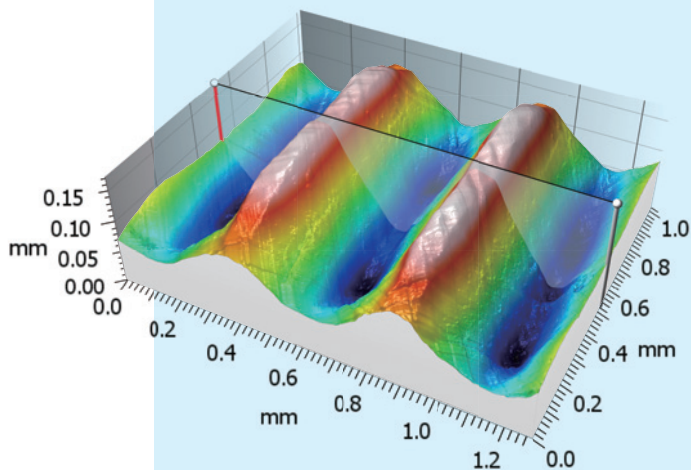
Specimen: Screw Accelerating voltage: 15 kV Magnification: x100 Signal: BE

More information  
about 3D

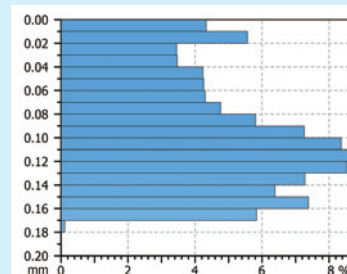
## SMILE VIEW™ Map\*<sup>2</sup>

SMILE VIEW™ Map is a multi-function software with tools for image enhancement, colorization, 3D reconstruction from stereo pair or 4 quadrant images\*<sup>1</sup>, and surface metrology calculations. After setting up the layout and workflow, the same analysis can be repeated. In addition, SMILE VIEW™ Map supports many surface analysis specifications like ISO4287.

3D reconstruction from 4 images



Distribution histogram of depth

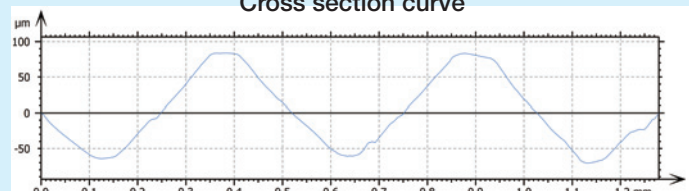


Surface roughness

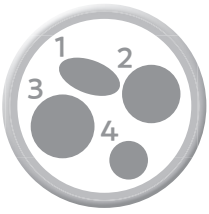
ISO 4287 - Primary profile	
F:	None
S-filter (λs):	Gaussian, 2.500 μm
Amplitude parameters	
Pp	83.89 μm
Pv	70.64 μm
Pz	154.5 μm
Pc	148.3 μm
Pa	42.58 μm

ISO4287

Cross section curve



\*1 Live 3D is a standard in LV (Low Vacuum), LA (Low Vacuum & Analysis). BE detector (option) can be equipped on BU (Base Unit), A (Analysis).  
\*2 SMILE VIEW™ Map is an option.



# Particle analysis

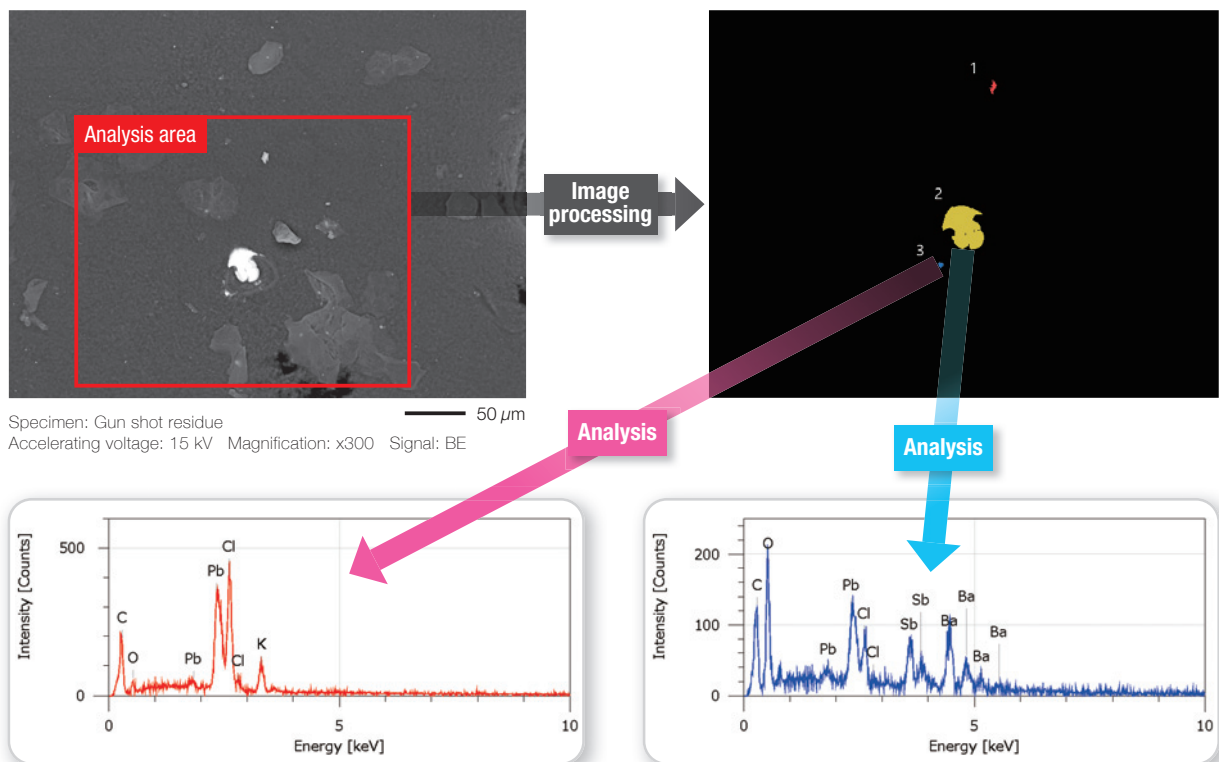
Target particles can be automatically detected and analyzed. Particle analysis software automates the detection, EDS analysis and classification of particles, grains, inclusions or other features in specimens.\* It is possible for statistical processing such as composition and shape that are detected particles based on information from particle analysis.

## Applications of particle analysis software

- Automobile parts cleanliness analysis library
- Gun shot residue (GSR) library
- Metal feature analysis library
- Asbestos investigation etc.

## Application of GSR

The particles are detected based on their brightness in an SEM image. Then the elemental composition of particles are obtained through EDS analysis.

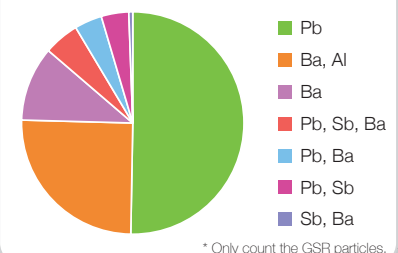


Specimen: Gun shot residue  
Accelerating voltage: 15 kV Magnification: x300 Signal: BE

## Example of measurement results

No.	Label No.	Particle image	Class name	SI							
				Area [ $\mu\text{m}^2$ ]	Perimeter [ $\mu\text{m}$ ]	Roundness	Heywood diameter [ $\mu\text{m}$ ]	Maximum length [ $\mu\text{m}$ ]	Breadth [ $\mu\text{m}$ ]	Aspect ratio	
1	Stub1-396-1		Sb,Ba	7.639	11.667	0.705	3.119	4.125	3.363	1.227	
2	Stub1-64-4		Pb,Sb,Ba	85.590	58.333	0.316				1.425	
3	Stub1-74-1		Pb,Sb,Ba	7.465	12.500	0.600				1.124	
4	Stub1-162-2		Pb,Sb,Ba	15.278	20.833	0.442				1.254	

### The ratio of number



\* Only count the GSR particles.

\* EDS is an option. A (Analysis) / LA (Low Vacuum & Analysis) is required for this analysis.



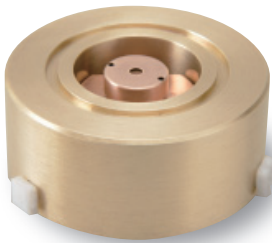
## Low temperature observation

Cryo-holder\* and cool stage\* are available for low temperature observation. JSM-IT510 is suitable for observing hydrated specimens like food and others.

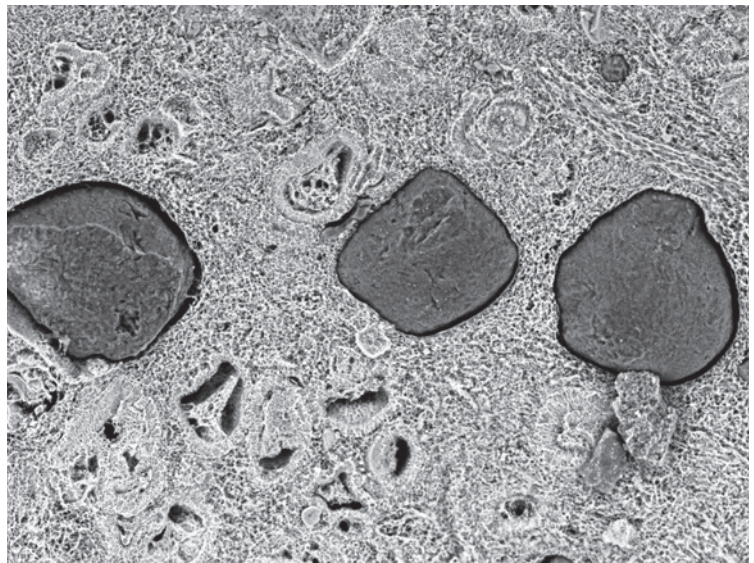


## Cryo-observation

The surface of a hydrated specimen like this example of a food product can be observed using the LV cryo-holder\* by keeping the specimen frozen.



Large LV cryo-holder



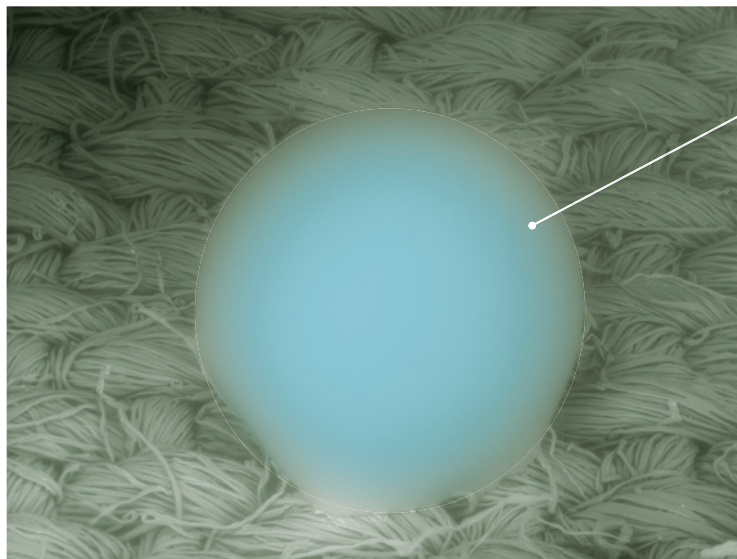
Specimen: Cross section of sausage Accelerating voltage: 10 kV  
Magnification: x500 Signal: LV BE

50 μm



## Aqua observation

The direct observation of water droplet is possible using Aqua Cover method.



Water droplet

Image of water droplet on a water repellent cloth.

The image is colored by image processing software.

Specimen: Water droplet on the water repellent cloth  
Accelerating voltage: 25 kV Magnification: x70 Signal: LV BE

200 μm

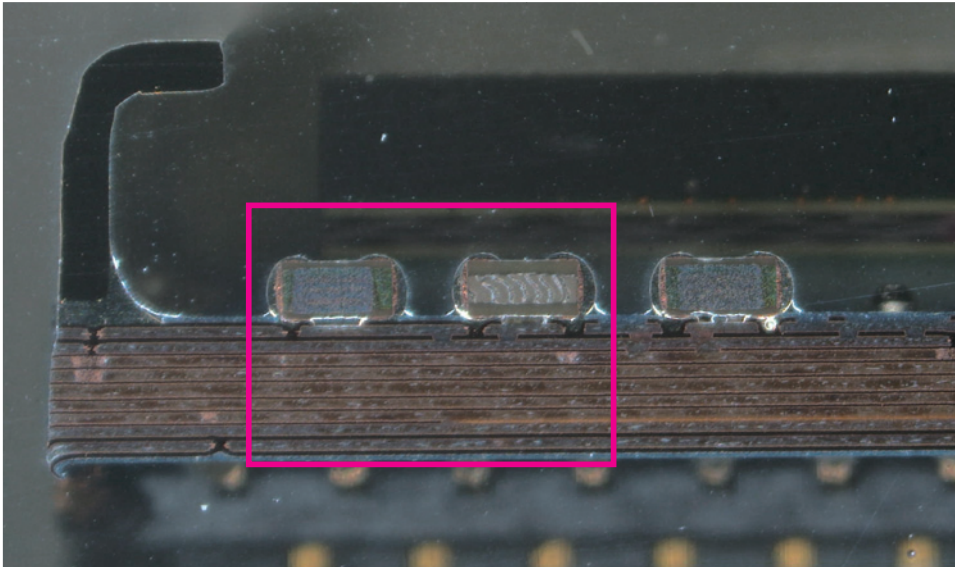
\* Option.



# Optical to electron ~the wo

## Optical microscope

- Color image



Automatic photo at different magnifications using SEM

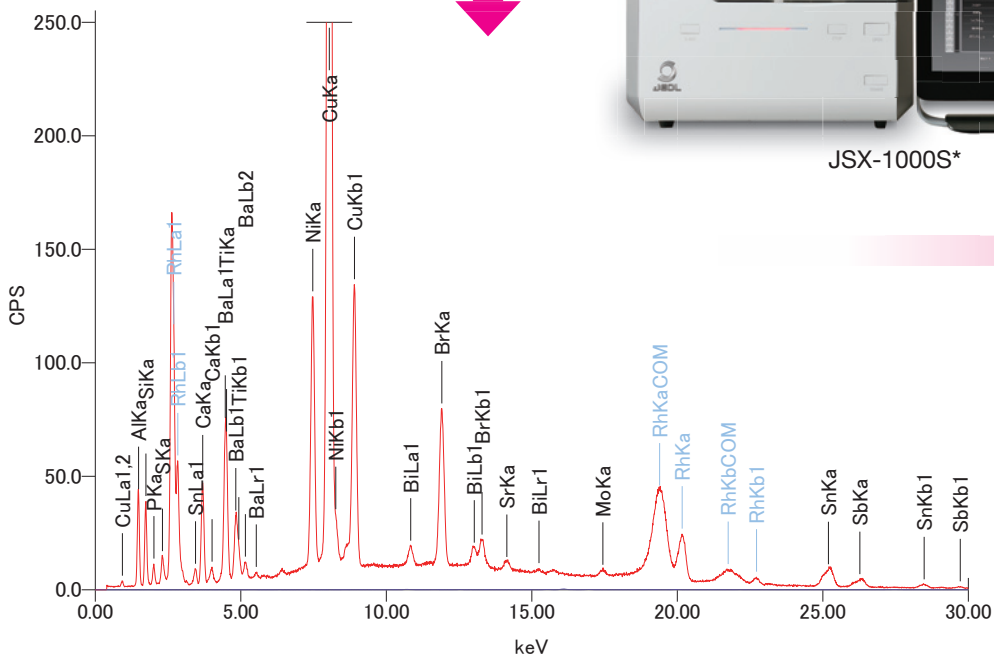
Specimen: Electronic device

1000 μm

## X-ray fluorescence spectroscopy (XRF)

- Elemental information of bulk

Composition analysis



JSX-1000S\*

EDS elemental map

\* Sold separately.

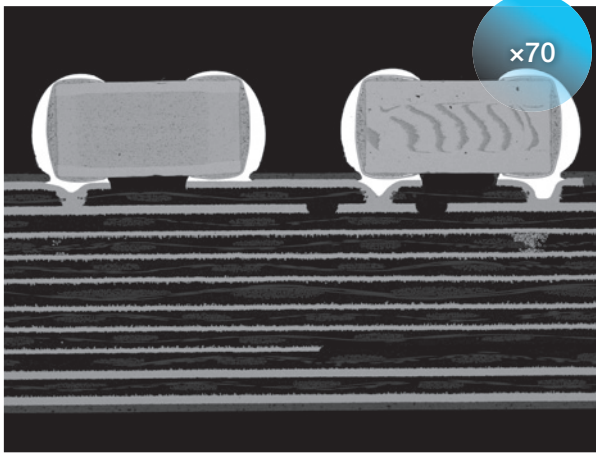
# World appears through SEM~



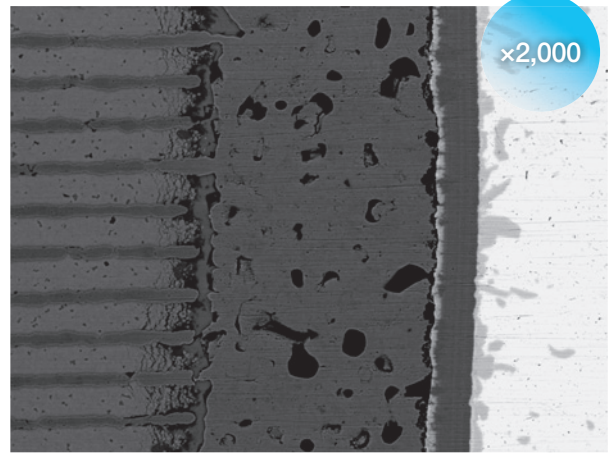
Simple SEM supports imaging specimens from low magnification to high magnification

After setting several specified magnifications, the JSM-IT510 will capture images automatically.

Simple SEM



Accelerating voltage: 10 kV Magnification: x70 Signal: BE



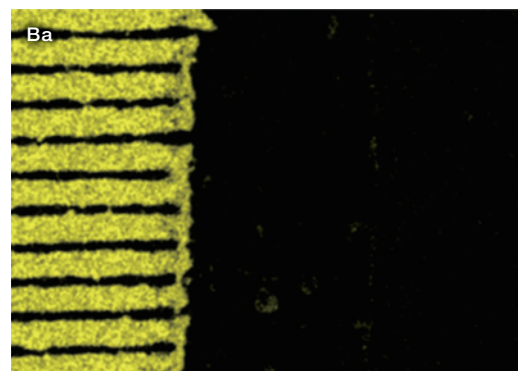
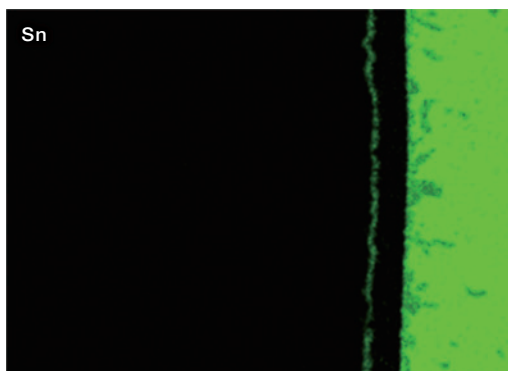
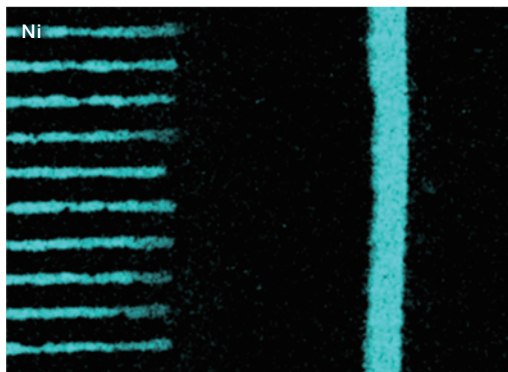
Accelerating voltage: 10 kV Magnification: x2,000 Signal: BE

Perform elemental analysis  
in the interested area



Investigate the elemental distribution in detail

EDS elemental map displays distribution of elements in the specimen.



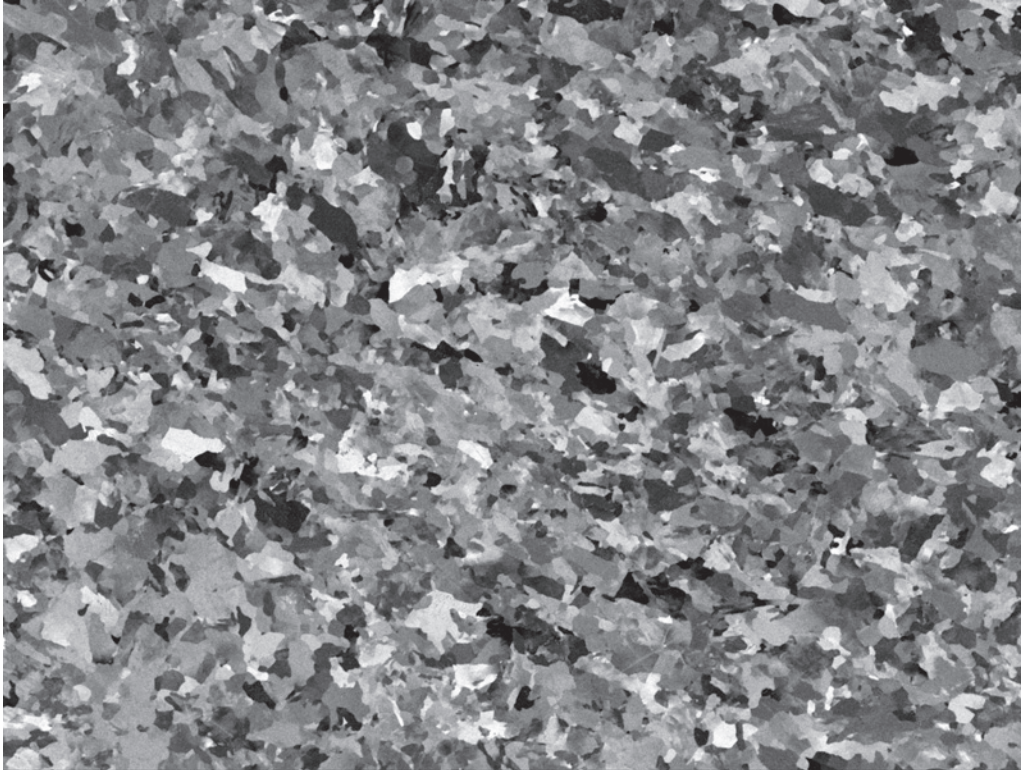
Accelerating voltage: 10 kV Magnification: x2,000

10 μm



# Metal

## Crystalline observation of steel



Specimen: Cross section of high-tension steel Accelerating voltage: 5 kV  
Magnification: x500 Signal: BE

50 μm

For crystalline materials, such as metals, the contrast (channeling contrast) caused by the difference in crystal orientation can be imaged.



### IB-19530CP\*1

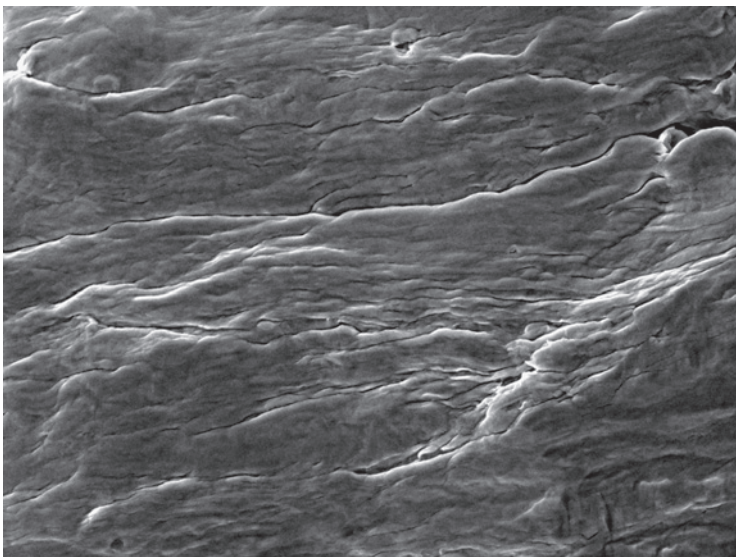
CROSS SECTION POLISHER™ (CP) is designed for producing cross section or surface milling by using a broad Ar ion beam to irradiate the specimen. Compared with mechanical milling, CP can easily produce a fine cross section without distortion.

\*1 Sold separately.

## Fracture surface observation

Fracture surface observation by SEM is widely used to study the causes of failure and crack growth.

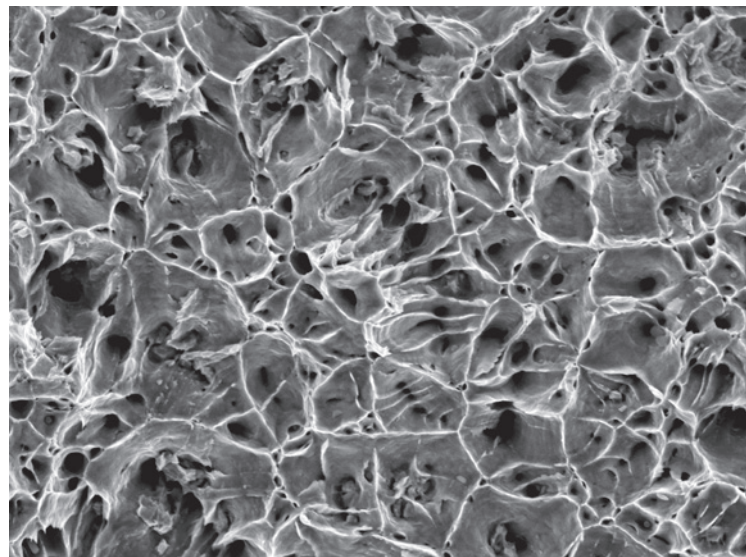
### Striations produced by fatigue fracture



Specimen: Austenitic stainless steel Accelerating voltage: 10 kV  
Magnification: x5,000 Signal: SE

5 μm

### Dimples produced by ductile fracture

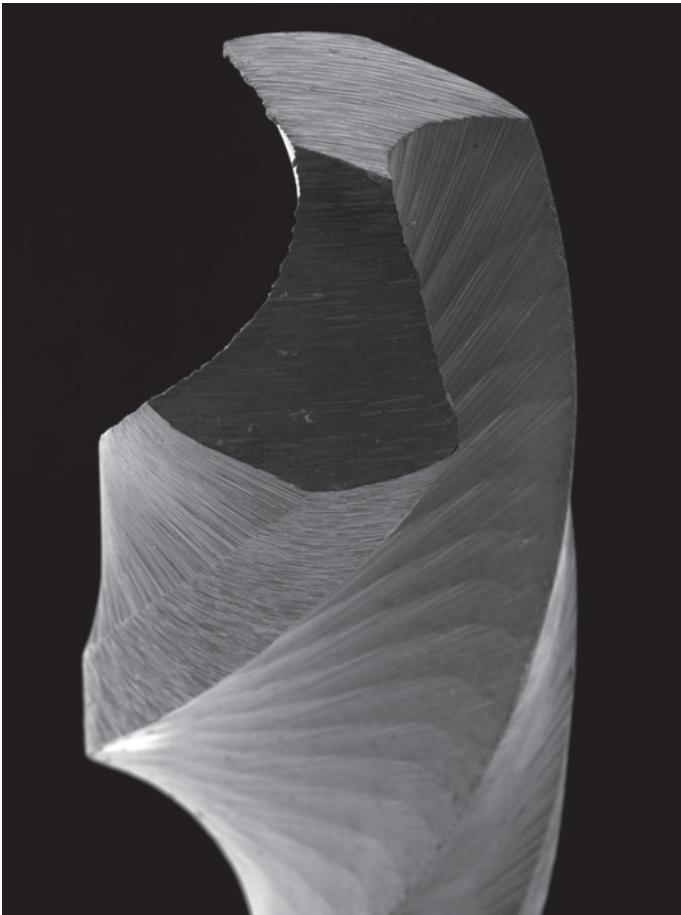


Specimen: Austenitic stainless steel Accelerating voltage: 10 kV  
Magnification: x5,000 Signal: SE

5 μm



## ◆ Drill bit observation

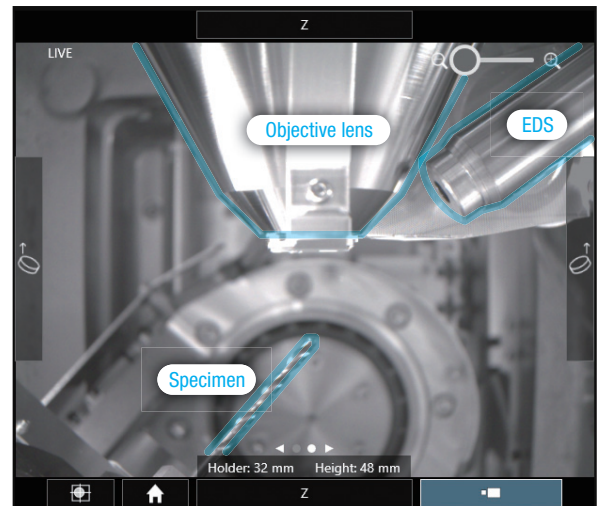


Accelerating voltage: 15 kV Magnification: x30  
Specimen tilting: 40° Signal: SE

500 μm

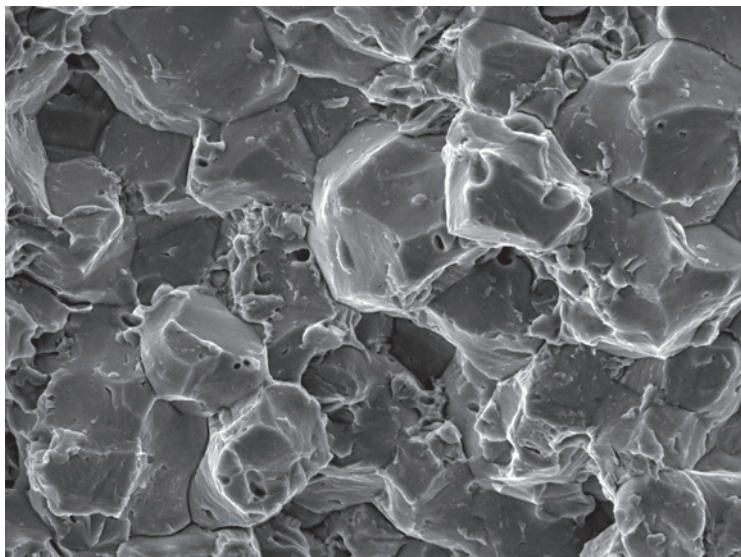
Tall specimens like this drill bit can be observed directly. Observation from different perspectives can be achieved by rotating and tilting the stage.

The rotation and tilt of stage is visible through the chamber scope.



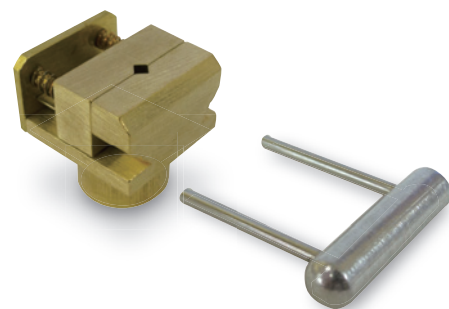
There is no color in real chamber scope.

## Rock candy pattern produced by intergranular fracture



Specimen: Austenitic stainless steel Accelerating voltage: 10 kV  
Magnification: x5,000 Signal: SE

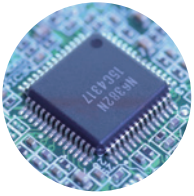
5 μm



### Small one-touch vise holder (90°)\*2

Spring type vise holder is ideal for observing cross sections.

\*2 Option.

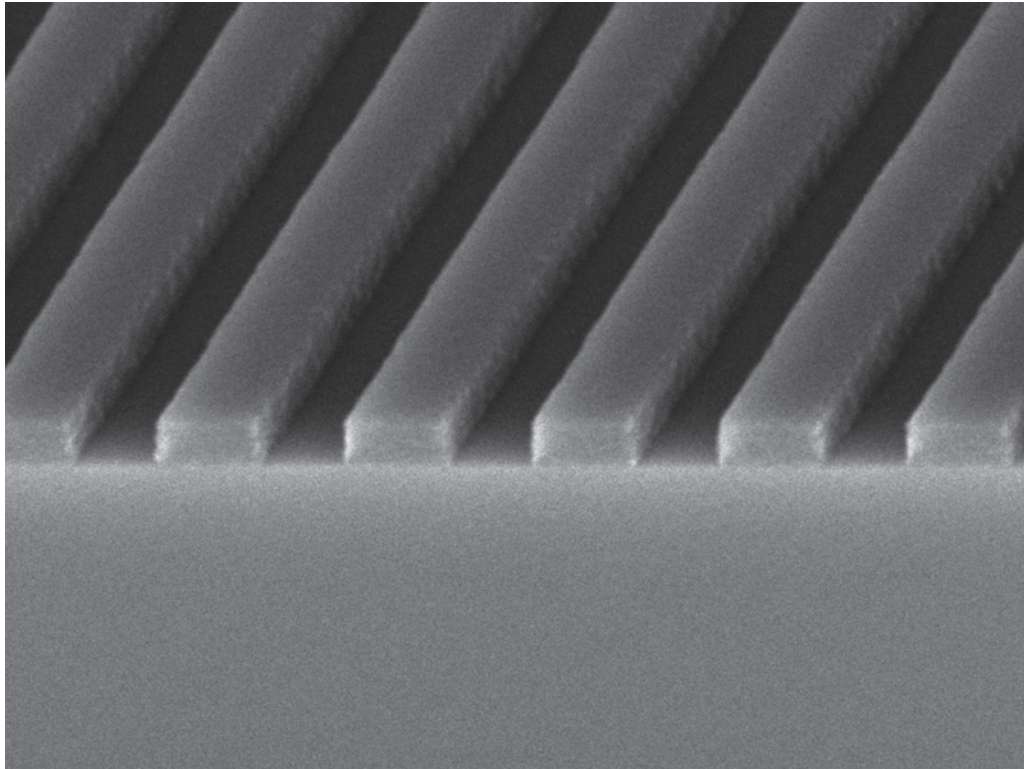


# Semiconductor

## Resist pattern observation

In semiconductor fabrication, quality management of resist by SEM is very important. The process can be confirmed by imaging the cross section of the resist pattern. Measuring line width is also possible.

Cross section of resist pattern (tilt to 35°)

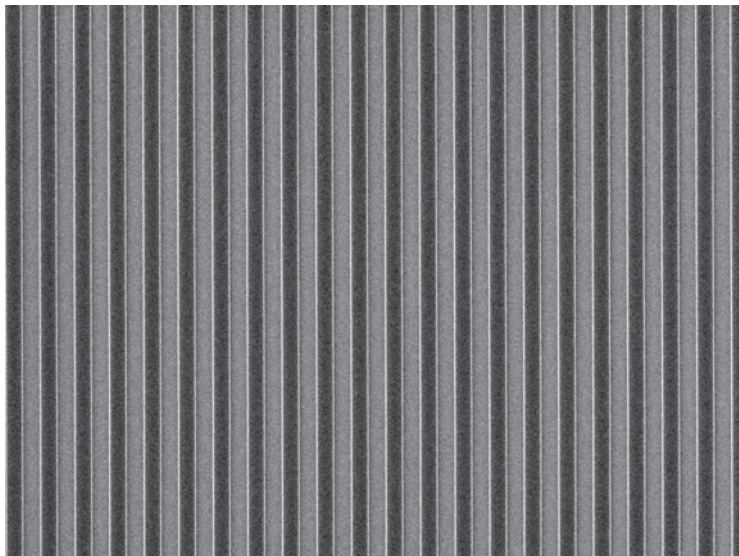


Accelerating voltage: 8 kV Magnification: x30,000 Signal: SE

500 nm

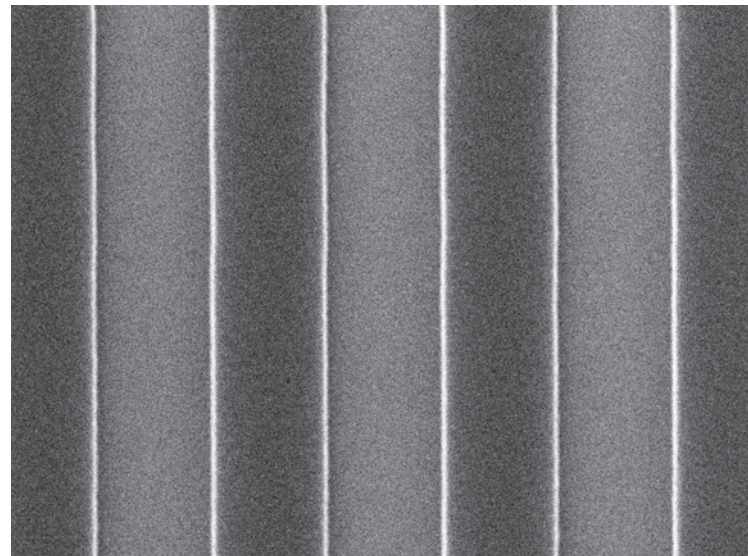


Resist pattern written on a Si wafer



Accelerating voltage: 10 kV Magnification: x3,000 Signal: SE

5  $\mu$ m



Accelerating voltage: 10 kV Magnification: x20,000 Signal: SE

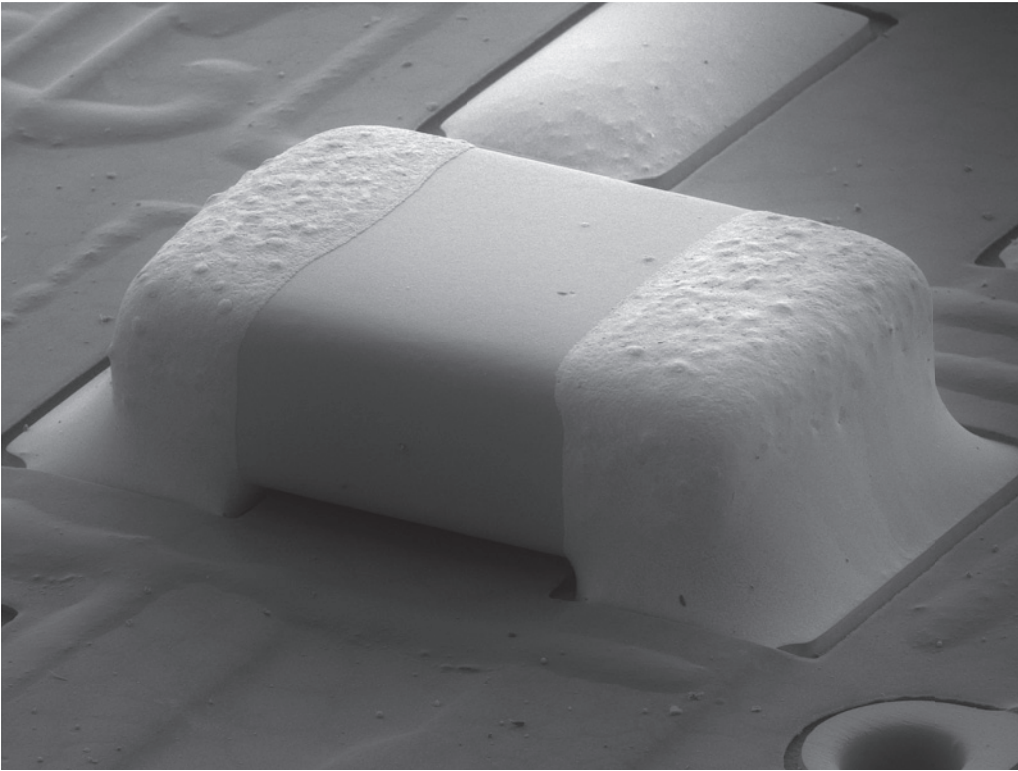
1  $\mu$ m

## Printed circuit board (PCB) inspection **LV**

SEM is an effective instrument in quality management of PCB.

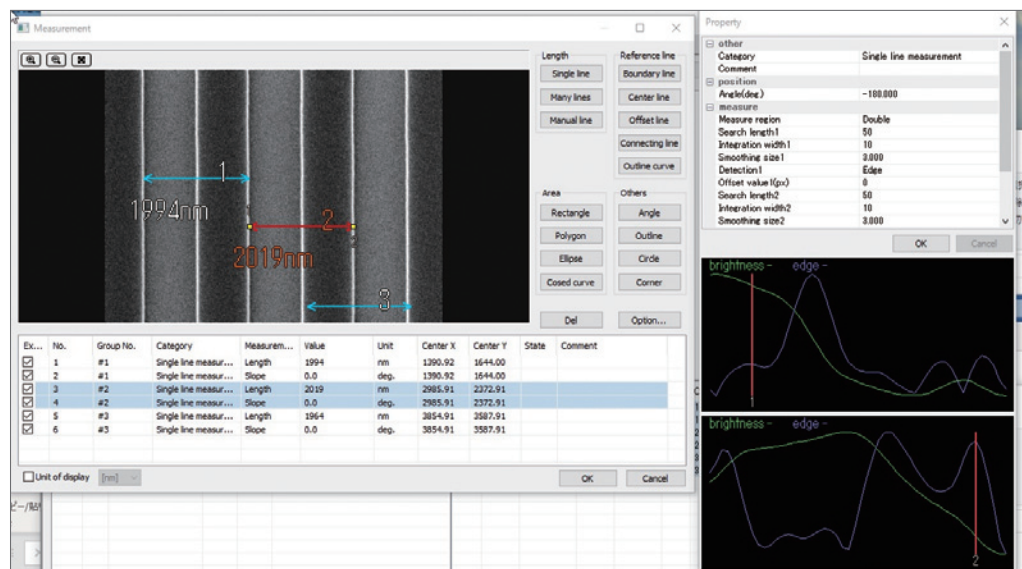
The low vacuum condition enables direct observation of the PCB without pre-treatment.

### Chip condenser on the PCB



Accelerating voltage: 15 kV Magnification: x45  
Signal: Mixed signal (LV backscattered electron: LV secondary electron = 3: 7)

Image analysis software\* allows measuring line width automatically.



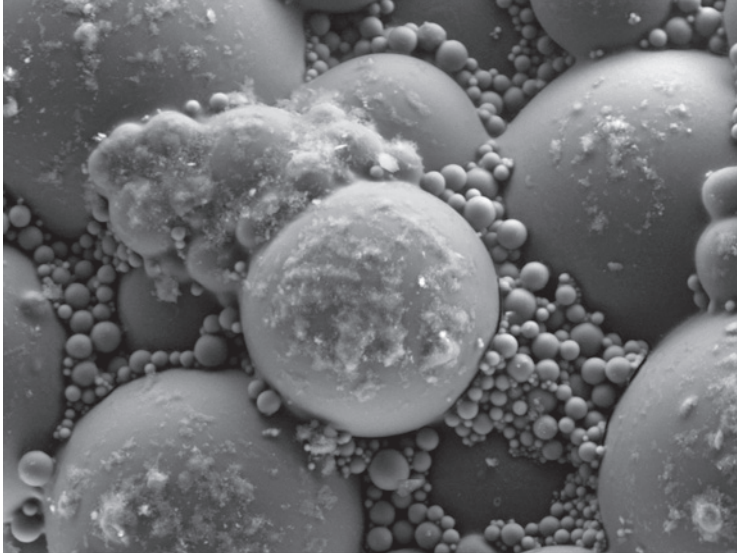
\* Option. MultiImageTool (produced by SYSTEM IN FRONTIER INC.)




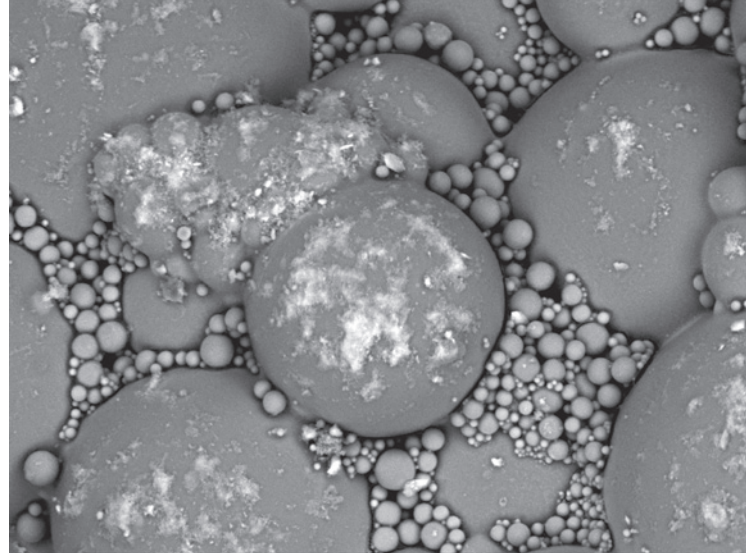
# Soft material / Polymer


JSM-IT510 under low vacuum condition is suitable for direct observation of non-conductive specimens,

## Superabsorbent polymer

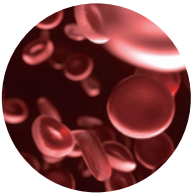


Accelerating voltage: 10 kV Magnification: x1,000 Signal: LV SE 



Accelerating voltage: 10 kV Magnification: x1,000 Signal: LV BE 

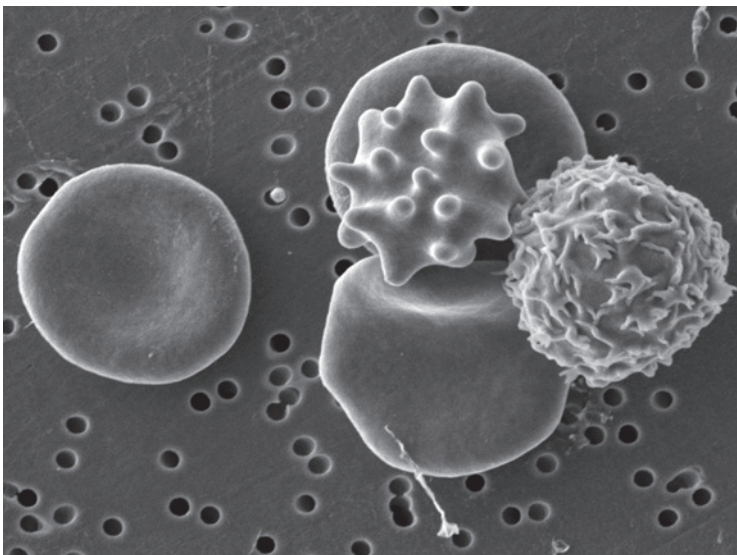
It is possible to obtain SE image and BE image simultaneously.  
The SE image provides shape information.  
The BE image shows bright areas indicating higher atomic number composition for this area.



# Biology

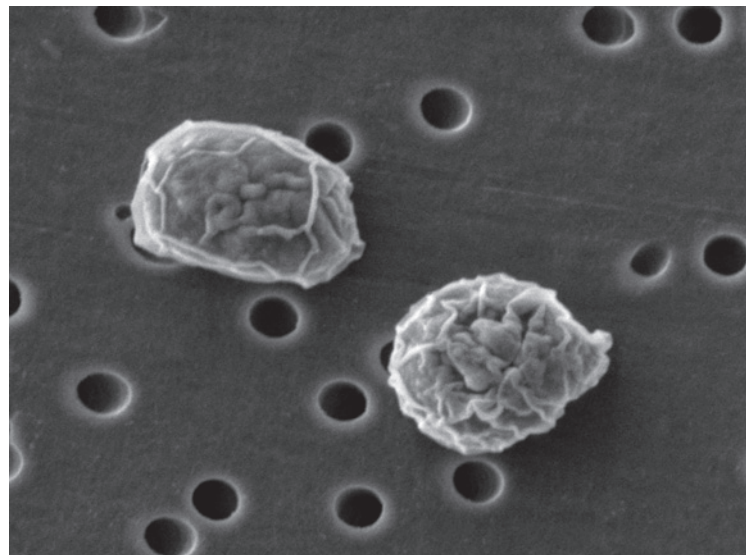
The normal shape of biological specimen, such as cells or microorganisms, can be confirmed after pre-

## Erythrocyte and leukocyte



Accelerating voltage: 3 kV Magnification: x7,000 Signal: SE 

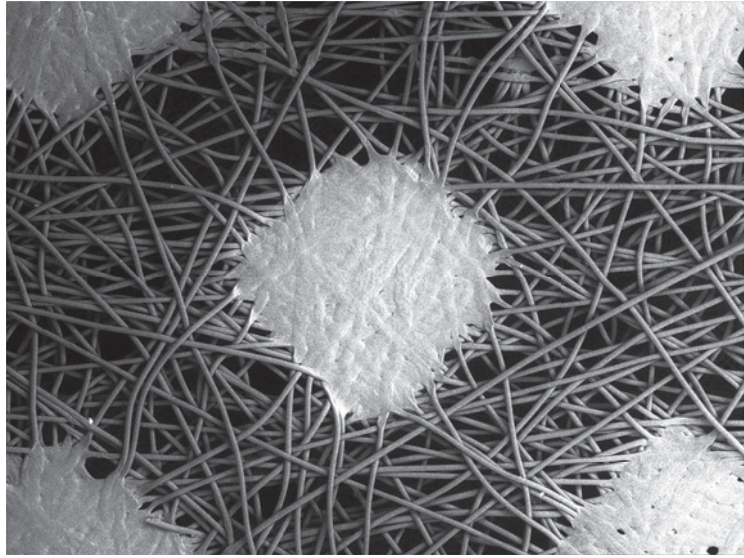
## Chlorella



Accelerating voltage: 3 kV Magnification: x15,000 Signal: SE 

such as superabsorbent polymer and mask.

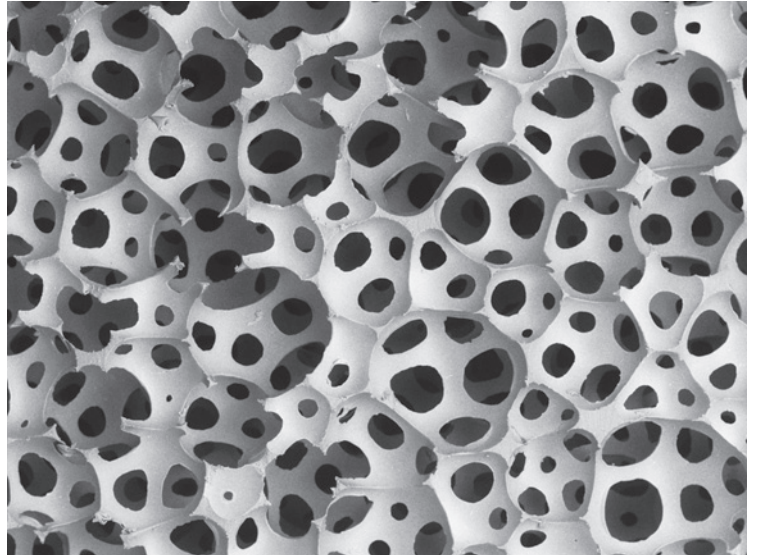
**Non-woven mask**



Accelerating voltage: 10 kV Magnification: x50 Signal: LV BE

500  $\mu$ m

**Urethane mask**

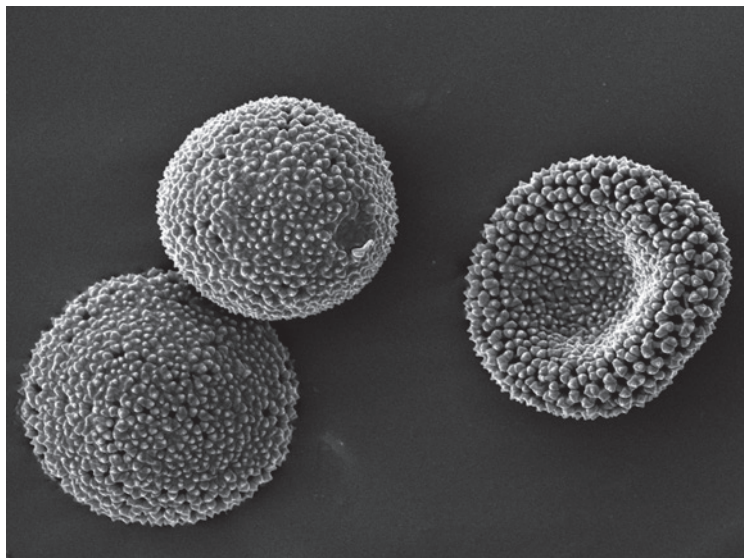


Accelerating voltage: 10 kV Magnification: x50 Signal: LV BE

500  $\mu$ m

treating them by chemical fixation or freeze drying method to keep their shape.

**Daphne pollen**



Accelerating voltage: 10 kV Magnification: x2,000 Signal: SE

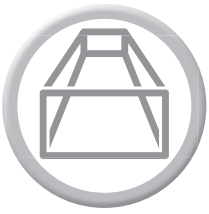
10  $\mu$ m



**JFD-320\***

This freeze drying device minimizes the effect of surface tension, suitable for drying hydrated specimens.

\* Option.



## Large multi-purpose chamber

### Insert large specimens

Specimens as large as 200 mm in diameter by 90 mm tall can be positioned easily in the JSM-IT510 chamber.



### Specimen exchange

#### Draw-out

This draw-out type specimen exchange system is suitable for large specimens with different shapes.

Chamber evacuation is quick, less than 2 minutes 50 seconds\*, for high speed specimen exchange.

\* Depend on the installation place and specimen.

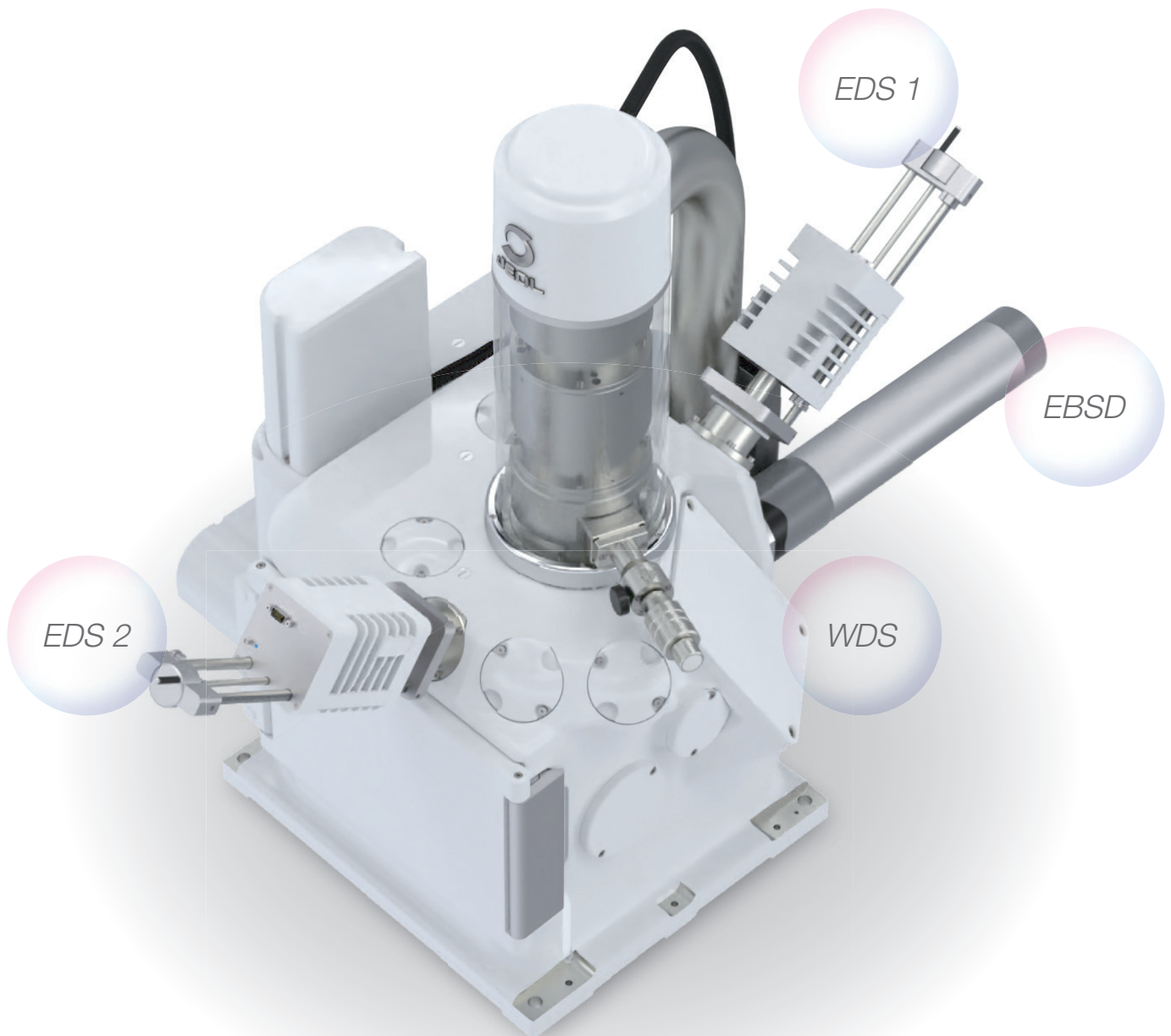
#### Load lock chamber

Load lock chamber (LLC) is suitable for faster specimen exchange or keeping the chamber clean.

\* Option.



Multi-purpose chamber



*JSM-IT510 has 11 ports.*

*It is feasible to perform both EDS and EBSD analysis simultaneously.  
Moreover, JSM-IT510 can install Dual EDS with 180° orientation.*

# Technical DATA

JSM-IT510 series can be equipped in the following 4 configurations: BU (Base Unit) / A (Analysis) / LV (Low Vacuum) / LA (Low Vacuum & Analysis).

BU (Base Unit)	Basic type for observation under high vacuum
A (Analysis)	Analysis type, EDS is attached on BU as a standard
LV (Low Vacuum)	Low Vacuum type, for high and low vacuum operation. BED included.
LA (Low Vacuum & Analysis)	Low vacuum type, for high and low vacuum operation, BED and EDS included.

## SEM specifications

Resolution	High vacuum mode 2.5 nm (30 kV), 10.0 nm (1.0 kV) Low vacuum mode*1 3.2 nm (30 kV BED)
Photo magnification	×5 to ×300,000 (Defined with a photo size of 128 mm × 96 mm)
Display magnification	×14 to ×839,724 (Defined with a photo size of 358 mm × 296 mm)
Electron gun	W filament, fully automatic gun alignment
Accelerating voltage	0.3 kV to 30 kV
Probe current	1 pA to 1 μA
LV pressure adjustment*1	10 to 650 Pa
Objective lens aperture	Four stage, with XY fine adjustment function
Automatic function	Filament adjustment, Gun alignment adjustment Beam alignment, Focus/ Astigmatism / Brightness / Contrast correction
Maximum specimen size	200 mm diameter × 75 mm height 200 mm diameter × 80 mm height*3 32 mm diameter × 90 mm height*3
Specimen stage	Large eucentric stage X: 125 mm Y: 100 mm Z: 80 mm tilt: -10 to 90° rotation: 360°
Image mode	Secondary electron image, REF image, Compositional image*1, Topographic image*1, Shadow image*1, PD image*4
Image size	640 × 480 1,280 × 960 2,560 × 1,920 5,120 × 3,840
Photo assist function	Montage, Simple SEM, Zeromag, Live 3D
Operation support function	Recipe (Standard recipe / Custom recipe) Measurement (distance between 2 points, distance between parallel lines, angle, diameter etc.) Specimen exchange navi Signal depth function 3D measurement*5
OS	Microsoft® Windows®10 64bit
Observation monitor	23.8 inch touch panel
EDS functions*2	Refer to EDS specification
Data management	SMILE VIEW™ Lab
Report generation One-click report	Output to Microsoft®Word Output to Microsoft®PowerPoint*6
Language switch	Japanese, English, Chinese*7 (operable on UI)
Vacuum system	Full automatic, TMP: 1, RP: 1 or 2*1

\* 1 Standard in JSM-IT510LV / LA.

\* 2 Standard in JSM-IT510A / LA.

\* 3 An optional holder is required.

\* 4 LHSED (option) is required.

\* 5 SVM (option) is required.

\* 6 Microsoft® Office must be installed.

\* 7 Chinese is optional.

\* 8 For JSM-IT510A / LA, EDS software is installed on the same PC as SEM control software.

\* 9 The optional probe current compensation unit (option) is required.

Automatic monitoring of the probe current is possible only when EDS is connected to the microscope PC.

\*10 Two EDS detectors with the same active sensor size are required.

There is a limitation for stage movements depending on installation ports.

## Main options

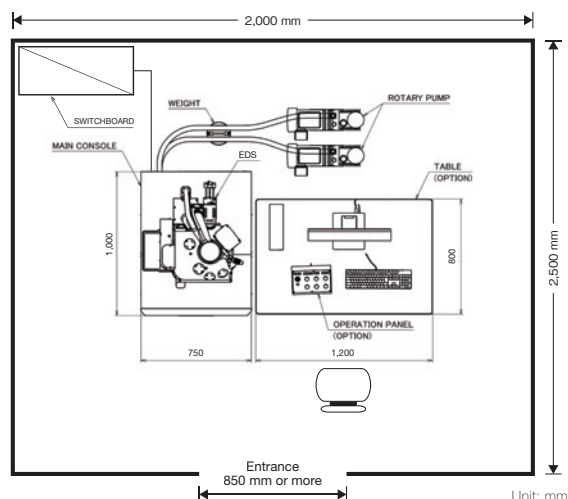
- Backscattered Electron Detector (BED)\*1
- Low Vacuum Hybrid Secondary Electron Detector (LHSED)
- Low Vacuum Secondary Electron Detector (LVSED)
- Energy Dispersive X-ray Spectrometer (EDS)\*2
- Wavelength Dispersive X-ray Spectrometer (WDS)
- Electron Backscatter Diffraction Pattern (EBSD)
- Load Lock Chamber (pre-evacuation chamber)
- Stage Navigation System (SNS)
- Stage Navigation System Large Sample (SNSLS)
- Chamber Scope (CS)
- Operation Panel (OP2)
- LaB6 Electron Gun (LAB6)
- 3D Analysis Software (SVM)
- Table (TBL)

## Installation Requirements

Power	Single-phase 100 V AC, 50/60 Hz, 3.0 kVA
Voltage fluctuation	Within ± 10% (voltage drop from 3.0 kVA by 3% or less)
Grounding	100 Ω or less
Installation room	Temperature: 20 ± 5 °C, Humidity: 60% or less Height: 2,000 mm or less, Stray AC field: 0.3 μT or less (50/60 Hz, Sine wave, WD 15 mm, 30 kV)
Room dimensions	2,000 mm × 2,500 mm × 1,800 mm or more Door size: 850 (W) mm × 1,800 (H) mm or more

	W (mm)	D (mm)	H (mm)	Weight (kg)
EOS column unit	750	1,000	1,470	Approx 405
Rotary pump (RP): 1	530	230	320	Approx 23
Vibration isolation weight	160	160	122	Approx 12
RP vibration isolation table (1)	400	180	15	Approx 2
EDS unit				Approx 5

## Installation Room Example





# EDS specifications

Applicable to A (Analysis) / LA (Low Vacuum & Analysis)

●: Standard ○: Option

		Standard
Control PC	OS: Microsoft®Windows®10 64bit*8	●
Language	Japanese / English / Chinese*7	●
Detector	SDD type	Select from the detector list
Spectral analysis	Qualitative analysis (peak identification, automatic qualitative analysis)	●
	Visual peak ID	
	Standard-less quantitative analysis (ZAF method)	
	Standard quantitative analysis (ZAF method)*9	
	PHI-RHO-Z (PRZ) method: quantitative correction method	
	QBase (Qualitative analysis database)	
Line analysis	Line analysis (parallel & arbitrary direction)	●
Elemental map	Elemental map (map with multiple colors, monochrome, 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 (time resolved spectral map)	
Serial analysis	Spectral analysis, Line analysis, Elemental map	●
	Comprehensive analysis of already-analyzed data (qualitative & quantitative analysis)	
Montage	Automatic montage (SEM image, Elemental map)	●
	Serial elemental mapping for multiple areas	
Particle analysis software	Particle analysis (auto / manual) & EDS analysis, Classification of particle analysis data, Graph display of statistical processed particle analysis data, Large-area serial particle analysis	○
	GSR (Gun Shot Residue) library	○
	Metal feature analysis library	○
	Automobile parts cleanliness analysis library	○
Report generation	SMILE VIEW™ Lab Output as Microsoft®Word, Microsoft®PowerPoint file*6	●
SEM integration	Integrated management of observation & analysis data	●
	Specifying analysis position on the SEM operation screen (Direct analysis on UI for SEM)	
	Graphical display of analysis positions	
Help function	Help guide	●
Dual detector	Analysis with two detectors*10	○
Off-line function	License software for off-line data analysis	○

## Specifications for DrySD™ detectors

Sensor size	Energy resolution	Detectable elements
30 mm <sup>2</sup>	129.0 eV or less	Be to U
60 mm <sup>2</sup> , 100 mm <sup>2</sup>	133.0 eV or less	Be to U



Specifications subject to change without notice.  
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