SEM (Scanning Electron Microscope) is a high-precision tool designed to observe minute parts of organs and forms. It allows obtaining in-depth focus images of samples in a higher magnification. Recently, the application of SEM is expanding, equipped with various detectors and thanks to its capacity for obtaining complex information of a sample.

COXEM’s SEM, which is armed with a wide range of functions and applications, will certainly be the right choice for the entire industry including researchers and scientists.
EM-30AX Plus

Features

- High Performance EDS System Integrated
- High Quality Images (0 nm resolution)
- Magnification Up To 150,000x
- Easy Navigation with the "Navigation Mode"
- Precise Control with a Joystick and the "Driving Mode"
- Combined SE and BSE Images
- Low Energy Consumption
- Intuitive User Interface

Specifications

- **Magnification**: x20 ~ x150,000
- **Acc Voltage**: 1 ~ 30KV (1kV increments)
- **Electron Gun**: Tungsten Filament (W)
- **Detector**: SE, BSE Detector (4 Channel Solid Type)
- **EDS**: Oxford: 129eV at MnK, B(5) ~ U(92)
  EDAX: 129eV at MnK, Be(4) ~ Ar(95)
  Bruker: 129eV at MnK, B(5) ~ Cf(98)
- **Stage**: Auto Stage (X: 35 mm, Y: 35 mm, T: 0 to 45°)
  Manual Stage (Z: 5 to 50 mm)
- **Image Shift**: X, Y, R(Rotation)
- **Operating System**: Microsoft Windows 7
- **Dimension**: 400(W) X 600(L) X 550(H) mm
- **Weight**: 95 kg
1. Effect of Working Distance

INTRODUCTION
Scanning Electron Microscopes (SEM), of which the field depth is very deep, are more effective when observing an object with big undulations. To increase the field depth, it is important to extend the Working Distance (WD) between the objective lens and specimen to deepen the depth of field for observation.

Benefits

Users can deepen the depth of field by adjusting WD when observing a specimen whose surface is rough, with some difference in height.

- Analysis Solution for:
  - Automotive Industries
  - Material Industries
  - Bioecology
  - Sandstone Industries

Availability

'Depth of Field' can be controlled in every product of COXEM.

- EM-30 Series
- EM-30Plus Series
- CX-200 Series

Operation

'Depth of Field' is adjustable, regardless of the vacuum state; if the distance between the objective lens and specimen increases, the focus area also increases. Another way to increase focus area is to set the electron beam’s size small.

<Spring samples>
2. Effect of High Resolution

**INTRODUCTION**

One of the greatest advantages of SEMs is that they use an electron beam with a short wavelength to ensure observation of an image in a higher magnification. SEM is particularly effective in obtaining a high resolution by adjusting accelerating voltage, working distance (WD), and electron beam's size (so called 'Spot Size').

**Benefits**

A higher resolution is useful when observing minute parts of objects, such as materials or components.

Analysis Solution for:
- Chemistry Industries
- Semiconductors and Electronics Industries
- Material Industries

**Availability**

- EM-30Plus Series
- CX-200 Series

**Operation**

It is possible to obtain a higher resolution image by setting the WD and electron beam's size to be short and small, while setting the accelerating voltage to be high.
3. SE / BSE Detector

INTRODUCTION

SEM allows creating images by collecting different signals. A typical example of this is information on uneven, rough surface gained by SE Detector, as well as elementary information and stereoscopic-like images gained by BSE Detector.

Benefits

These detectors can be used to obtain morphological and topographic images of a sample.

Analysis Solution for:
- Automotive Industries
- Material Industries
- Chemistry Industries
- Semiconductors and Electronics Industries
- Smartphones and Display Industries

Availability

All COXEM products are equipped with SE / BSE detectors.

- EM-30Plus Series (BSE standard)
- EM-30 Series (BSE optional)
- CX-200 Series (BSE optional)

Operation

For BSE, it is recommended to collect adequate signals by amplifying energy emitted from the sample. Therefore, you must set the size of the ‘electron beam’ and ‘aperture’ large enough to receive adequate signals.

< Mineral >

BSE-COMP mode

BSE-TOPO mode

SE

< A crack in an auto part >

SE

BSE
<Ceramic>

<Alloy>

<Semi-conductor>

<Mineral>
**4. SE+BSE Mode**

**INTRODUCTION**

COXEM offers an image merging function to combine SE and BSE images, which allows for observing each and every property of SE and BSE, at a glance.

### Benefits

You can obtain SE and BSE images, at the same time.

**Analysis Solution for:**
- Automotive Industries
- Material Industries
- Chemistry Industries
- Semiconductors and Electronics Industries
- Smartphones and Display Industries

### Availability

- EM-30Plus Series

### Operation

You can obtain an optimal SE + BSE united image by selecting proper spot sizes for both images.

---

**<Ceramic>**

![BSE](image1) ![SE](image2) ![SE+BSE](image3)

**<Electronic part>**

![BSE](image4) ![SE](image5) ![SE+BSE](image6)

**<Spring>**

![BSE](image7) ![SE](image8) ![SE+BSE](image9)

**<Alloy>**

![BSE](image10) ![SE](image11) ![SE+BSE](image12)
5. Low Vacuum Mode

ΙΝΤΕΡΝΟΤΙΟΝ
Using the ‘Low Vacuum’ mode, you can obtain an image of a biological sample or insulation material without a special pretreatment for the specimen.

Benefits
Useful for samples including biological samples that cannot be pretreated for coating.

Analysis Solution for:
- Automotive Industries
- Material Industries
- Chemistry Industries
- Semiconductors and Electronics Industries
- Bioecology

Availability
‘Low Vacuum’ mode is available as an option.
- EM-30Plus Series (LV optional)
- CX-200 Series (LV optional)

Operation
Without a pretreatment process, you can analyze a nonconductor sample.

<Paper>
High vacuum mode
Low vacuum mode

<Semiconductor>
High vacuum mode
Low vacuum mode

<Ant>
High vacuum mode
Low vacuum mode

<Flower>
High vacuum mode
Low vacuum mode
6. Effect of Accelerating Voltage

INTRODUCTION
SEM enables observing an image with the accelerating voltage (acc. voltage) adjusted from 1kV to 30kV. The lower acc. voltage is convenient for two occasions: when there is concern that the sample might be damaged by electron beams and when the user wishes to observe certain points of the surface.

Benefits
To avoid any damage to the sample by the electron beam’s heat, bring down the Acc. Voltage, by considering the nature of the sample, especially for polymer or metal samples - sensitive to heat.

Analysis Solution for:
- Automotive Industries
- Material Industries
- Chemistry Industries
- Semiconductors and Electronics Industries

Availability
Acc. voltage setting is available in all products of COXEM.
- EM-30Plus Series
- EM-30 Series
- CX-200 Series

Operation
The ‘Interaction volume’ for the sample may vary depending on the voltage, so users can obtain the surface information more effectively by lowering the voltage to reduce the ‘Interaction volume.’ This is also true when the sample is likely to be damaged by electron beams.
7. Effect of Tilt Angle

**INTRODUCTION**

In most cases, an analysis may be proceeded without any information about the shape of the sample. In such a case, one of the most commonly made errors is analyzing the sample by observing it simply from above to obtain fragmentary information.

### Benefits

By tilting the sample stage, it is possible to observe the sample in different types of images from different angles.

Analysis Solution for:
Used in many applications.

### Availability

You can observe the sample by tilting the sample stage for all COXEM products.

- EM-30Plus Series
- EM-30 Series
- CX-200 Series

### Operation

To identify an accurate shape of the specimen, apply tilt effects in multiple angles.

**<Solar Cell>**

- Solar Cell
- 0°
- 45° tilted

**<Silicon Wafer>**

- Silicon Wafer
- 45° tilted
- 90° tilted

**<Glass>**

- Glass
- 0°
- 45° tilted

**<Car Wiper>**

- Car Wiper
- 0°
- 90° tilted
Cost-Effective Normal SEM Solution

CX-200TA

Features

- Magnification Up To 300,000x
- Full Auto Stage (X, Y, R, T, Z Axis)
- Panorama Shot
- Click & Move Stage Control
- Auto Functions : Filament, Focus, Contrast, Brightness
- Higher Image Pixel : 5120 X 3840 Pixel

Specifications

- Magnification : x15 – x300,000
- Acc Voltage : 1 ~ 30 kV (1kV increments)
- Electron Gun : Tungsten Filament (W)
- Detector : SE (standard)
  BSE, EDS (optional)
- Image Shift : X, Y, R(Rotation)
- Stage : Auto Stage
  (X: 40 mm, Y: 40 mm, T: -20° to 90°, R: 360°, Z: 5 to 60 mm)
- Operating System : Microsoft Windows 7
- Dimensions : 800(W) x 900(L) x 1500(H) mm
- Weight : 400 Kg
8. Effect of Sample Preparation

**INTRODUCTION**

For SEM, it is not necessary to prepare a special preparation for the sample, and there are only few limitations for samples, which make it highly useful. However, it is better to, identify the sample's conductivity or contamination before processing a pretreatment to obtain a higher-quality image of the sample.

**1) Effect of Coating**

SEM is designed to detect and analyze signals to obtain different types of images generated by electrons – being projected at an extremely fast speed - colliding with the sample. In this process, if an excessive portion of electrons remain on the specimen, there will be a 'Charging effect' which has a negative effect on the image. To prevent such an effect, you must use an 'Ion sputter coater' to cover the sample's surface with a thin conductive layer.

![Ion Sputter Coater (SPT-20)](image)

**2) Chemical Etching Effect**

To observe a fine structure of a specimen, it is required to use chemical etching.

**3) Polishing**

A polishing process can be applied to any sample whose surface is not smooth - such as a semi-conductor chip section or a grain boundary in metal – for accurate observation.
9. Application of Coolstage

INTRODUCTION

A biological sample requires various chemical treatments including dehydration and fixing. To reduce this complex sample preparation process, you can use a Coolstage function which rapidly lowers the temperature of the sample stage to instantly freeze the sample against any damage to it.

Benefits

Useful for a sample containing moisture.

Analysis Solution for:
- Bioecology

Availability

Coolstage can be mounted in all COXEM equipment.

- EM-30 Series (Coolstage optional)
- EM-30Plus Series (Coolstage optional)
- CX-200 Series (Coolstage optional)

Operation

With Coolstage, you can observe a sample with moisture by freezing it up to 25 degrees below zero, against any damage to its structure, without a special pretreatment.

![Comparison of samples with and without Coolstage](image-url)
10. Application of Panorama Shot

**INTRODUCTION**

'Panorama Shot' function (so called MxN) is designed to repeatedly shoot multiple images. This function allows observing the entire image at a glance.

**Benefits**

This function is optimized for analyzing large areas such as a semiconductor surface, minerals and other metals.

Analysis Solution for:
- Semiconductors and Electronics Industries
- Material Industries
- Sandstone Industries

**Availability**

MxN function can be used in COXEM’s console-type SEM.

- CX-200TA

**Operation**

An image can be generated automatically, by selecting a desired area and mode. After analysis, it is also possible to move or reshoot a particular cell image for observation.
11. Application of 3D Topography Software

INTRODUCTION

Using 3D imaging software, users can obtain reconstructed 3D SEM images fast and easy. Advanced functions such as image colorization, enhancement and surface metrology including roughness are also available.

Benefits

Reinforce the surface information to obtain an image.

Analysis Solution for:
- Material Industries
- Chemistry Industries

Availability

Installation of the program is possible in all COXEM systems.

- EM-30 Series (optional)
- EM-30Plus Series (optional)
- CX-200 Series (optional)

Operation

![3D reconstruction of SEM image]

![Colorization of SEM image]
12. Application of Scanning Transmission Electron Microscopy (STEM)

**INTRODUCTION**

STEM is designed to project electron beams generated by an electron gun onto a sample and extract electrons transmitted to create an image from them. This system is generally used to observe cells, structures or Nano construction.

1) **Bright Field Mode**

BF (Bright Field) images show a two-dimensional structure synchronized on the sample's surface with signals transmitted, while a detector placed on the beam axis catching the electrons transmitted. This tool is useful especially when observing the information about the form and structure of 'bulk samples.'

2) **Dark Field Mode**

DF (Dark Field) images are created without receiving the central beam and with a donut-shape detector installed in 'spawn areas' with sharp angles. This is useful when it is difficult to observe the structure in detail or when analyzing the structure of a defect.

3) **STEM with EDS Mode**

You can use a STEM Holder that does not affect a light elements analysis for more accurate observation of light elements.

### Benefits

COXEM’s STEM solution allows a large-area observation, which was limitedly possible with STEM-in-TEM, under a relatively low magnification.  

Analysis Solution for:  
- Bioecology

### Operation

Check the image with COXEM’s special sample holder.  
'Low Vacuum' mode is useful in minimizing any damage to the sample.
13. Application of EDS

INTRODUCTION
By collecting and detecting ‘Characteristic X-rays’ generated by deviating electrons from electron beams using an energy dispersive spectroscopy, it is possible to make both a quantitative and qualitative analysis to determine constituent elements of the sample, including identification, concentration, and distribution.

1) Point Analysis
A quick analysis result can be obtained by designating a section, dot and other desired areas.

Benefits
EDS allows convenient obtainment of both quantitative and qualitative values.

Analysis Solution for:
- Material Industries
- Chemistry Industries
- Semiconductors and Electronics Industries
- Sandstone Industries
- Automotive Industries

Availability
Can be mounted in every COXEM system.
- EM-30Plus Series (EDS optional)
- EM-30 Series (EDS optional)
- CX-200 Series (EDS optional)
* EM-30AX and EM-30AX Plus have EDS integrated.

Operation
Making the sample as flat as possible may help obtain accurate values.

< An image showing particular points in an analyzed metal sample >
2) Mapping Analysis

If the sample consists of multiple elements, it is useful in representing the components in different colors to identify the distribution of each element.

Benefits

It provides images of elemental distributions in a sample without requiring quantitative point analysis.

Analysis Solution for:
- Material Industries
- Semiconductors and Electronics Industries
- Sandstone Industries

Operation

Mapping allows obtaining the information, by offsetting the ‘Peak overlap’ and the ‘background.’

< An image showing the comparison of Map, TruMap ('Peak Overlap' offset), QuantMap (a quantitative map), and PhaseMap (a phase map) >
3) Large Area Mapping

This function is designed to implement a high-resolution 'Elemental composition image' and EDS mapping for a large selected area.

Benefits

Useful when identifying the distribution of all the components of a sample.

Analysis Solution for:
- Material Industries
- Sandstone Industries

Operation

Each field can be observed in 'Zoom in' mode.

< An image mapping all components of an alloy sample >

< An image mapping all the wheat grains >
4) Gun Shot Residue (GSR) Analysis

This is an analysis method designed to detect remnants generated during a gun shot. The user can conduct the analysis by setting the conditions to analyze all the 42 detectable elements. This method is generally used in a Forensics application such as CSI (Crime Scene Investigation)

**Benefits**

Useful for forensic science.

Analysis Solution for:
- Scientific Investigation Industries

<table>
<thead>
<tr>
<th>Element</th>
<th>Wt %</th>
<th>σ</th>
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<tbody>
<tr>
<td>Barium</td>
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<td>Oxygen</td>
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<td>Sulfur</td>
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<table>
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<th>&lt;Morphology&gt;</th>
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<td>Area (μm²)</td>
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<tr>
<td>Aspect Ratio</td>
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<tr>
<td>Breadth (μm)</td>
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<tr>
<td>Direction (°)</td>
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<tr>
<td>ECD (μm)</td>
</tr>
<tr>
<td>Length (μm)</td>
</tr>
<tr>
<td>Perimeter (μm)</td>
</tr>
<tr>
<td>Shape</td>
</tr>
</tbody>
</table>
5) Multi Layer Analysis

Identify the thickness of a specimen composed of multiple layers by using just an X-ray, without a special pretreatment.

Benefits

Analysis Solution for:
- Material Industries
- Semiconductors and Electronics Industries

< An image showing the layers of a semiconductor sample >

6) Mineral Map Analysis

For a mineral sample with multiple components, you can observe the distribution of each component with a mapping analysis.

Benefits

Analysis Solution for:
- Sandstone Industries

< A mapping image for a mineral sample >
Perfect Table Top SEM for General Purpose

EM-30Plus

Features

- High Quality Images (5 nm resolution)
- Magnification Up To 150,000x
- Easy Navigation with the “Navigation Mode”

- Precise Control with a Joystick and the “Driving Mode”
- Combined SE and BSE Images
- Low Energy Consumption
- Intuitive User Interface

Specifications

- **Magnification**: x20-x150,000
- **Acc Voltage**: 1-30 kV (1kV increments)
- **Electron Gun**: Tungsten Filament (W)
- **Detector**: SE, BSE Detector (4 Channel Solid Type)
- **Image Shift**: X, Y, R(Rotation)

- **Stage**: Auto Stage (X: 35 mm, Y: 35 mm, T: 0-45°)
- Manual Stage (Z: 5 to 50 mm)
- **Operating System**: Microsoft Windows 7
- **Dimensions**: 400(W) x 600(L) x 550(H) mm
- **Weight**: 85 Kg
## Specifications

<table>
<thead>
<tr>
<th>Items / Model</th>
<th>EM-30Plus</th>
<th>EM-30AX Plus</th>
<th>EM-30</th>
<th>EM-30AX</th>
<th>CX-200TA</th>
<th>CX-200TM</th>
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<td>5.0 nm at 30 kV</td>
<td>20 nm at 30kV</td>
<td>3.0 nm at 30 kV</td>
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<td>Measurement Tool</td>
<td>Panorama Shot</td>
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<td>Special Multi Holder</td>
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<td>Special Features</td>
<td>Signal Mixing(SE+BSE)</td>
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