sec
e-beam pioneer





**X-ray Inspection System**
**Scanning Electron Microscope**

# sec

*e-beam pioneer*

SEC CO., LTD. designs and manufactures industrial X-ray inspection system and scanning electron microscope.

Established in 1991, SEC pioneered e-beam control technology and served most advanced inspection & analysis system to customers for laboratory research and quality assurance.

SEC prides itself on observing today's ever-changing needs for its customers by providing the most advanced and efficient technology in order to meet customer's production demands. Additionally, our goal is to provide the best service and attention to detail in order to exceed our customer's needs in a constantly evolving, technological environment.

# SEC Solution

## X-ray Inspection System

X-eye SF160

X-eye 3100

X-eye 5100

X-eyeMicro CT

X-eye 7000BS

X-eye 7000B

X-eye 6200

X-eye 6300

X-eye NF120

### X-ray Inspection System

Industrial X-ray inspection system, X-eye Series, cover all non-destructive X-ray inspection application. All X-eye series features outstanding configuration flexibility with various software tools, unparallel operator-friendly ergonomic design.

### X-eye Series

• SF160 Series    Semiconductor, PCB/SMD 3D Analysis.
• 7000 Series     Castings, LargeProduct NDT.
• 5100/3100       Semiconductor, SMT Assemblies Inspection / Analysis
• Micro CT        DeskTop 3D CT Inspection
• 6200            Automated In-line 2D X-ray Inspection / Analysis
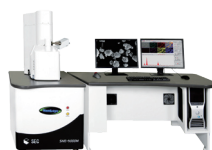• 6300            Automated In-line 3D X-ray Inspection / Analysis

## Scanning Electron Microscope

SNE-4500M

SNE-3200M / SNE-3000MB

SNE-5000M

Coater

EDS

### Scanning Electron Microscope

SEC provides premier electron microscope for nanotechnology. Nano-eye series covers affordable table-top electron microscope for entry level as well as conventional scanning electron microscope for experienced level.

### Nano-eye Series

• SNE-4500M    Max. 100,000x Tilt · Rotation strokes added
• SNE-3200M    Max. 60,000x, SE-BSE Image Dual Type
• SNE-3000MB   Max. 30,000x, 5kV to 30kV Variable Accelerating Voltage
• EDS System   Elemental Analysis Option.

# X-eye SF160ACT

## The Ultimate Solution for X-ray 3D CT Analysis



## Major Features

- 160kV Micro-focus X-ray Open Tube (1um Spot Size)
- 460mm x 510mm Table Size with full X, Y, Z, T, R strokes
- Max. magnification up to 4,800x
- Unparallel User Interface with various software tools
- Micro-CT Module & Oblique CT Scanning

## The Ultimate Solution for 3D CT Analysis

**SF160ACT** is a high-resolution micro-focus X-ray system for the inspection of semiconductor, PCB assembly, and electronic component. With its superior X-ray imaging, micro-scale hidden defects can be detected in high resolution.

SF160ACT equips 160kV micro-focus open tube with $1\mu m$ spot size. The system can magnify the object up to 4,800x and display the X-ray image at any angle using 6-axis manipulator configuration.

- Intuitive and Flexible User Interface
- No Complicated Jog-stick or Mouse Control
- Real-time Image Acquisition
- Auto Focus Tracing - Never lose your point of view
- Auto Teaching - Maximize Inspection Throughput
- GPU Based Ultra-fast 3D CT Reconstruction
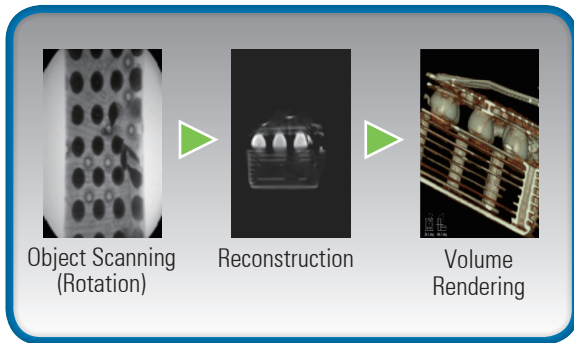- Easy Click-in Change Filament Replacement
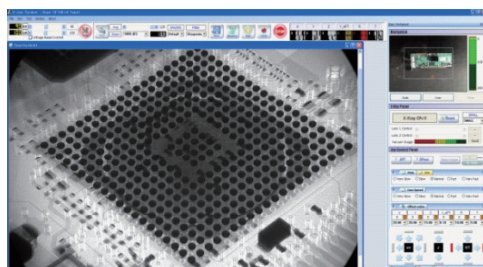


User Interface
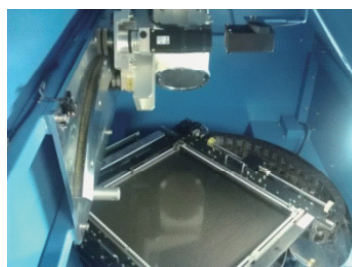
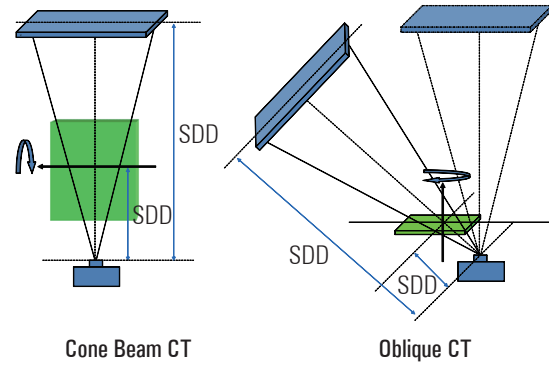

Manipulator



Jog-sticks & One-click Teaching Buttons

## Oblique CT Scanning Technology



Object Scanning (Rotation)　　Reconstruction　　Volume Rendering



SDD

SDD

SDD

SDD

**Cone Beam CT**　　　　**Oblique CT**

**3D CT** (Computed Tomography) visualizes all hidden structure and even micro-scale defects inside the object.
SEC unique oblique CT technology realizes high-magnified 3D CT visualization of large sample. Generally, it is known that CT scanning is limited by the object size, but oblique CT technology overcomes the size limitation and can be adapted to PCB assemblies, large-size Multilayer boards  and even to semiconductor wafers.

**Oblique CT** scans from an oblique direction while the object is rotating horizontally. The unique technology provides high magnified 3D images of flat and large components by horizontal object rotation without geometric interferences, and this realizes short source-to-object distance (SOD).
While inspecting the object in 2D, simply click the Oblique-CT scan button without any table switching, and the system will provide you the 3D CT images within minutes. GPU-based CT Reconstruction Engine will improve your throughput tremendously.

## X-ray Images by Application

• SMT (Surface Mount Technology) Assembly
　- BGA / CSP - Open, Crack, Cold Soldering
　- General Solder Joint - Bridging, Void
　- Auto Voiding Area Calculation

• Semiconductor Packaging / LED
　- Wire Bonding - Broken Wire, Lifted Wire, Sweeping
　- Bump / Pattern Delamination, Void, Crack
　- 3D Packaging - MCP, TSV, FCB micro defect

• Multilayer PCB (Printed Circuit Board)
　- Multilayer Pattern Open/Short Inspection / Analysis
　- Via-Hole Alignment, Copper Wall Plate
　- FPCB (Flexible PCB) - Blind Via Hole (Laser Via)

• Electronic Components
　- Connector - Internal Wire Connection
　- Camera Module - Component Attachment
　- General Pattern Open / Short, Hidden Contamination

## 3D CT Software Features

• VR (Volume Rendering) for 3D

• Visualization from any angle

• DICOM 3.0 standard compatible

• 3D Sync.

• Unlimited Oblique Slice / Unlimited level Oblique View

• VR with cut plane, MIP, MPR

• 3D Measurement with Analysis Features

• 3D Zoom

• Report Function
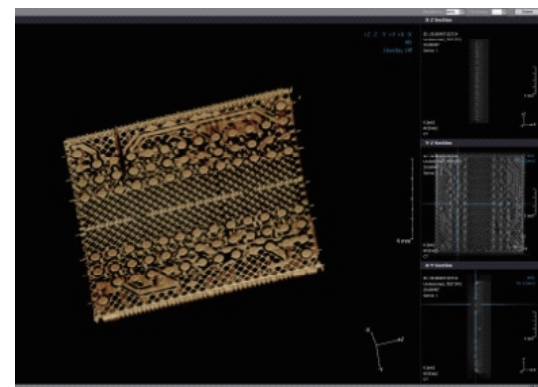
# X-eye 5100 / 3100 Series

## High Performance X-ray Inspection System



## Major Features

- 100kV Micro-focus Closed-tube (5$\mu$m Focal Spot Size)
- Flat Panel X-ray Detector Equipped
- Max. 4-axis manipulator configuration (X, Y, Z, Tilt)
- Auto Teaching (CNC Programming)
- Various Measuring Tool & Auto BGA Inspection Module

## The Ultimate Solution for X-ray Inspection

X-eye 5100 / 3100 Series are high-performance X-ray Inspection systems for general non-destructive testing and failure analysis. With 100kV micro-focus closed tube & High Resolution Flat Panel Detector equipped, X-eye 5100 / 3100 Series provide high quality X-ray image at high magnification.

With programmable multi-axis control, X-eye 5100 / 3100 Series can inspect the object at any magnification with the ease of use. With Auto Teaching (CNC programming), the system can be used as a semi-automatic inspection system.

X-eye 5100 / 3100 Series come with user-friendly operating environment. Various measuring and annotation tools are included.
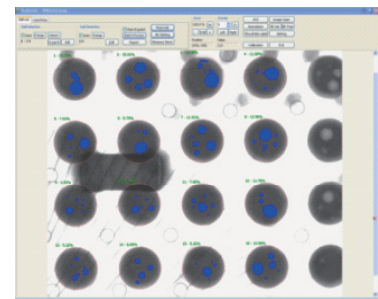
## Applications

- SMT Assemblies Inspection
  - BGA Void, Open, Missing, Bridging
  - General Solder Joint Inspection
- Semiconductor
  - Wire Bonding Inspection, Epoxy Voids
  - LED
- Electronic Components
  - Connector, Camera Module
  - Internal Structure, Hidden Component
- Storage Battery Inspection
- Plastic Components
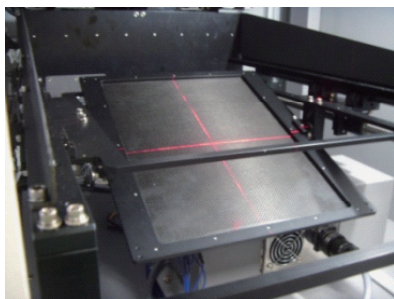


Manipulator
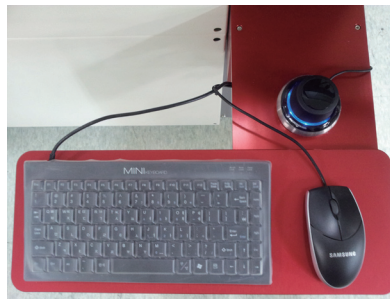


Jog-stick Control



Auto BGA Inspection Module

# X-eye Micro-CT

## Tabletop  X-ray Inspection System

## Major Features

• 90kV Micro-focus Closed-tube (5$\mu$m Focal Spot Size)

• Flat Panel X-ray Detector Equipped

• 50mm ($\Phi$) x 100mm(H) Table Size

• GPU Based High-Speed 3D Reconstruction

• Various 2D/3D Measuring & Annotation Tool

## High-Performance 3D CT System
## for laboratory NDT analysis

X-eye Micro CT is compact X-ray 3D CT system for laboratory NDT analysis. With micro-focus X-ray tube, the system provides the internal structure of component such as semiconductor packaging, small electronic parts (MEMS), or molded plastic components.

With 3D CT (Computed Tomography) module integrated, X-eye micro CT system visualizes all hidden structures with slice-section image or 3D rendering image. This non-destructive 3D CT inspection technology will totally replace number of time-consuming section analyses and will identify the location  of the defect perfectly with all geometric information.

## Applications

• Electronic Components
  - Connector - Internal Wire Connection
  - Camera Module - Component Attachment
  - General Pattern Open / Short, Hidden Contamination

• Semiconductor Packaging
  - Wire Bonding - Broken Wire, Lifted Wire, Sweeping
  - Bump / Pattern Delamination, Void, Crack
  - 3D Packaging - MCP, TSV, FCB micro defect
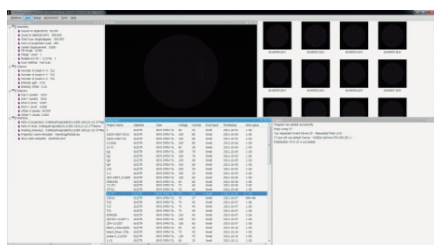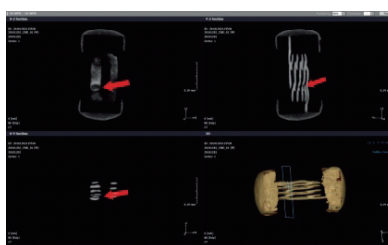
CT Reconstruction                    3D Rendering Software                    Manipulator

7
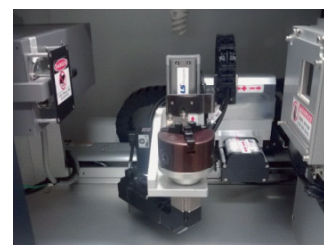
# X-eye 7000 Series

## Non-destructive X-ray Inspection and Analysis



## Major Features

• 160kV/225kV Micro-focus Open-tube

• Max. Sample loading up to 600mm ($\Phi$) x 900mm(H) / 50kg

• Max. 5-axis manipulator configuration (X, Y, Z, Tilt, Rotation)

• Auto Teaching (CNC Programming)

• 3D CT Module - Provide Computed Tomography Solution

## The Ultimate Solution for X-ray Inspection

X-eye 7000 Series provide NDT (Non-destructive X-ray Testing) solution for medium-large sized product. Equipped a high-power micro-focus X-ray Source, X-eye 7000 series provide X-ray image of the inspection object at any view, at any angle with large FOV. Various image enhancement tools and Auto-teaching (CNC programming) function will provide you the best X-ray inspection solution.

3D CT (Computed Tomography) module can be integrated to X-eye 7000 Series. With superior 3D CT Visualization, 100% of industrial demanding defects such as cracks and porosities in casting components can be detected in high resolution.
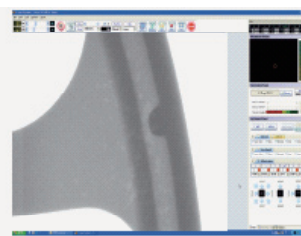
## Applications

• **Automotive Component (Die Casting)**
  - Mission Housing, Engine Block, Wheel, Piston
  - General Aluminum Casting Component

• **Electronic Components**
  - Automotive Controller Module (ECU)
  - Storage Battery (Pouch Type)

• **Quality Assurance - 3D CT Analysis**
  - 3D Rendering of Object
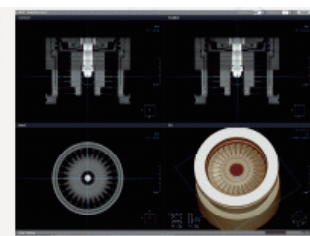  - Unlimited Oblique Slices
  - Reverse Engineering



Manipulator (X-eye 7000BS)          Manipulator (X-eye 7000B)          User Interface          3D Rendering Software

# X-eye 6200/6300

## SMT 2D/3D In-line AXI

## Major Features

• Automated In-line 2D/3D X-ray Inspection

• High detection of industrial demanding defect on PCBA

• Intuitive - Flexible Configuration, Easy to Program

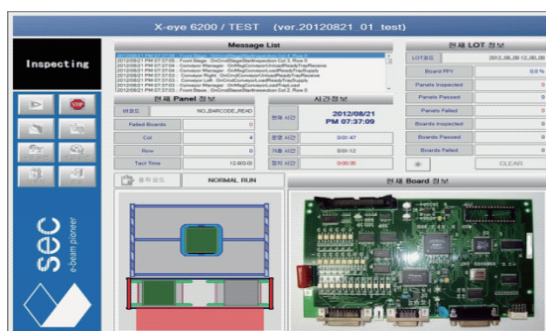• Fast Throughput (Max. 1200 sq. mm / sec)

• Cost Effective

## The Ultimate Solution for Auto X-ray Inspection

X-eye 6200/6300 System provides complete automated in-line X-ray inspection of solder joints and other hidden component on PCB assemblies. With tray-to-tray conveyor configuration and processing capabilities to find defects, X-eye 6200/6300 System's AXI technologies successfully deliver a variety of solutions meeting industrial demanding challenges.

X-eye 6200/6300 System is intuitive to use, fast to create the inspection routine and built to high quality standards. With simple program creation and tuning, X-eye 6200/6300 System increases the productivity of your inspection programming staff.

X-eye 6200/6300 System's AXI solution offer a new level of in-line X-ray inspection performance to deliver the highest throughput and superior detection with a minimal of false calls.
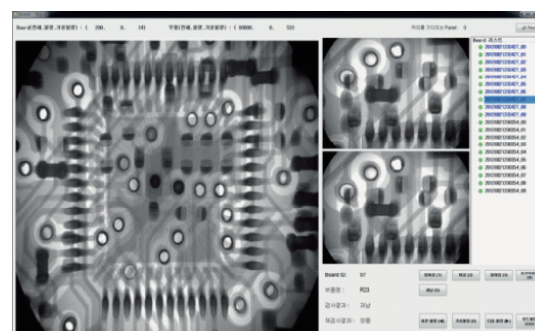
## Inspection Component

• BGA
• QFN / TR
• QFP
• Chip Component

## Inspection Item

• Open / Short
• Insufficient / Excessive Solder
• Void
• Component Presence and Position

## Applications

• Hidden Solder Joint
• Shielded Component



User Interface (Automated Inspection Mode)



User Interface (Operated Inspection Mode)

# SPEC Overview

## X-eye SF160A

| | |
|---|---|
| X-ray Tube | 160kV Open Tube / 1μm Spot Size |
| X-ray Detector | 2/4" or 4/6" Dual-fold Image Intensifier |
| Manipulator | 460mm x 510mm Table Size |
| Axis Control | X, Y, Z, T, R 5-axis Full Strokes |
| Dimension | 1550(W) x 1750(D) x 1850(H) mm |
| Application | PCBA, Semiconductor Packaging Inspection, Failure Analysis, 3D CT* |

## X-eye 5100/3100

| | |
|---|---|
| X-ray Tube | 100kV Micro-focus Closed Tube |
| X-ray Detector | Flat Panel X-ray Detector |
| Manipulator | 460mm x 340mm Table Size / 350mm x 270mm |
| Axis Control | X, Y, Z, T 4-axis / X, Y, Z 3-axis (T axis Option) |
| Dimension | 1300(W) x 1000(D) x 1500(H)mm / 900(W) x 1000(D) x 1500(H)mm |
| Application | SMT Assemblies, Semiconductor, Electronic Components, Storage Battery Inspection / Analysis |

## X-eye 6200/6300

| | |
|---|---|
| X-ray Tube | 100kV Micro-focus In-line  X-ray Tube |
| X-ray Detector | 4/6" Image Intensifier |
| Manipulator | Max. 330mm x 250mm |
| Axis Control | X, Y, Z 3-axis |
| Dimension | 1300(W) x 1650(D)  x 1960(H)mm |
| Application | BGA, QFN / TR, QFT, Chip Component Inspection / Analysis |

## X-eye Micro CT

| | |
|---|---|
| X-ray Tube | 90kV Closed Tube |
| X-ray Detector | 2" Flat Panel X-ray Detector |
| Sample Size | Ø50 x 100(H) mm / 5kg |
| Axis Control | X, Y, Z, R 4-axis |
| Dimension | 1,000(W) x 800(D) x 1200(H) mm |
| Application | Semiconductor Packaging, Electronic Component Failure Analysis, 3D CT* |

## X-eye 7000BS

| | |
|---|---|
| X-ray Tube | 160kV Open Tube |
| X-ray Detector | 4/6" or 5/7/9" Image Intensifier |
| Sample Size | Ø200 x 300(H) mm / 15kg |
| Axis Control | X, Y, Z, T, R 5-axis (Object Tilt) |
| Dimension | 1,900(W) x 1,400(D) x 1,600(H)mm |
| Application | Electronic Component , Small-Medium Die Casting Inspection / Analysis |

## X-eye 7000B

| | |
|---|---|
| X-ray Tube | 160kV / 225kV Open Tube |
| X-ray Detector | 5/7/9" Image Intensifier |
| Sample Size | Ø600 x 900(H) mm / 50kg |
| Axis Control | X, Y, Z, T, R 5 axis (Tube-Detector Tilt) |
| Dimension | 2,250(W) x 1,750(D) x 2,000(H)mm |
| Application | Medium-Large Die Casting Inspection  / Analysis |

# X-Ray Application

## PCB / SMD

▷ BGA/CSP on PCB - Open / Short / Missing . Void
▷ General Solder Joint - QFN / Connector / Resistor
▷ Auto Void Calculation / Auto Teaching
▷ Open / Cold Soldering - 2D Oblique View / 3D CT
▷ SEC Oblique CT - CT Scan of PCBA (No destruction)
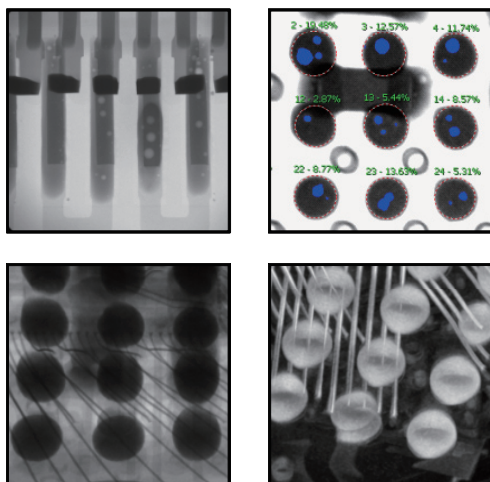


## Semiconductor Packaging

▷ Production Line - 2D Inspection
    - Bonding Wire (Au/Cu), Bump / Void Inspection
▷ Quality Assurance - 3D CT Analysis
    - TSV, Bump Delamination, Multi-Chip Packaging
    - 3D Packaging
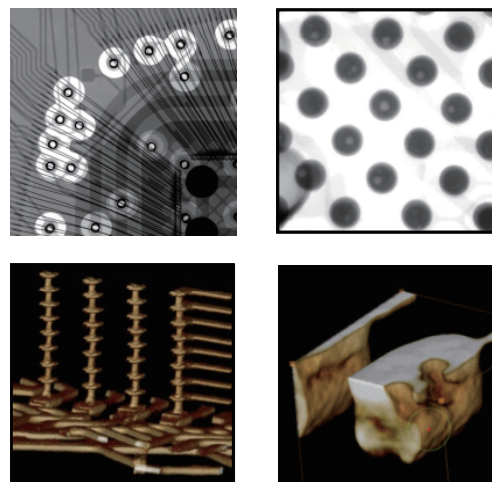


## Electronic / Automotive Component

▷ Electronic Component
    - Camera Module, Connector, Battery, LED
▷ Automotive Component
    - Connector, Harness Cable, Switch
▷ Internal Structure / Hidden Component
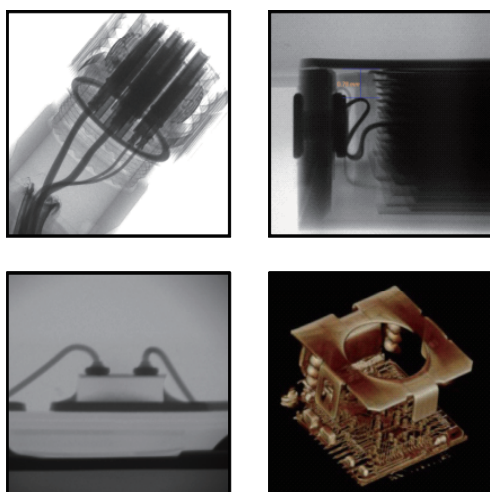


## Castings

▷ Automotive Component (Die Casting)
    - Mission Housing, Engine Block, Wheel, Piston
    - General Aluminum Casting Component
▷ 3D CT - Reverse Engineering
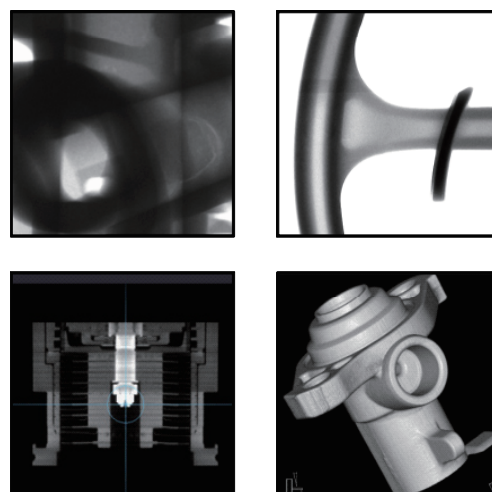
# Mini-SEM SNE-4500M



## Major Features

• Max. 100,000x Magnification

• SE Detector (Option – BSE Detector)

• 5kV to 30kV Variable Accelerating Voltage

• Multi-Vacuum Mode – Standard / Charge Up Reduction

• Image Observation Ready within 2 min.

• 5-axis Strokes – X, Y, R, Z, T

• 4-Hole Variable Aperture (30/50/100/200 μm)

• Options – EDX System, Cooling Stage, Low Vacuum Control

## Best specification ever among table-top Electron Microscope

SNE-4500M is focused on two essentials: powerful performance and user-friendly environment. Even with the table-top configuration, SNE-4500M provides high-quality SEM images with the ease of use. No doubt about strong performance and flexible integration - full stroke control including tilt and rotation, optional EDX system and many other tools for your application. Mini-SEM can easily magnify up to 100,000x with variable (5kV to 30kV) accelerating voltage in seconds. Auto-focus, Auto-brightness and contrast produce an excellent image every time.

EDS (Energy Dispersive Spectroscope) can be adapted SEC Mini-SEM. With powerful performance of Mini-SEM, it brings a very accurate analysis information including spot analysis, mapping, and so on.
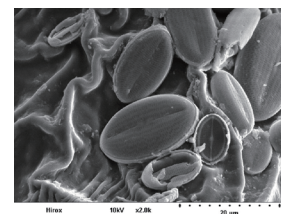
## Mini-SEM User Interface
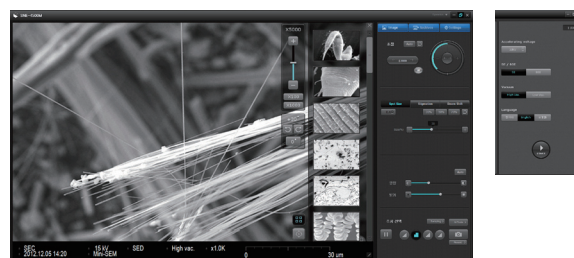


Sample Image :
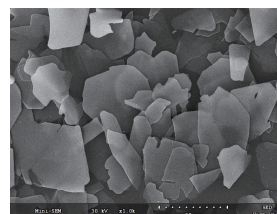


Aluminium Powder                  Flower's Stamen

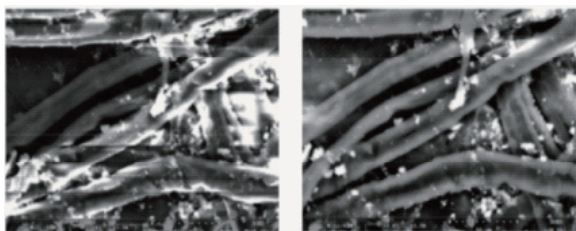# Mini-SEM SNE-3200M / 3000MB



## Major Features

- Max. 60,000x Magnification
- SE Detector, BSE Detector - Multi Mode / SNE-3200M
- 5kV to 30kV Variable Accelerating Voltage
- Multi-Vacuum Mode - Standard / Charge Up Reduction
- Image Observation Ready within 2 min.
- 5-axis Strokes - X, Y, R
- Options - EDX System, Cooling Stage

## SEC Mini-SEM the ultimate tool for Nanotechnologists

**Mini-SEM** is a table-top, high resolution, high magnification, high performance scanning electron microscope. The Mini-SEM combines the performance of conventional SEM, with the size, price, and ease of use you would expect from a table-top version. Mini-SEM can easily magnify up to 60,000x with variable (5kV to 30kV) accelerating voltage in seconds. Auto-focus, Auto-brightness and contrast produce an excellent image every time.

**EDS** (Energy Dispersive Spectroscope) can be adapted SEC Mini-SEM. With powerful performance of Mini-SEM, it brings a very accurate analysis information including spot analysis, mapping, and so on.

## Major Applications

- **Material Science**
  - Metal / Ceramic Surface, Fiber Texture
  - Particle Distribution and Size Measurement
  - Failure Analysis - Corrosion, Stress

- **Semiconductor**
  - Wafer, Bonding Wire, LED, Micro-Pattern
  - CNT (Carbon Nano Tube)

- **Biological / Pharmaceutical**
  - Food, Bacteria, Medicinal Powder

- **Education / Healthcare**

Sample : Paper (Non-coating)



Standard mode          Charge-up reduction mode

Sample : Metal Surface



BSE Image                    SE Image

13
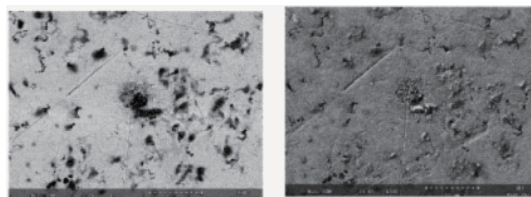
# EDS System



## Nano-Analysis for Electron Microscope

EDS (Energy Dispersive Spectroscope) can be adapted to all SEC Scanning Electron Microscopes. Elemental Analysis is the most widely used technique for elemental identification and visualization of material. EDS analysis facilitates the characterization of nearly all matter simultaneously starting from beryllium (4) on the periodic table. This technique is critical to the development of novel materials in research and development and for analyzing failures in the manufacturing process.

## Major Features

- SDD Type - Nitrogen Free
- Elemental Detection from Boron (5) to Americium (95)
- Spectrum Resolution < 133 eV (MnKa)
- Multi - point Analysis / Line Scan / Elemental Mapping
- Window - SUTW (Super Ultra Thin Window)
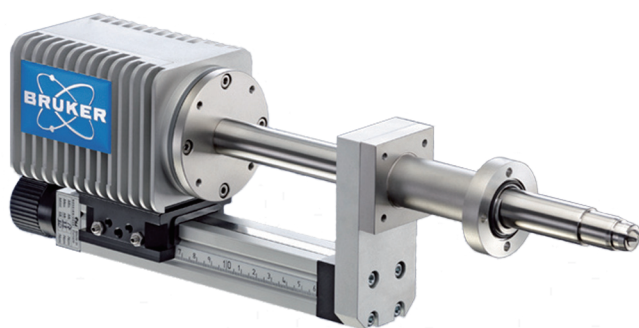


# Ion Sputter Coater

## MCM-100

## Major Features

- Quick and Easy Operation
- Sample Loading Size - Max. 50mm
- Target Material - Au (Gold)
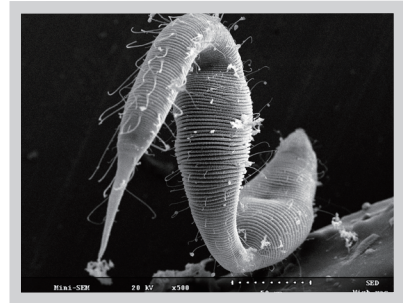- Dimension / Weight - 180(W) x 310(D) x 310 (H) / 15kg
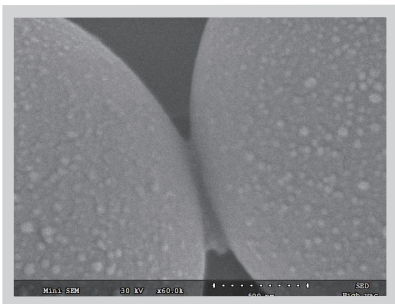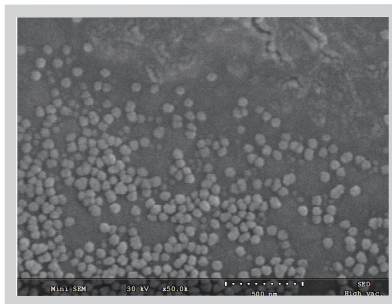
# SEM Application
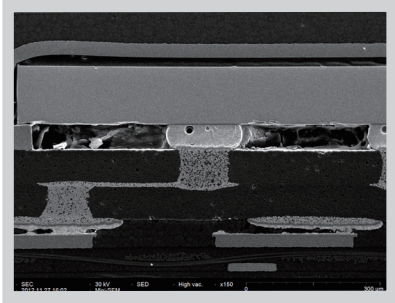
BGA Section
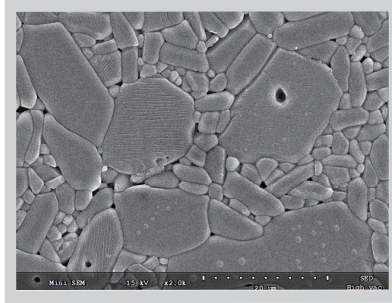
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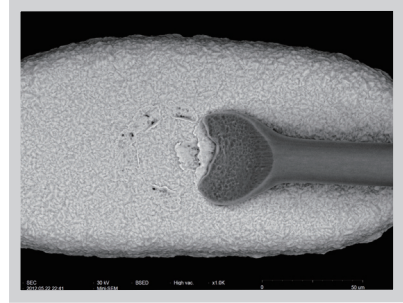
Chip Pad
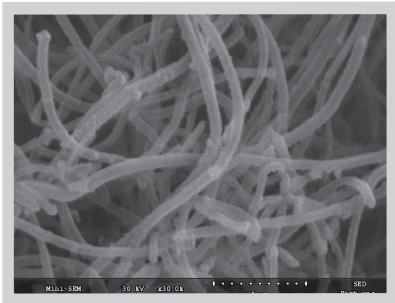
Carbon Nano Tube (CNT)

Fiber
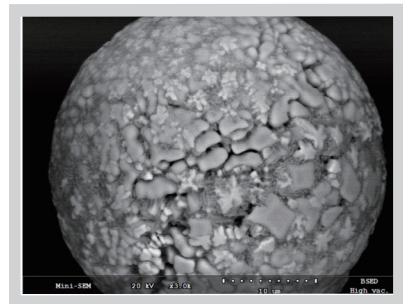
Sea Animal

Silicon Latex

Nano Powder

Powder
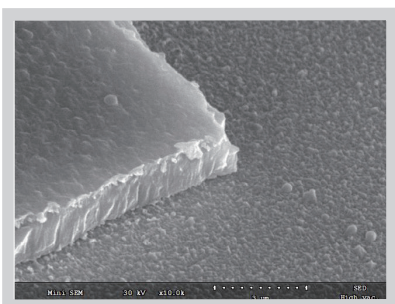
Wafer
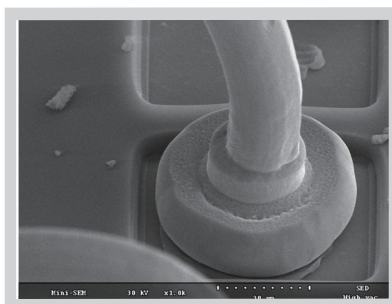
Bonding Wire
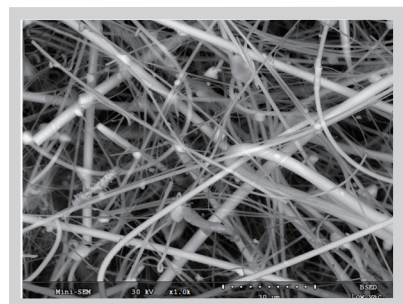
Wool

## South Korea - Headquarter

415 Factory World, 332-2 Woncheon-Dong
Suwon, South Korea 443-758

T e l :  +82 31 215 7341
F a x :  +82 31 215 7343
E-mail:  sales@seceng.co.kr
**www.seceng.co.kr/eng**

## China - Shanghai Office

Room 101, Building 5, No. 100 Zixiu Road,
Minhang District, Shanghai, China 201103

T e l :  021 6083 0707
E-mail:  sales@seceng.co.kr
**www.seceng.co.kr/CHI**

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