

Electron Probe Microanalyzer

# EPMA-8050G



# **Debut of the Grand EPMA**

## **Featuring a Cutting-Edge FE Electron Optical System for the Ultimate in Advanced Shimadzu EPMA Analysis Performance**

This instrument is equipped with a cutting-edge FE electron optical system, which provides unprecedented spatial resolution under all beam current conditions, from SEM observation conditions up to 1  $\mu$ A order. Integration with Shimadzu's high-performance X-ray spectrometers achieves the ultimate advance in analysis performance.

Introducing the grand EPMA, the ultimate EMPA system.

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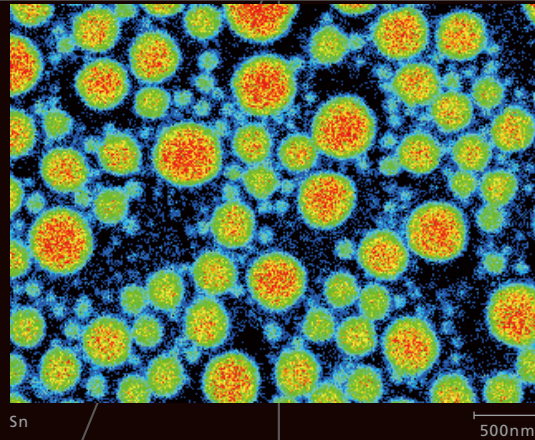
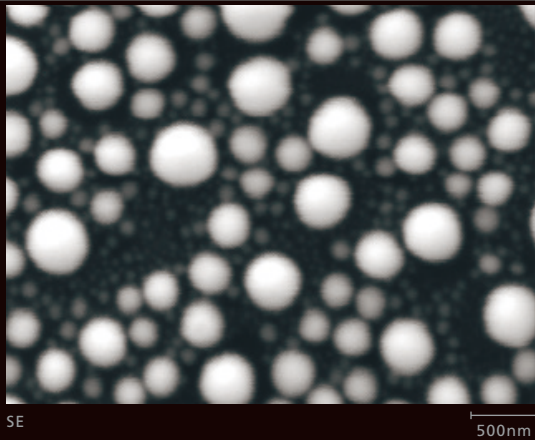
EPMA-8050G  
ELECTRON PROBE MICROANALYZER

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**EPMA-8050G**  
ELECTRON PROBE MICROANALYZER

## Ultra-High-Resolution Mapping

A mapping analysis of Sn balls on carbon was performed at a magnification of 30,000x. Even Sn particles as mere 50 nm in diameter, visible in the SE image (left), can be confirmed precisely in the X-ray image (right).



## The Benefits of Cutting-Edge Technology

### Unprecedented Spatial Resolution

The secondary-electron image resolution of 3 nm (30 kV accelerating voltage) is the highest level for an EPMA system.

This is the ultimate secondary-electron image resolution under analysis conditions. (With an accelerating voltage of 10 kV, 20 nm at 10 nA / 50 nm at 100 nA / 150 nm at 1  $\mu$ A)

### Large Beam Current Enabling Ultra-High-Sensitivity Analysis

This system achieves a maximum beam current of 3.0  $\mu$ A (30 kV accelerating voltage). There is no need to replace the objective aperture across the entire beam current range.

### Up to Five High-Performance 4-Inch X-Ray Spectrometers Can be Mounted

The 52.5° X-ray take-off angle is in a class by itself.

The 4-inch Rowland circle radius provides both high sensitivity and high resolution. The system can accommodate up to five X-ray spectrometers of the same type.

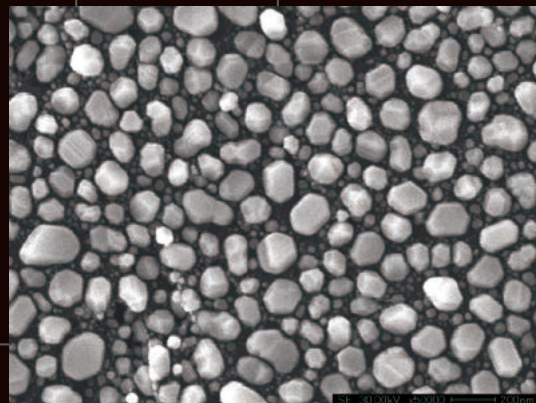
### Simple and Easy-to-Understand Operations for All Analyses

Advanced operability ensures that all operations can be performed with just a mouse. The user interface is designed for ease of use.

Easy mode analysis automates all processes up to generating reports.

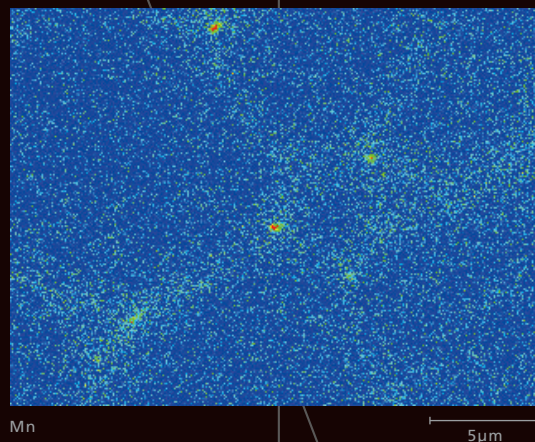
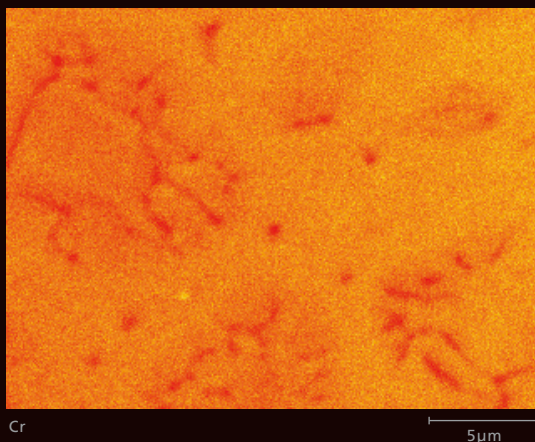
### Highest Secondary-Electron Image Resolution of 3 nm

This is a sample observation of gold particle deposition on carbon. A maximum resolution of 3 nm (at 30 kV) is achieved. The beam is focused even at a comparatively large beam current, so a smooth, high-resolution SEM image is easily obtained.



## Ultra-High-Sensitivity Mapping

A mapping analysis of stainless steel was performed with a beam current of 1  $\mu$ A at a magnification of 5,000x (Left). The distribution of phases with slightly different Cr concentrations is precisely captured (Right). The system succeeds in visualizing a distribution of Mn content under 0.1 %.



# Advanced Technology Enabling Ultra-High-Sensitivity Analyses of Minute Areas

## 1 High-Brightness Schottky Emitter

A high output Schottky emitter with a larger tip diameter than ordinarily used in SEMs is adopted for the FE electron gun. A stable electron beam is obtained that while bright has the large current indispensable for high-sensitivity analysis.

## 2 Special EPMA Electron Optical System

The electron optical system has a proprietary configuration and control method (Japan Patent No. 4595778). The condenser lens is set as close as possible to the electron gun. Crossover is formed not with the condenser lens but with an iris lens, with the objective aperture arranged at the same position. While this is a simple lens configuration, a large current can be obtained. At the same time, the angular aperture can be optimally configured under all current conditions, minimizing the electron beam diameter. Naturally, there is no need to replace the objective aperture.

## 3 Ultra-High-Vacuum Evacuation System

A two-stage differential evacuation system has been adopted, partitioned at the orifices between the electron gun chamber, intermediate chamber, and analysis chamber. Minimizing the orifice between the intermediate chamber and analysis chamber limits the flow of gas to the intermediate chamber. The electron gun chamber is always maintained at an ultra-high-vacuum level, stabilizing emitter operation.

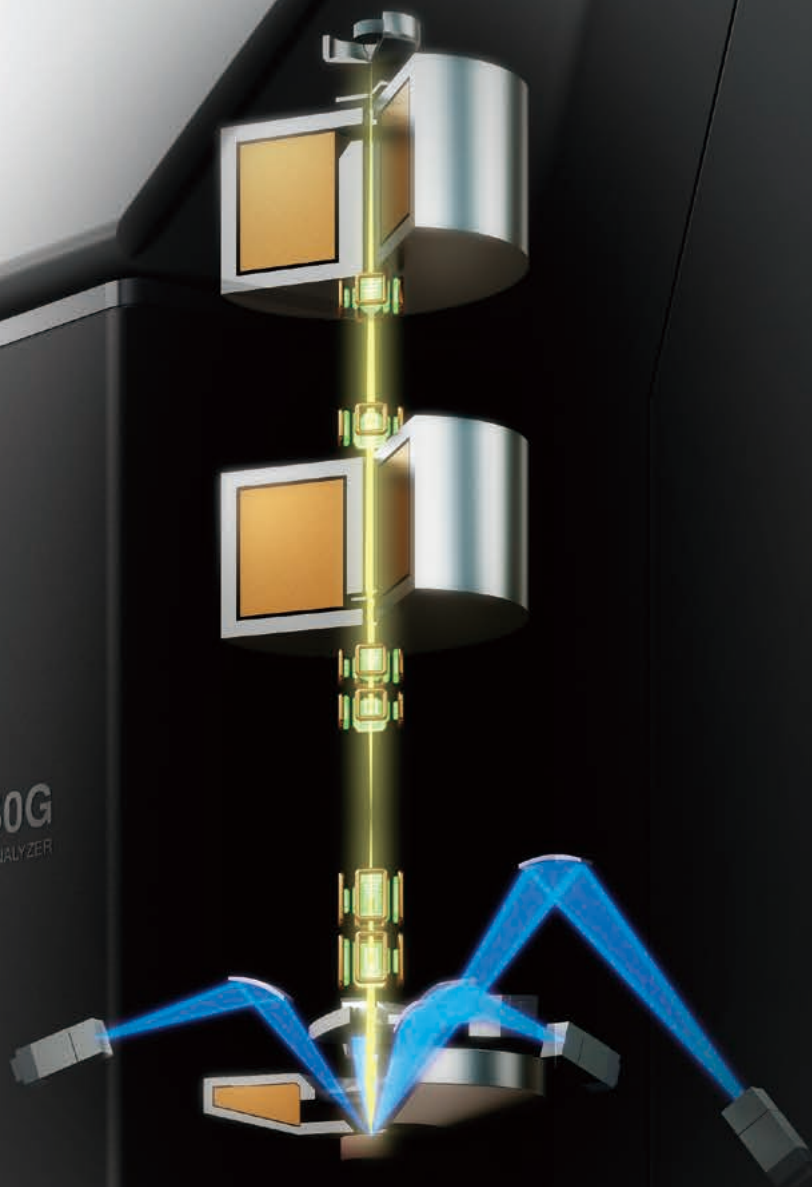
## 4 X-Ray Spectrometers with High Sensitivity

The system can be equipped with up to five 4-inch X-ray spectrometers, which provide both high sensitivity and high resolution.

The 52.5° X-ray take-off angle enhances the spatial resolution of the X-ray signal, while enabling high-sensitivity analysis with minimal X-ray absorption by the sample.

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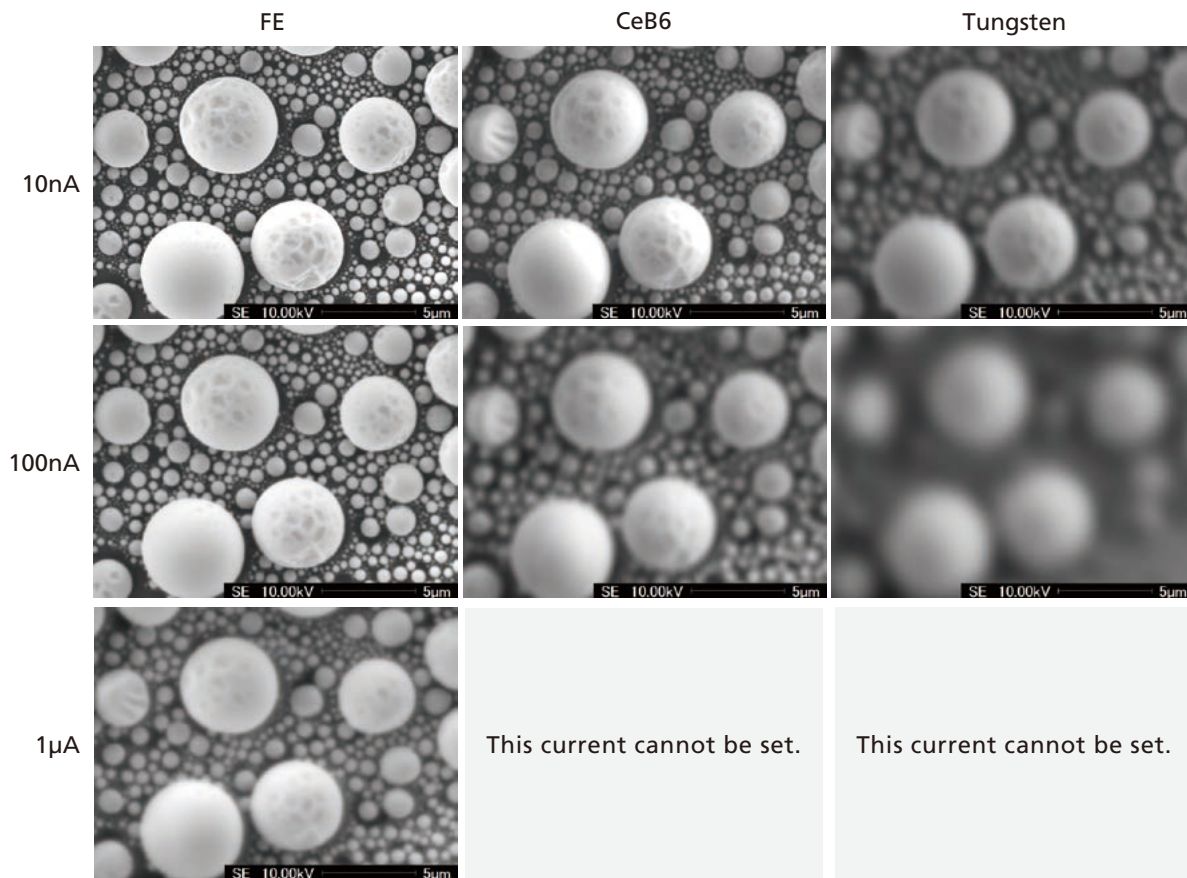


# Unprecedented Spatial Resolution

The system offers the ultimate in secondary-electron image resolution under the beam current conditions used for analysis. (With a 10 kV accelerating voltage, 20 nm at 10 nA / 50 nm at 100 nA / 150 nm at 1  $\mu$ A). The results are very clear in comparison to a conventional electron gun (CeB6, tungsten).

The same resolution image can be obtained with a dramatically larger beam current than with a conventional electron gun, so extremely high-sensitivity X-ray analysis can be performed.

A further point of interest is SEM imaging with a 1  $\mu$ A beam current. Only the EPMA-8050G provides a beam current of at least 1  $\mu$ A, and moreover, finely focuses the beam to this point.



Comparison of Electron Gun Beam Characteristics (10 kV accelerating voltage)

EPMA-8050G	Irradiation Current	Resolution
Resolution at each current condition (Acceleration voltage is 10 kV)	10 nA	20 nm
	100 nA	50 nm
	1000 nA	150 nm

\*The resolution described is the secondary electron resolution under each condition.

\*Switching and adjustment of the objective aperture are not necessary.

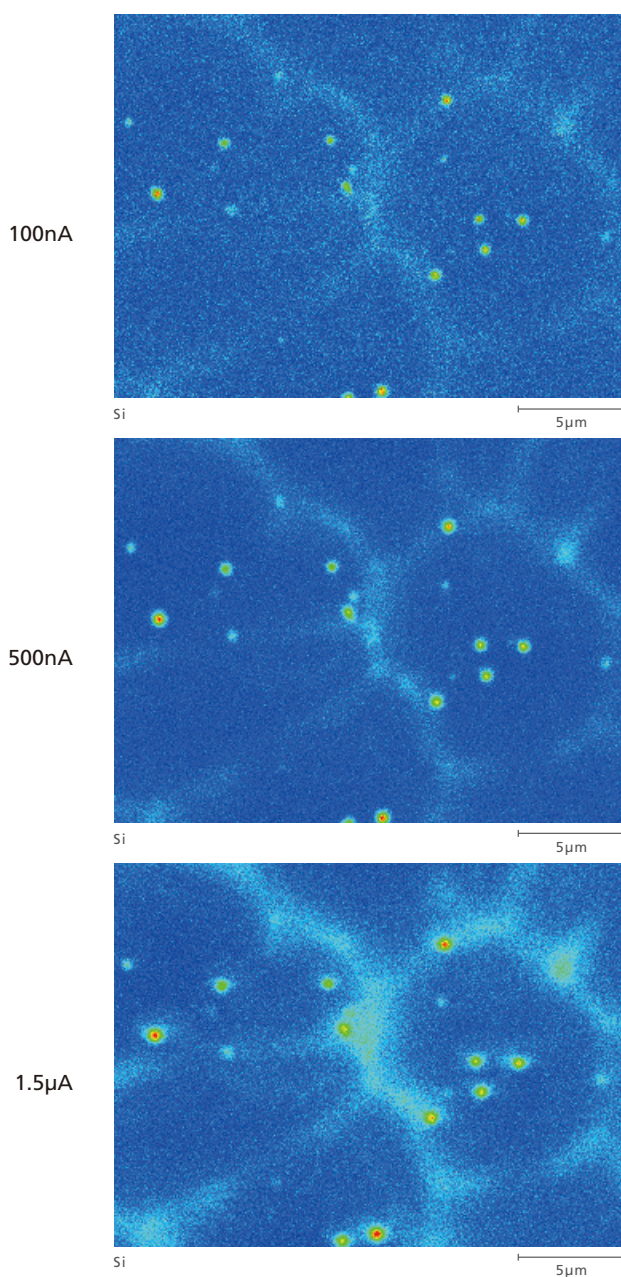
# Large Beam Current Enabling Ultra-High-Sensitivity Analysis

In SEM and EPMA with the FE type, the uniquely large beam current (up to 3  $\mu\text{A}$  with a 30 kV accelerating voltage) dramatically enhances the detection sensitivity for ultra trace elements. This enables ultra-trace component imaging in element mapping.

In addition, there is no need to replace the objective aperture across the entire beam current range, so the analysis process can be fully automated, with no concerns about axis offset.

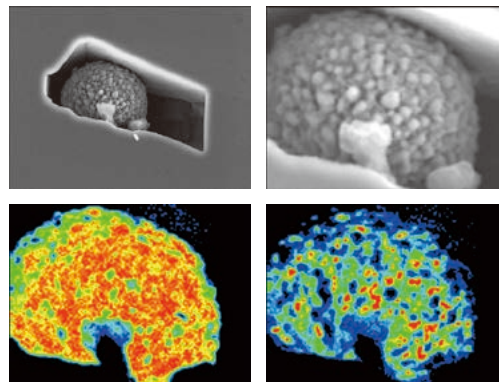
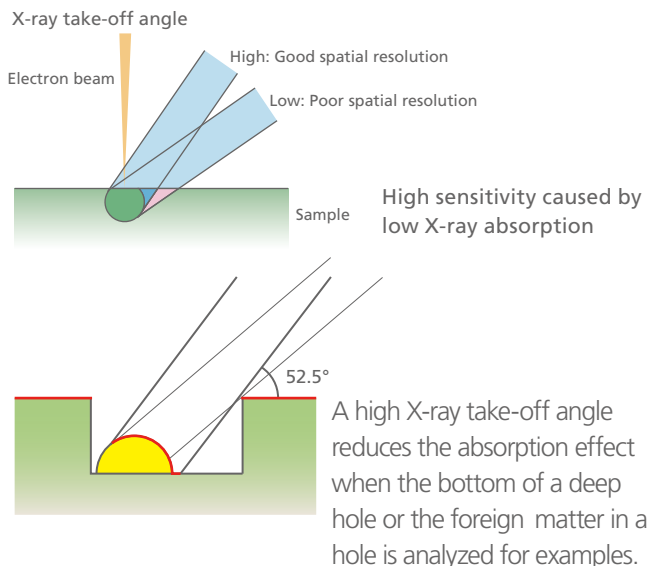
These three images show the results\* of a mapping analysis of approx. 1 % Si in stainless steel, using different beam currents. The roughness decreases as the beam current increases, enabling the areas containing Si to be precisely identified.

\* In all of the measurements, the accelerating voltage was 10 kV and the sampling interval was 50 msec. The measurements required approx. 1 hour.



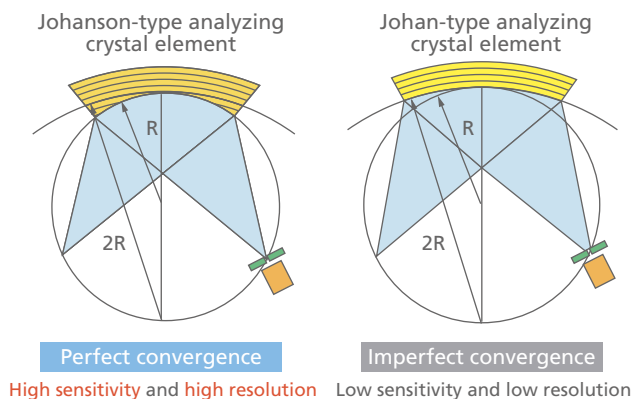
# Up to Five High Performance 4-Inch X-Ray Spectrometers Can be Mounted

Maintains the 52.5° X-ray take-off angle that is fundamental to analytical performance.



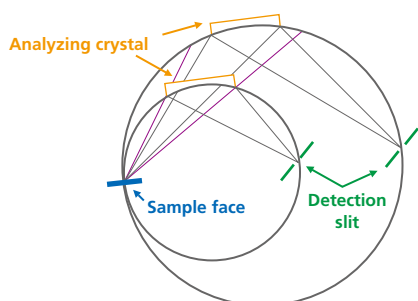
Analysis data for foreign matter in a pit. Bottom-left is the distribution of iron (Fe); bottom-right is the distribution of titanium (Ti). The high take-off angle used by the EPMA-8050G ensures highly accurate analysis of rough samples.

Johanson-type analyzing crystal achieves perfect convergence.



Shimadzu applied its unique crystal manufacturing expertise to offer analyzing crystals that deliver both high sensitivity and high resolution. The Johanson-type analyzing crystal achieves perfect convergence with no aberration.

EPMA-8050G accommodates up to five 4-inch spectrometers that offer both high sensitivity and high resolution.



The Rowland circle radius in the X-ray spectrometer is an important factor affecting an EPMA's analytical performance. Increasing the radius of the Rowland circle by one inch reduces the detection sensitivity by more than 30%. Shimadzu EPMA instruments accommodate up to five 4-inch spectrometers to cover the entire spectral range.

# Spectrometer Configuration

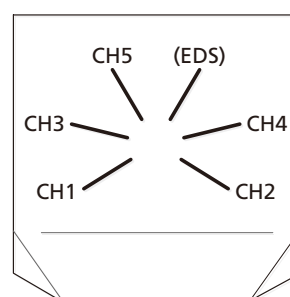
## Elements analyzed by each crystal and recommended spectrometer configuration

When multiple spectrometer channels are equipped, the optimal spectrometer element for the target must be selected from a large number of spectrometer elements.

Shimadzu's EPMA is designed to maintain optimal performance without replacing the objective aperture or otherwise changing the instrument parameters. The same philosophy was applied to the X-ray spectrometer, so that maximum sensitivity and optimal resolution are assured without the need to select the Rowland circle radius or replace the slit during analysis.

	Qualitative analysis	Quantitative analysis	Mapping/line analysis	State analysis
X-ray spectrometer providing good sensitivity and resolution (Shimadzu EPMA)	Supported	Supported	Supported	Supported
	* Only the Shimadzu EPMA spectrometer, which offers both good sensitivity and resolution, achieves optimal analysis conditions in all analysis modes.			
X-ray spectrometer emphasizing good sensitivity	Supported to an extent Peaks can overlap, causing incorrect evaluation.	Supported	Supported	Not supported More difficult to capture changes in wavelength.
X-ray spectrometer emphasizing good resolution	Supported to an extent	Not supported More difficult to reproduce peak intensity.	Not supported Greater sample surface effects; more difficult to maintain stable peak intensity over long periods.	Supported to an extent Difficult to detect small peaks.

**Spectrometer Arrangement Diagram**



## Types of Crystals

Crystal name	2d value (nm)	Detector	Comments
LiF	0.401	Kr-EXA	*
PET	0.874	Kr-EXA	*
ADP	1.064	Kr-EXA	
RAP	2.612	FPC	*
PbST	10.02	FPC	*
LSA55	Approx. 5.5	FPC	For high-sensitivity analysis of O, F
LSA70	Approx. 7	FPC	For high-sensitivity analysis of O
LSA80	Approx. 8	FPC	For high-sensitivity analysis of N
LSA120	Approx. 12	FPC	For high-sensitivity analysis of C
LSA200	Approx. 20	FPC	For high-sensitivity analysis of B
LSA300	Approx. 30	FPC	For high-sensitivity analysis of Be

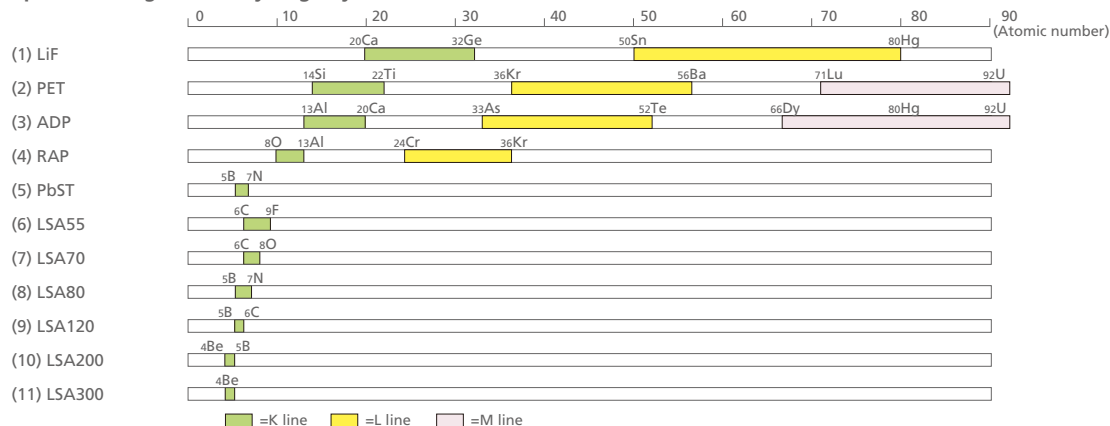
Combinations of analyzing crystal marked \* support analysis from 5B to 92U.

## Examples of Analyzing Crystal Combinations

Spectrometer No.		2Units specification	3Units specification	4Units specification	5Units specification	
					Mainly heavy elements	Mainly light elements
CH1	Main	RAP	RAP	RAP	RAP	RAP
	Sub	PbST	PbST	LSA120	LSA120	LSA120
CH2	Main			PbST	PbST	PbST
	Sub			LSA70	LSA70	LSA70
CH3	Main	LiF	LiF	LiF	LiF	LiF
	Sub	PET	PET	PET	PET	PET
CH4	Main		LiF	LiF	LiF	LiF
	Sub		ADP	ADP	ADP	ADP
CH5	Main				LiF	LSA80
	Sub				PET	LSA200

\* No analyzing crystal combination is subject to sample stage drive range restrictions, option restrictions, or other restrictions.

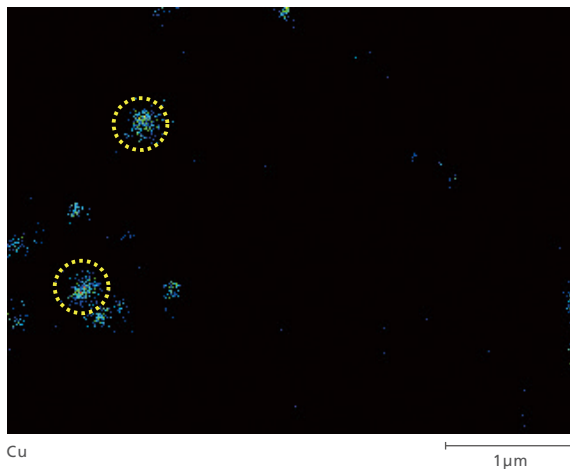
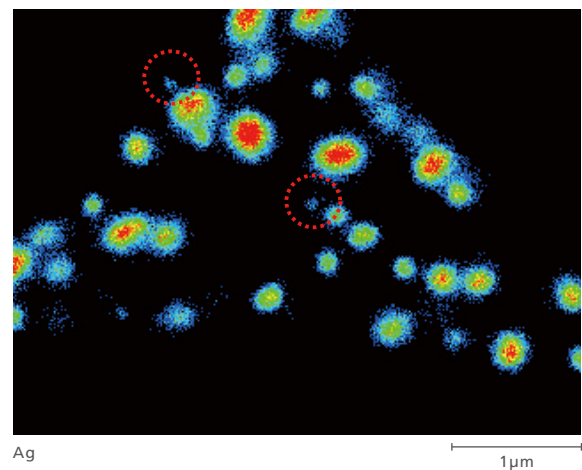
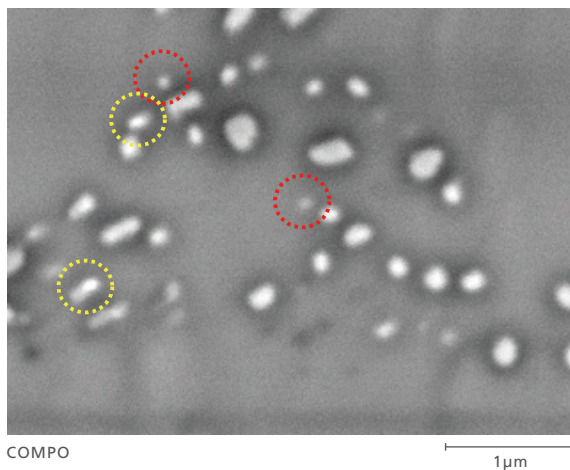
## Spectral Range of Analyzing Crystals



# Applications

## Distribution of Ag and Cu in Lead-Free Solder

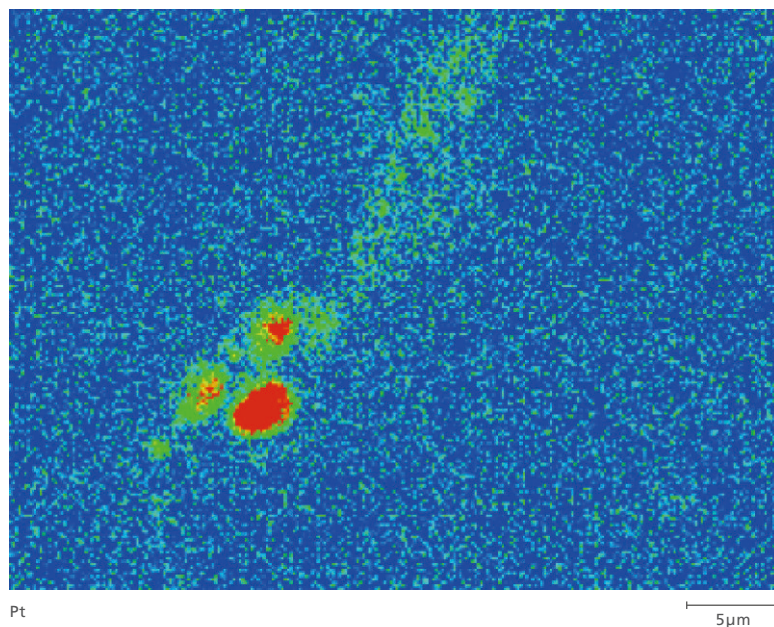
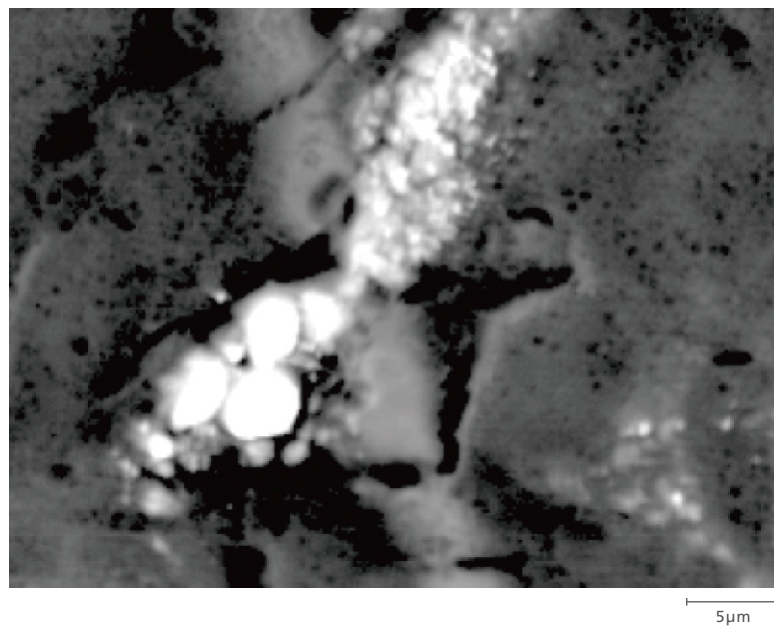
This data is from a mapping analysis of areas in lead-free solder containing a large amount of Ag. (Accelerating voltage: 10 kV; beam current: 20 nA) The shape of the particles in the Ag X-ray image agrees well with the shape of the particles in the BSE image (COMPO). It is evident that the particles with a diameter of about 0.1  $\mu\text{m}$ , indicated by the red dashed lines, are also Ag particles. In addition, the existence of Cu-containing particles can also be confirmed, as shown by the yellow dashed lines.



### Metallic Elements in Biological Tissues (DDS)

This EPMA element imaging data shows the existence of platinum (Pt), a component (platinum complex) of the anticancer drug carboplatin, delivered (by a DDS) into the tissue of a head and neck tumor in a mouse.

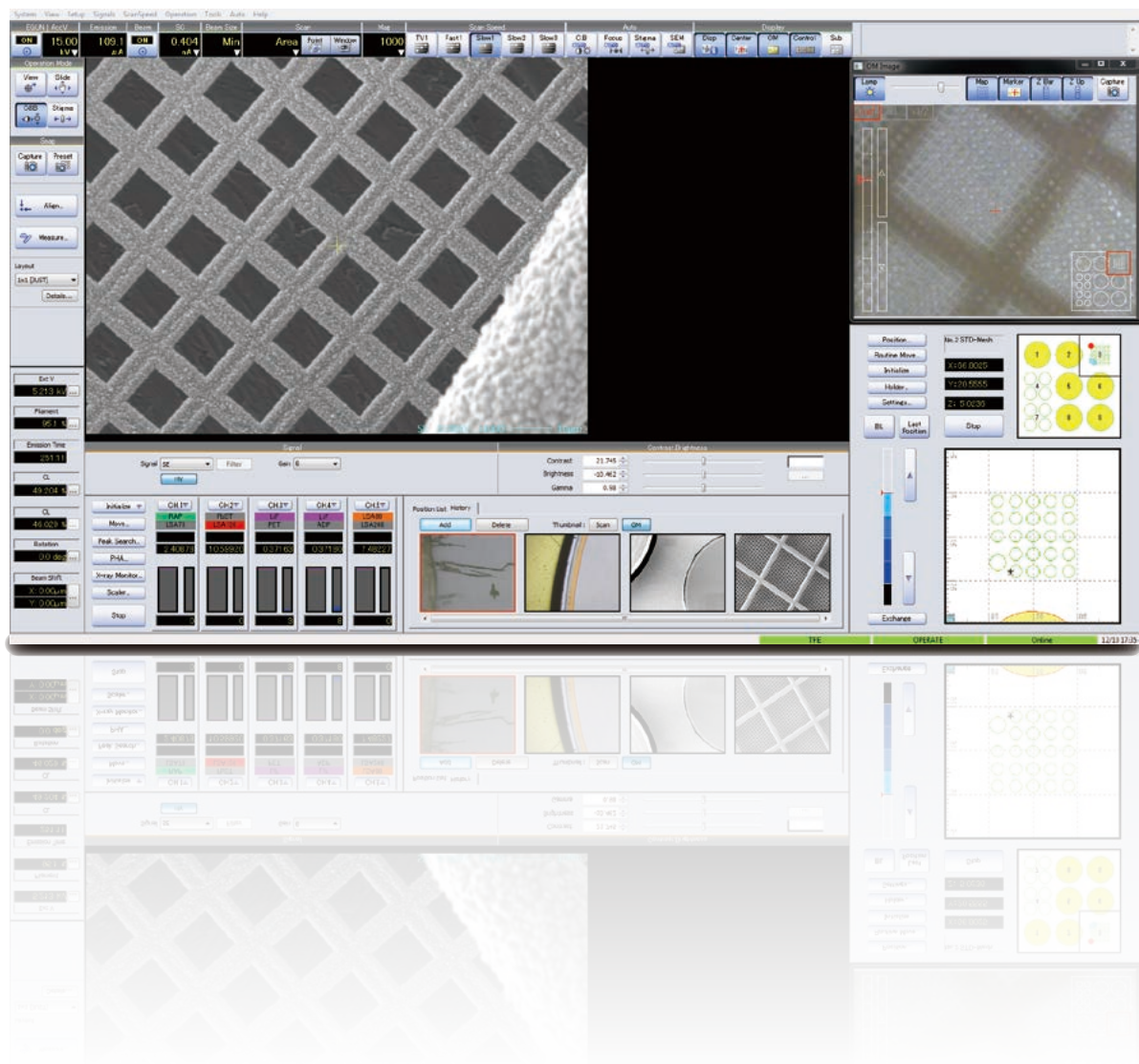
By binding with DNA strands, the genetic substance inside the cancer cells, the carboplatin prevents cell division (DNA replication), destroying the cells. The element imaging clearly shows the manner in which the anticancer drug is delivered within the cancer cells.



# Simple and Easy-to-Understand Operations for All Analyses

This system is equipped with a number of new functions to enable simple and easy-to-understand operations. These include advanced operational performance, with all operations controlled using just a mouse, as well as an easy-to-understand user interface and a built-in easy analysis mode. While easy enough for even novices to use, it also supports sophisticated analysis by experienced users.

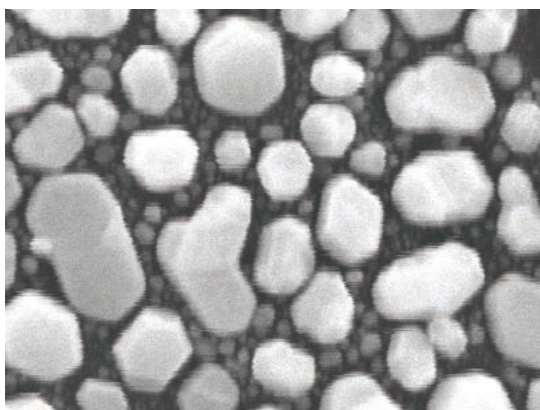
- Easy operations for everything from sample mounting to report generation
- Even novices can easily perform everything from sample searching to SEM imaging
- Unprecedented operability dramatically heightens operational efficiency prior to the start of the analysis
- The user interface has been designed in a visual, easy-to-understand format
- Equipped with an easy analysis mode that automates all processes up to generating reports



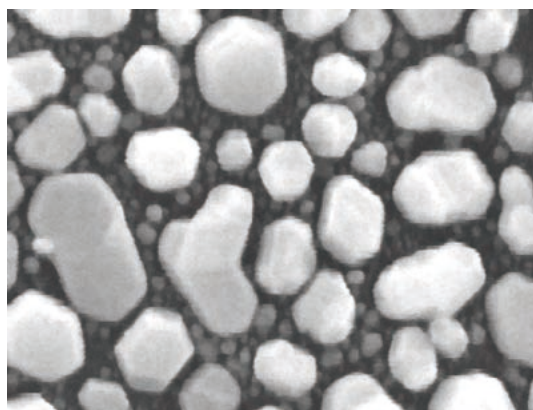
# Advanced image processing technology brings out even High Performance

## Jag-Reduction Function (Standard Equipment)

Reduces the whisker-like distortion (caused by mechanical vibration or magnetic field fluctuations) in SEM images that becomes more noticeable at higher magnification. It uses state-of-the-art image processing technology that relocates each pixel to the optimum position and reconstructs the image. It reduces image distortion without compromising the original resolution, resulting in a sharper SEM image.



Before Correction

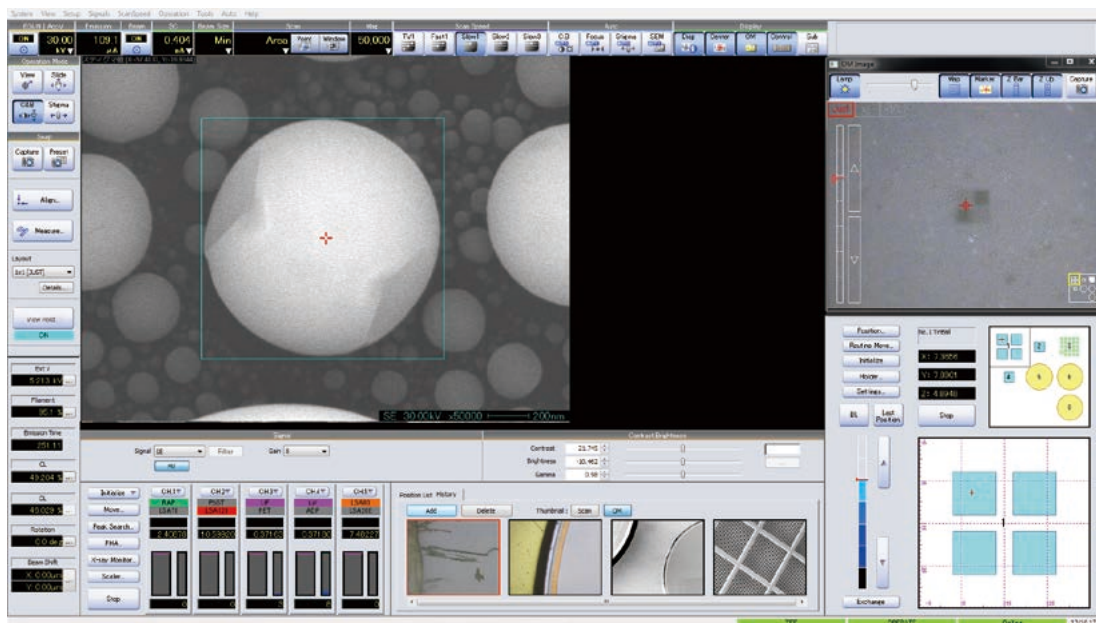


After Correction (Jag-Reduction)

The above image is an example of a SEM image of a gold-deposited particle taken at a magnification of  $\times 100,000$  and compared before and after correction. The corrected image not only reduces the edge distortion of the large particles, but also clearly shows the shape of the small particles.

## View Hold Function (Standard Equipment)

This function prevents the electron beam from deviating from the target foreign matter and outputting the composition information of the wrong part when performing qualitative analysis of minute foreign matter.



This is an example of the screen with the View Hold function activated. The electron beam is controlled so that the target in the middle of the SEM image does not move within the rectangular area.

# Options

## Trace Mapping Analysis

Trace functions can be added to standard mapping analysis. For samples with surface irregularities or inclination, when the height changes as a function of the X-Y position, the sample's Z axis height can be corrected, enabling high-accuracy mapping analysis in which reductions in signal intensity are minimized.

This feature is achieved by minutely controlling the stage's Z axis coordinates during the analysis, based on height data obtained beforehand from multiple points. The trace surface found from the configured height data can be confirmed via contour lines and 3D displays.

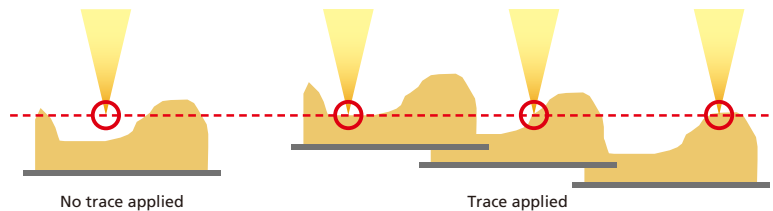
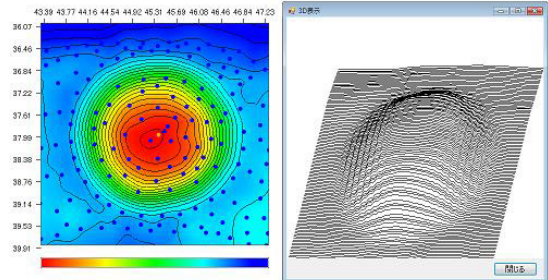


Illustration of the Basic Principle

## Mapping Analysis Results

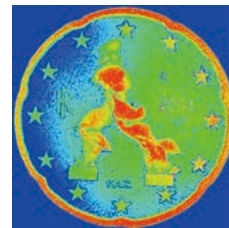
### Example of a sample 20 cent coin: Cu mapping

A more correct elemental distribution is obtained by using the trace.

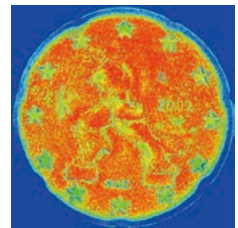
\*The trace is centered on the figure and periphery. The stars and the border are not targeted.



Topographical image



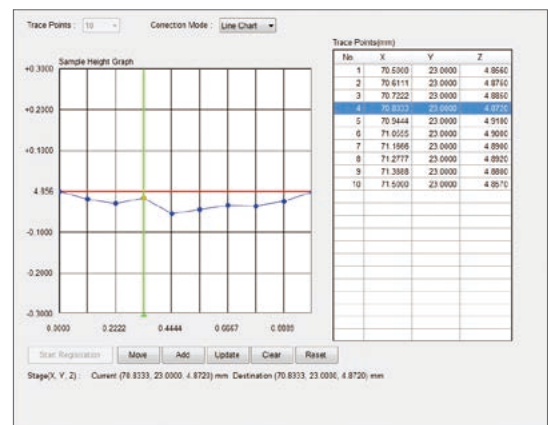
No trace applied



Trace applied

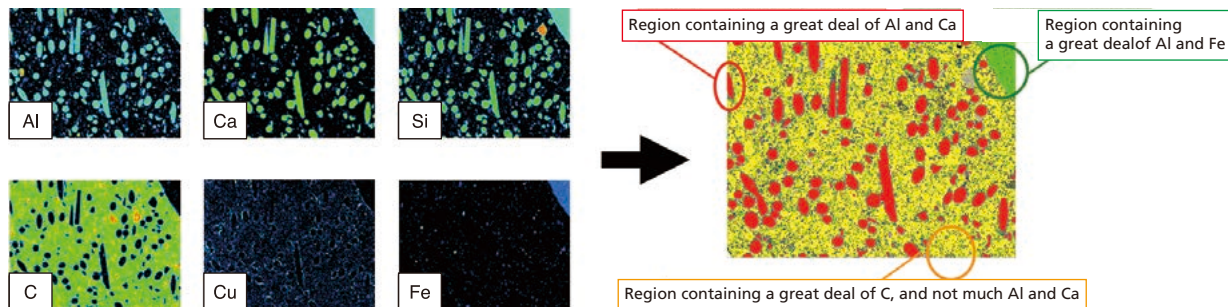
## Trace Line Analysis

As with trace mapping analysis, trace functions can be added to a standard line analysis.



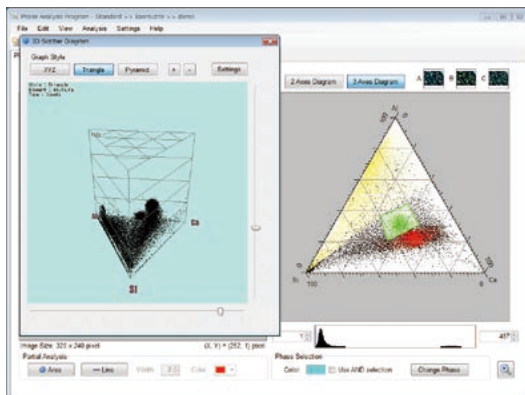
## Phase Analysis

A scatter diagram is created with the 2D or 3D correlations obtained from mapping data for each element. Regions featuring a particular relationship between elements are displayed in different colors. In addition, multiple scatter diagrams can be displayed simultaneously, enabling the observation of correlations between multiple elements.

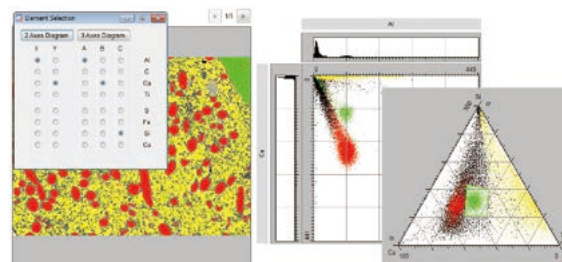


### Features

By creating a 3D image of the scatter diagrams, it is possible to observe the correlation from a variety of observation points.

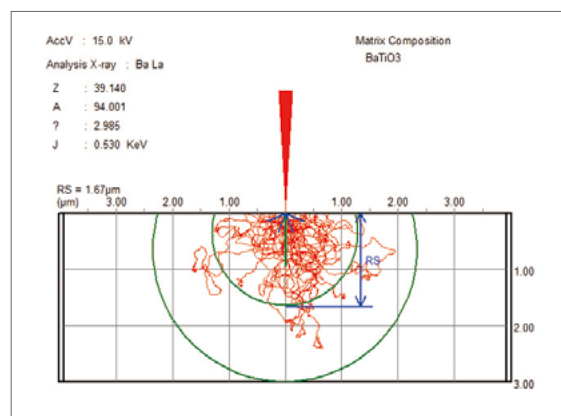


Multiple correlations can be analyzed while switching between elements and scatter diagrams.



## Electron Penetration Simulator

It is possible to simulate the analysis depth and width of the irradiating electron beam penetrated from the surface of the sample. The X-ray penetration domain can be calculated by using either the analysis volume model with which the electron beam diffusion size and the analysis domain are found, or the Monte Carlo method, which follows individual electron trajectories to obtain the total electron trajectory (penetration domain).



## Image Tracking Software

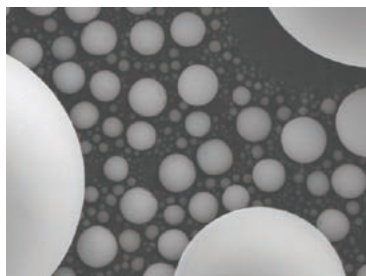
In general, in mapping analysis, the higher the magnification and the longer the time, the more likely the image is to be distorted due to image drift. However, this software corrects image drift during analysis and reduces image distortion.

### ● Features

This software corrects the drift in real time without stopping the beam scanning. The time required for analysis is the same as in normal cases, so the sample is not excessively damaged by heat. In addition, since the high-precision correction operation is frequently repeated, a level difference caused by the correction is hardly generated in the image, and the element map image with little distortion is obtained generally.

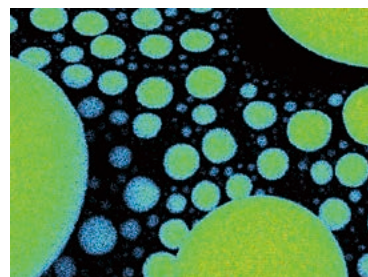
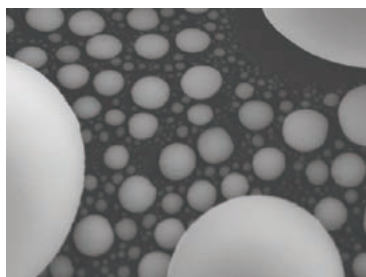
#### Scanning image for a short time

Scanning image for a short time is not distorted, but...



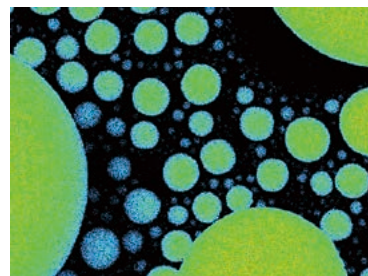
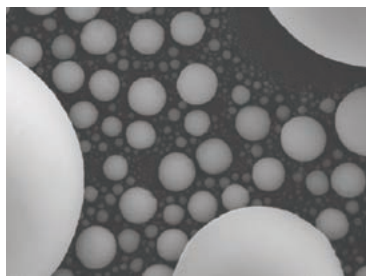
#### Typical Long Time Mapping Analysis Example

In the long time mapping, the image is easy to be distorted by the effect of the image drift.



#### Example of analysis using image tracking function

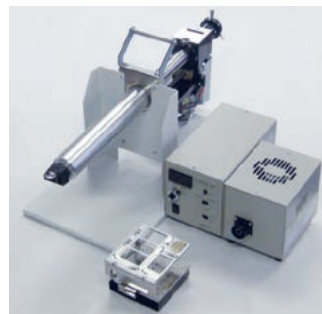
By using the image tracking function, it is possible to obtain a mapping image with little distortion.



## Transmitted Polarization Observation System

With this option, some of the functions of a transmission polarization microscope, widely used in mineralogy and crystallography research, are achieved with an EPMA optical observation system. Rock flakes and other flaked samples are exposed to polarized light from below, and the transmitted light is observed with an EPMA optical observation system, enabling polarization observation.

When samples are observed with a transmission polarization microscope already in the customer's possession, and are then observed or analyzed via EPMA based on the knowledge obtained, the observational functions of this product will be useful in searching for target positions. Observation and analysis can be performed using an electron beam while performing polarization observations.



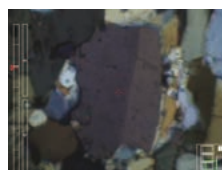
### ● Features

**Observations can be performed in both open nicol and crossed nicols modes.**



#### Sample Observation in Open Nicol Mode

In open nicol mode, light passed through a polarizing element (polarizer) is used to illuminate the sample from below. The transmitted light is then observed with the EPMA optical microscope. Mineral types are inferred by observing the boundary between neighboring minerals, and comparing refractive indices and studying the presence or absence of coloration.



#### Sample Observation in Crossed Nicols Mode

In crossed nicols mode, observation is performed through a polarizing element (analyzer) configured to an angle orthogonal to the polarizer. Mineral types are inferred from interference colors that appear depending on the type and thickness of the mineral sample.

### Polarization observations can be performed without rotating the sample.

With this system, the angle of the polarized light is changed by controlling the rotation angle of the polarizer and analyzer. As a result, observations can be performed without rotating the sample.

#### Sample Observations When the Polarization Angle Is Changed



Polarization Angle: 85°

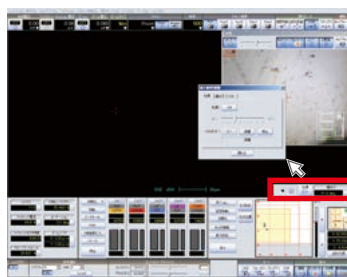


Polarization Angle: 113°

### Collisions between the light guide and sample base due to improper operation are prevented.

When polarization observations are performed, the polarization observation sample base is used, and the tip of the polarization illumination optical path (light guide) is moved directly below the sample. When a standard sample base is used, the light guide tip is retracted to prevent collisions with the sample base. This system identifies the polarization observation sample base, and controls the stage and light guide accordingly, enabling it to prevent collisions due to improper operations.

### The control window for polarization observations is linked to insertion of the polarization observation sample base.

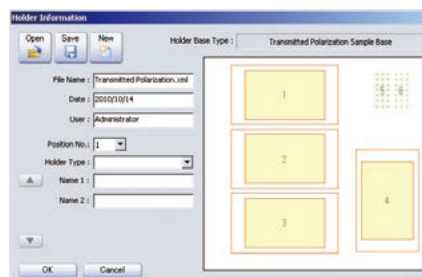


Window display is linked to the polarization observation sample base

#### Operational Windows in the Observation Window

The control window for polarization observations displayed on the PC is linked to insertion of the polarization observation sample base into the instrument. Operations following insertion of the polarization observation sample base can be smoothly performed.

### The stage map for the polarization observation sample base can be used.



#### Stage Map Selection Window

The stage can be moved to the intended observation position utilizing the stage map corresponding to the polarization observation sample base.

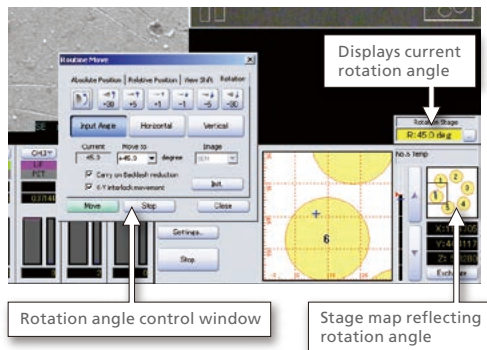
## Sample Rotation Stage Kit

The sample rotation stage kit is an optional system that enables using the sample stage as a 4-axis stage, moveable in X, Y, Z, and R-axis directions, by attaching a computer controlled sample stage equipped with a rotating mechanism (sample rotation stage) to the EPMA-8050G sample stage. This allows using the computer screen operations to rotate the sample in any direction desired for observation and analysis.

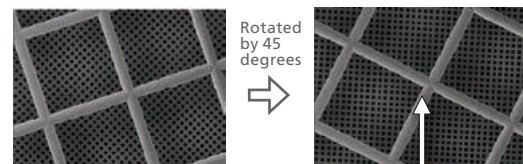


### ● Features

Allows displaying a stage map that changes depending on rotation angle.



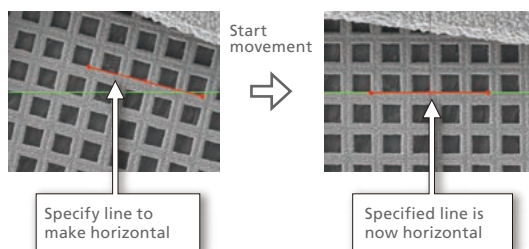
Since X-Y coordinate control is linked to rotation angle, rotation angle can be controlled without missing any observation angles\*.



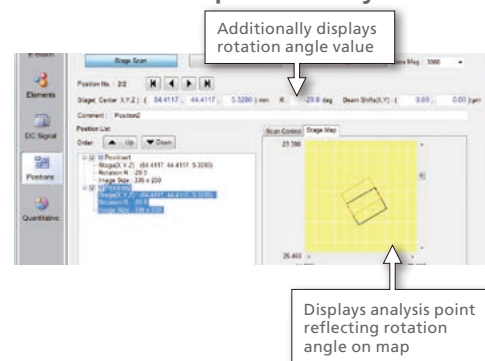
\* When an optical microscope image or an SEM image with the same field of view (magnification rate of 250) is viewed

The position prior to rotation can be observed near the center of the field of view

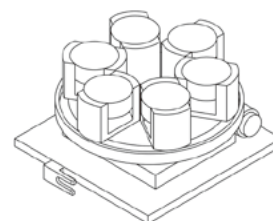
The stage can be rotated to orient any specified line on the observation image horizontally or vertically.



Rotation angles are recorded along with stage coordinates, and can be used for positional conditions in respective analysis modes.



Six samples of 1-inch diameter can be placed simultaneously using the multi-sample stage and sample holders included.



## Other Options

### ● Collection Of EPMA Spectrum

This is a collection of qualitative spectrum data measured on standard samples of metals and compounds of 76 elements. When analyzing qualitative analysis results of samples containing trace elements or complex elements, you can make complex judgment by comparing actual spectra with them.

### ● Analysis PC Set

This is an analysis operating PC that is necessary to the computer system of EPMA. If this option is not chosen, please prepare PC that meets the requirements for the system before the installation.

### ● External PC/External PC Software

This is a PC on which EPMA analytical software is installed or EPMA analytical software (if installed on a PC provided by the customer) for data processing.

By connecting the external PC to the host PC via a network, you can view the analysis data of the host PC, download and analyze the analysis data of the host PC, and upload the analyzed analysis data to the host PC.

### ● Air Compressor

EPMA-8050G uses separate compressed air for air valve drive and air damper drive.

If necessary, order a separate compressor for each.

### ● Cooling Water Circulation Unit

This is a cooling water circulation device with low vibration and excellent temperature stability for cooling the electron optical system of EPMA-8050G.

### ● Ion Pump Backup Power Supply

This is a backup power supply for the ion pumps to automatically continue vacuum evacuation of electron gun when power supply to EPMA is stopped or power outage occurs.

### ● Interface for EDS detector

This is an interface module that is required when an EDS (Energy Dispersive X-ray Spectroscopy) system is installed on EPMA. With control from the EDS system, the beam of the EPMA can be scanned to obtain SEM image. In addition, if the EDS system can output an X-ray signal, EPMA can capture that signal in a mapping or line analysis.

## Special Accessories (By Separate Arrangement)

- |                                    |                                   |
|------------------------------------|-----------------------------------|
| ● Sample Holders                   | ● X-Ray Generation Indicator Lamp |
| ● Large Specimen Stage (L Stage)   | ● Emergency Machinery Stop Button |
| ● Cathodoluminescence Spectrometer | ● Transfer Vessel                 |

# Specifications

Electron Optical System		
Electron Source	Schottky emitter	
Secondary-Electron Image Resolution	3 nm (30 kV accelerating voltage)	
Analysis Conditions for Secondary-Electron Image Resolution	20 nm (10 nA beam current) / 50 nm (100 nA beam current) / 150 nm (1 μA beam current) (10 kV accelerating voltage each)	
Accelerating Voltage	0.1 kV to 30 kV (in 0.1 kV increments. At 5 kV or less, can be set in 10 V units.)	
Maximum Beam Current	3 μA (30 kV accelerating voltage)	
Beam Current Stability	±0.3 %/h (Beam current: 50 nA, accelerating voltage: 10 kV)	
Magnification	40x to 400,000x	
Maximum Pixel Size for Saved Images	5120 × 3840	
Back-Scattered Electron Detector	4-block, semiconductor detector	
Objective Aperture	Fixed Type (No selection required)	
Observation Optical System		
Resolution	1 μm (for observation with the naked eye)	
Field of View	Approx. 600 μm dia. (for observation), approx. 480 μm × 360 μm (on a computer screen)	
Depth of Field	4 μm	
Sample Stage System		
Maximum Sample Dimension	100 mm × 100 mm × 50 mm <sup>t</sup>	
Maximum Sample Weight	2kg	
Maximum Stage Drive Range	X,Y : 90mm Z : 7mm	
Minimum Feed Distance	X,Y : 0.02μm Z : 0.1μm	
Maximum Stage Drive Speed	X,Y : 15mm/sec Z : 1mm/sec	
X-Ray Spectrometer System		
Analyte Elements Range	4Be~ <sub>92</sub> U	
Number of X-Ray Spectrometers	2 to 5 channels	
X-Ray Take-Off Angle	52.5°	
Rowland Circle Radius	4 inch (101.6 mm)	
Evacuation System		
Vacuum Level	Main Chamber	1.0 × 10 <sup>-3</sup> Pa or less
	Electron Gun Chamber	3.5 × 10 <sup>-7</sup> Pa or less
Evacuation Pump	Turbomolecular pumps	One unit for main evacuation; one unit for preliminary evacuation
	Rotary pumps	One unit for main evacuation; one unit for preliminary evacuation
	Ion pumps	Two units for the electron gun chamber; one unit for the intermediate chamber
Vacuum Detection	Penning gauge, Pirani gauge, and ion gauge	
Automated Functions	Automatic evacuation (main chamber evacuation, shut-down, sample loading chamber evacuation), safety operations via error detection	
Computer System		
Display	23-inch touch panel LCD (Full HD, 1920 pixels × 1080 pixels), two monitors (One each for observation and analysis operations)	
System for Observation Operation	Built-in Type: Windows® 10 IoT (64bit)	
PC for Analysis Operation	(Reference Spec) OS: Windows® 10 Pro (64bit) , CPU: Intel® Core™ i7-8700 or higher (Recommended), Memory: 8GB or higher, Network: LAN(RJ-45) 1 port required	
Analysis Software		
Analysis Mode	Qualitative analysis, mapping analysis, quantitative analysis, calibration curve analysis, state analysis, line analysis	
Automated Analysis	Auto sequence analysis, easy mode analysis	
Operation Support	Data browser, report function, instrument monitor	
Management Functions	Environment set-up program	
Observation Software		
Control Functions	Electron optical system control, observation system control, sample stage control, X-ray spectrometer control, evacuation system control	
Automated functions	Auto focus, auto stigma, auto contrast/brightness, filament automatic saturation, automatic beam current settings	

# Installation Requirements

## Ambient Conditions

- Temperature 18 °C to 28 °C  
(Provide an air conditioning system to control temperature fluctuation within  $\pm 1$  °C.)
- Humidity 30%RH to 60%RH
- Heat Generation Rate When used with natural cooling water discharged:  
Approx. 2.5 kW  
When used with cooling water circulation unit:  
Approx. 3.3 kW (including heat generated by that unit)

## Installation Room

- Floor Area W4m min.xD3.5m min.xH2.5m min.
- Door Width: 1.25 m min., height: 1.8 m min.

## Power Requirements

- Analyzer Single phase 200 V AC  $\pm 10\%$ , 30 A, 50/60 Hz, 1 circuit
- PC Single phase 100 to 240V AC  $\pm 10\%$ , 5A 50/60Hz, 1 circuit
- Ion Pump Backup Power Supply  
Single phase 200 V AC  $\pm 10\%$ , 30 A, 50/60 Hz, 1 circuit

## Grounding Resistance

- 100  $\Omega$  max.

## Cooling Water

- Water Supply Water pressure: 0.08 MPa to 0.18 MPa  
Water temperature: 20 °C to 25 °C  
Flow rate: 0.7 L/min  
Faucet outer diameter: 11mm.
- Water Drainage Natural drainage (same height as floor)

## Gas

- PR Gas Mixture of Ar (Argon) + CH<sub>4</sub> (Methane) 10vol%.  
Pressure: 1 kPa to 3 kPa  
Flow rate: 10 mL/min to 14 mL/min  
Connection port: Connect a gas cylinder filled to the following specifications.  
Gas filling pressure: 15 MPa max.  
Cylinder port : W22 - 14 right-handed male screw
- Compressed Air Prepare the following compressed air sources for driving the air valves and air dampers. (Two systems)  
Pressure: 0.45 MPa to 0.6 MPa; connection port: Rc 1/4
- Dry Nitrogen Gas (EPMA-1720H only. Recommended for purging electron gun when using CeB<sub>6</sub>.)  
Pressure : 0.08 MPa to 0.1 MPa  
Connection port: Joint for tube with 6 mm diameter

## Vibration and Stray Magnetic Fields

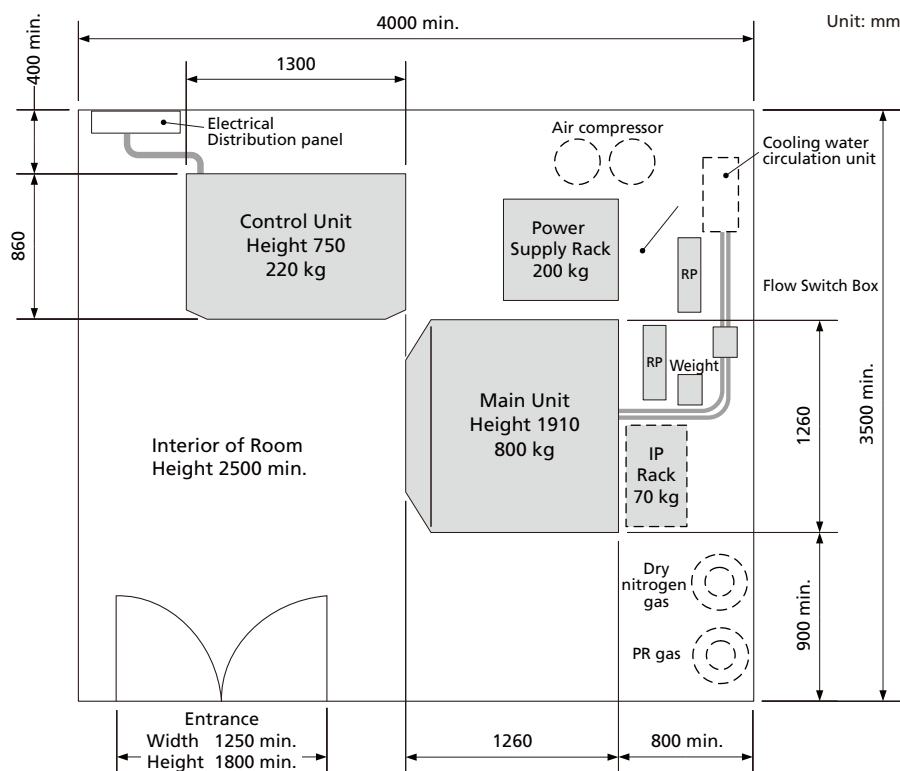
Indicated in the Pre-Installation Requirements. For more information, contact your Shimadzu representative.

## Laws and Regulations

To prevent X-ray radiation accidents, safety regulations and standards for devices equipped with X-ray generators have been established in each country. Observe the laws and regulations for X-ray generators that are applicable in the country where the product is used. For notifications on installation and safety controls, follow the necessary procedures in compliance with the laws and regulations applicable in the country where the product is used.

- (1) Rated output: 30 kV, 1 mA max.
- (2) Dose rate: 1 $\mu$ Sv/h or less.

## Layout Example



Note) Parts shown in broken lines are not included in the standard configuration.

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