

SCANNING
ELECTRON
MICROSCOPE

SU3500

Notice: For correct operation, follow the instruction manual when using the instrument.

Specifications in this catalog are subject to change with or without notice, as Hitachi High-Technologies Corporation continues to develop the latest technologies and products for our customers.

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Bringing the frontier to the forefront.

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HTD-E203 2012.7

Hitachi High-Tech

HITACHI

SCANNING
ELECTRON
MICROSCOPE

SU3500

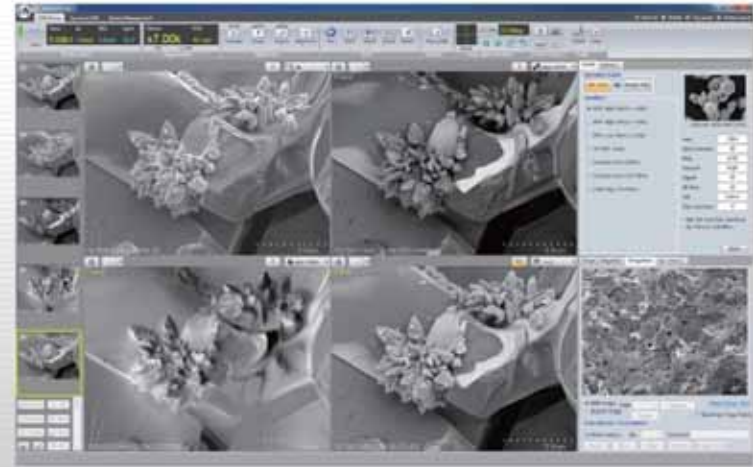


A New Dimension in Image Quality

SU3500



Screen shows simulated image



Operation GUI for SU3500
Upper left : Secondary Electron (SE) image, Upper right : Backscattered Electron (BSE) Compositional image
Left below : Backscattered Electron Topographic image, Right below : SE and BSE mixed image

Unparalleled Image Quality

Novel and innovative electron optics and image display rendering engine

P3

Multi-Functional, Automated Specimen Stage

Enhanced navigation via new analytical chamber and automated stage functions

P11

Robustness & Versatility

Image observation and analysis without traditional specimen preparation techniques

P5

Intuitive Operation

Delegation technology affords easy operation and increased throughput efficiency

P7

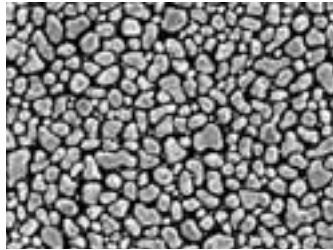
SU3500

SCANNING ELECTRON MICROSCOPE

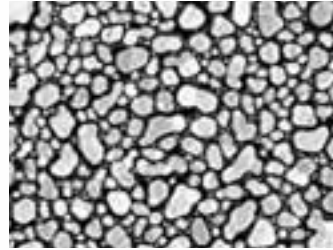
High Resolution at Low Accelerating Voltage

7nm SE Image Resolution at 3kV, 10nm BSE Image Resolution at 5kV

The electron optics design yields unmatched imaging performance. The SU3500 employs a new low-aberration objective lens and improved bias function that provides higher emission current at low kV. These improvement gains allow the SU3500 to achieve 7nm SE image resolution at 3kV accelerating voltage and 10nm BSE image resolution at 5kV accelerating voltage.



Accelerating Voltage: 3kV, Secondary Electron (SE) Image
Magnification: x40,000, Resolution:7nm



Accelerating Voltage: 5kV, Backscattered Electron (BSE) Image
Magnification: x30,000, Resolution:10nm

Sample:
Gold particles
on Carbon

Maximizing Signal Intensity

High imaging performance at low accelerating voltage

The emission current extracted from a tungsten filament is proportionally reduced as the accelerating voltage is decreased; therefore, the image signal-to-noise ratio is typically compromised. The SU3500 employs an improved gun bias system that optimizes the emission current at several acceleration voltage levels for enhanced brightness, but also optimizes the emission across the entire 300-30kV range. The result is best-in-class image sharpness (S/N) at low accelerating voltages.



Previous model



SU3500

20sec Scan,
Accelerating Voltage 1.5kV
Magnification: x110
Sample: Copepod
With Ionic liquid

Improved Signal Processing

New image display engine allows quick and easy focus and astigmatism correction

The SU3500 incorporates a revolutionary Image Signal Processing function that optimizes the image quality on the fly, makes it easier for focus adjustment and astigmatism correction during real time observation.

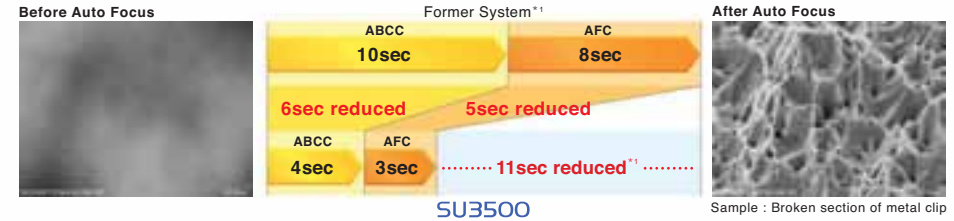


Live image at fast scan
Sample : Printed circuit board

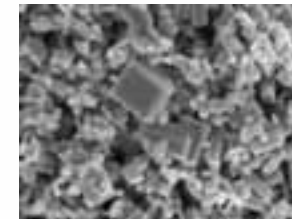
Improved Processing Speed and Accuracy

Highly efficient Automatic Focus Control (AFC) and Auto Brightness/Contrast Control (ABCC) functions

More accurate and faster AFC and ABCC algorithms enable optimized image observation and higher throughput**.



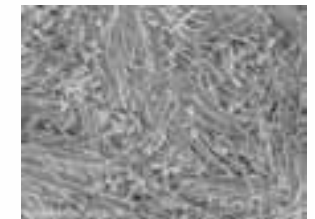
Application Data from High Vacuum Mode



Sample : ZnO
Accelerating Voltage : 5kV, Magnification : x30,000
Without metal coating



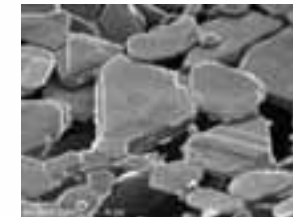
Sample : Titanium Oxide Particle
Accelerating Voltage :3kV,
Magnification : x15,000, Without metal coating
Sample : Courtesy of Prof.Masato Kakiyama,Tohoku University



Sample : Tablet (Confectionery)
Accelerating Voltage : 1.5kV,
Magnification : x10,000
Without metal coating



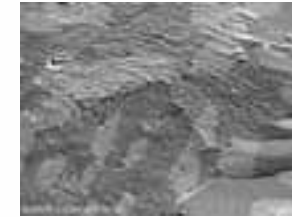
Sample : *Helicobacter bilis*, Accelerating Voltage : 2kV,
Magnification : x17,000,With OsO₄ coating
Sample : Courtesy of Prof. Yoshiaki Kawamura,
Aichigakuin University



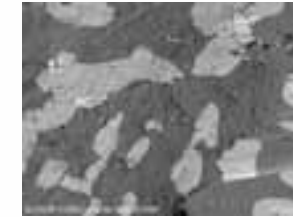
Sample : Al₂O₃/Fe₂O₃ sintered body, Accelerating Voltage : 3.0kV,
Magnification : x20,000, Without metal coating
Sample : Courtesy of Prof.Minoru Fukuhara,
Okayama University of Science



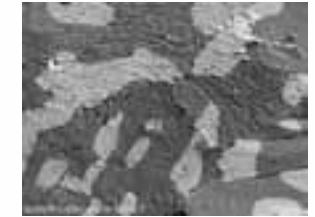
Sample : Gold-Isocyanide Complex
Accelerating Voltage : 1.5kV,
Magnification : x2,100
Without metal coating



Sample : Solder
Accelerating Voltage : 5kV
Magnification : x10,000
Pressure : High Vacuum
Secondary Electron (SE) Image
Without metal coating



Sample : Solder
Accelerating Voltage : 5kV
Magnification : x10,000
Pressure : High Vacuum
Backscattered Electron (BSE) Image
Without metal coating



Sample : Solder
Accelerating Voltage : 5kV
Magnification : x10,000
Pressure : High Vacuum
Mixed Image (SE Image + BSE Image)
Without metal coating

** 1 Comparison S-3400N
* 2 AFC and ABCC throughput may vary depending on many factors.

Low Vacuum Mode Advantages

The SU3500 incorporates variable pressure capability. The newly designed vacuum system enables low vacuum settings within the range of 6-650Pa. The vacuum condition is actively monitored in real-time for maintaining stable vacuum levels at the selected pressure.

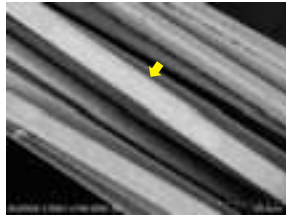
Charge less observation without metal coating of non-conductive specimen possible.

Metal coating, such as Au or Pd absorbs SE, BSE, and X-ray signals from the specimen and weaken SEM detectable signals.

No peak overlapping X-ray analysis is possible without metal coating.



High Vacuum mode without metal coating : Image distortion due to surface charging.



Observation with metal coating : Material contrast of Ti (arrowed) is reduced by metal coating.

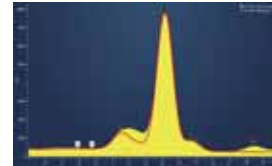


Low Vacuum mode without metal coating : Less specimen surface charging.

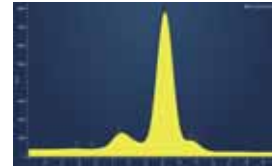


Observation without metal coating : Clearer material contrast of Ti (arrowed) at low vacuum mode.

Sample : Photocatalytic Fiber



EDS Spectrums with metal coating : Spectrums of Zr and Pt (coating material) are overlapped.



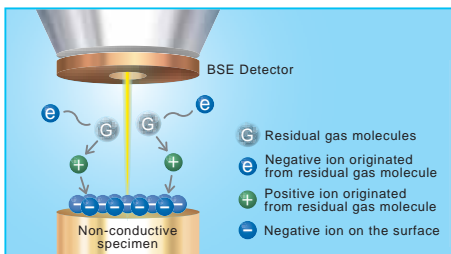
EDS Spectrums without metal coating : Spectrums of Zr can be clearly identified.

by Oxford EDX AZtec(Optional)

Sample : Zirconium Sulfide

Operating theory of Low Vacuum mode

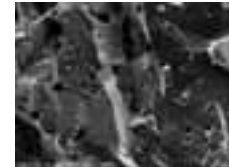
Utilizing a low vacuum environment can allow observation of water or oil based specimens in a natural state. The positively charged ions originated from the residual gas molecules generated by electron beam neutralize negatively charged electrons impinged on the specimen surface. Low vacuum observation eliminates traditional sample preparation requirements such as specimen dehydration or metal coating.



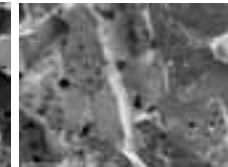
Observation at Low Vacuum

The new, innovative Ultra Variable-Pressure Detector (UVD) (Optional)

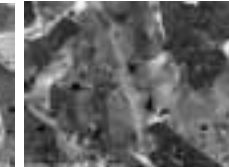
The new Ultra Variable-Pressure Detector (patent pending) is a highly sensitive detector for low vacuum mode, which is optimized for imaging surface details at low acceleration voltages. The UVD image provides compositional contrast information at higher acceleration voltage - as shown below. The combination of the UV and BSE detectors simultaneously provides detailed, complimentary compositional and surface information.



Accelerating Voltage : 15kV



Accelerating Voltage : 5kV



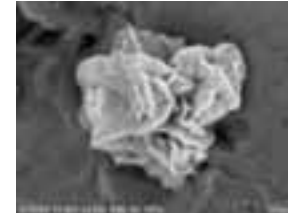
Accelerating Voltage : 1.5kV

Sample : Varistor
Vacuum : 30Pa

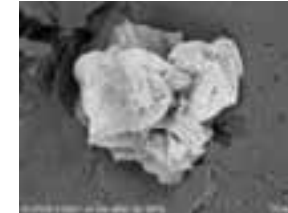


External view of Ultra Variable-Pressure Detector

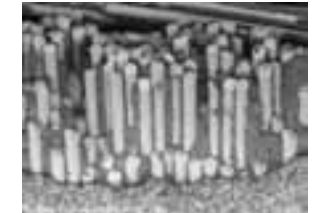
Application Data from Low Vacuum Mode



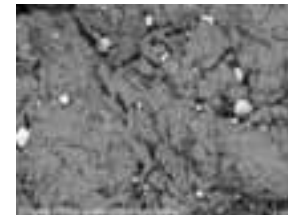
Accelerating Voltage : 15kV
Sample : Copper Mineral, Vacuum : 70Pa,
Magnification : x4,500, Detector: BSE Detector
Without metal coating



Accelerating Voltage : 5kV
Sample : Copper Mineral, Vacuum : 30Pa,
Magnification : x4,500, Detector: BSE Detector
Without metal coating



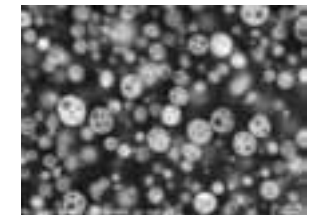
Sample : Filler (Glass fibers) in Resin
Accelerating Voltage : 5kV, Vacuum: 50Pa,
Magnification : x1,000, Detector: BSE Detector
Without metal coating



Sample : Polyvinyl Alcohol
Accelerating Voltage : 3kV, Vacuum: 60Pa,
Magnification : x1,000, Detector: BSE Detector
Without metal coating



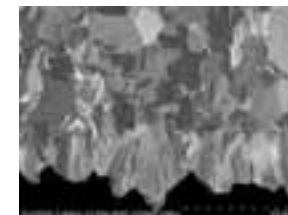
Sample : Polyvinyl Alcohol
Accelerating Voltage : 3kV, Vacuum: 60Pa,
Magnification : x1,000, Detector: Ultra Variable-
Pressure Detector, Without metal coating



Sample : ABS Resin
Accelerating Voltage : 10kV, Vacuum 30Pa,
Magnification : x20,000, Detector: BSE Detector
With OsO4 staining



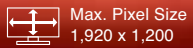
Sample : Cross section of Printed Circuit Board
Accelerating Voltage : 5kV, Vacuum : 30Pa,
Magnification: x150, Detector : BSE Detector
Without metal coating
Treated by the Hitachi Ion milling system IM4000



Sample : Cross section of Printed Circuit Board
Accelerating Voltage : 3kV, Vacuum : 20Pa,
Magnification : x5,000, Detector: BSE Detector
Without metal coating
Treated by the Hitachi Ion milling system IM4000

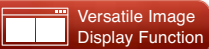


Sample : Sphaeromatidae
Accelerating Voltage : 15kV, Vacuum : 50Pa,
Magnification : x85, Detector: BSE Detector
Without metal coating



Improved Visibility and Operation with a 24.1 inch Wide Screen

The wide screen allows to display single large size image or multiple images for multi-functional purposes.



Real time multi-signal processing and display

Single image, dual image, quadruple image, and full screen image display layouts are available. This allows multi-signal image observation simultaneously and real time image comparison.



Single image display (800 x 600 pixels) Good for finding observation target or focus adjustment.



Dual image display (800 x 600 pixels x 2) Two different signal of live images are displayed simultaneously. This allows effective image comparison like the SE/UVD for surface info or BSE compositional image.



Quadruple image (640 x 480 pixels x 4) Real time 4 different image display for effective multiple image comparison, for example, SE image, BSE compositional image, BSE topographic image, and BSE 3D image.

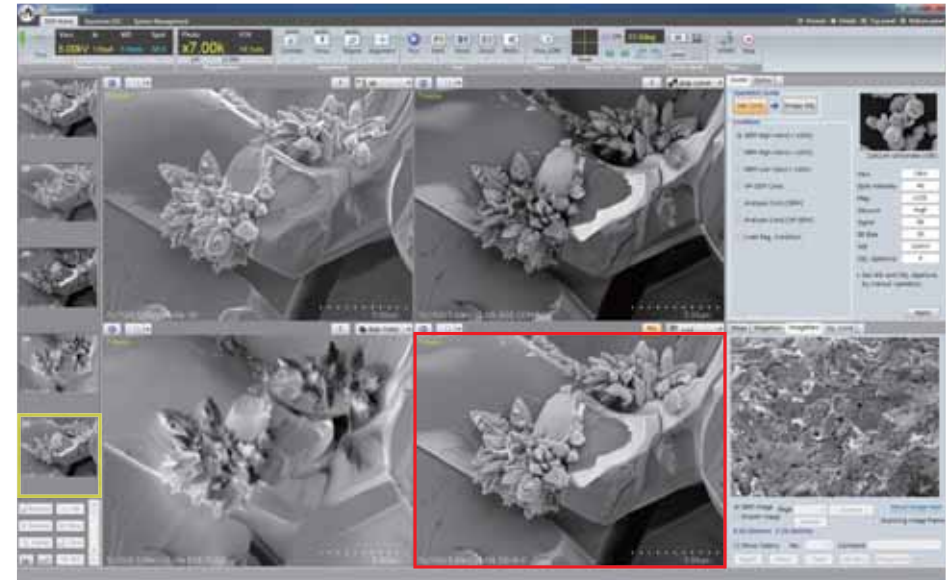


Full screen image (1,280 x 960 pixels) Real time high resolution & large sized image display suitable for observing the image with multiple users.



Unique live signals can be mixed and displayed as a combined live image

Multiple live signals for the same view can be mixed and displayed as one combined live image. This allows effective image analysis with multiple signals in one image; for example, the secondary electron (SE) providing surface rich information and the back scattered electron (BSE) signal for compositional information. (outlined picture in red: SE and BSE mixed image)



Two-way selectable Magnification Display

Two selectable magnification display available based on either the conventional Polaroid Size (127mm x 95mm) or the image size on the LCD screen.



User customizable icon setting

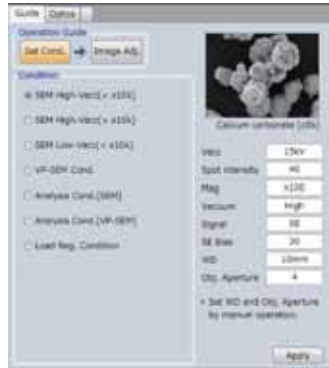
The icon selection and setting can be customized depending on needs and frequency of use. This will help improve work efficiency.



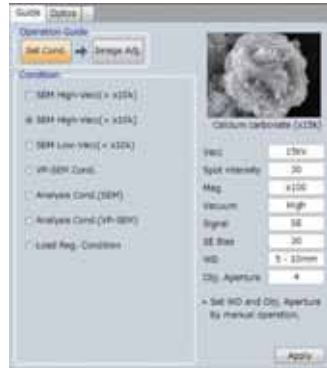


“Operation Guide” enables inexperienced users to select the optimum condition easily

Six commonly used operating condition sets are pre-registered on the SU3500 by Hitachi. This will allow any users to find the basic observation condition quickly. Also the user defined condition set can be registered and retrieved for quick start.



SEM High-Vacc (< x10K)



SEM High-Vacc (> x10K)

The Easy Flow Wizard guide assists at each operation step that allows even an occasional user to use the SEM effortlessly.



Guide screen for focus adjustment

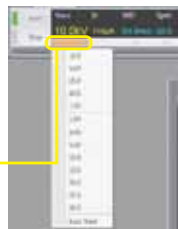


Guide screen for astigmatism correction

Auto Start function

“Auto Start” executes electron beam irradiation, adjustment of focus, brightness, and contrast automatically at the selected accelerating voltage.

Acc.Voltage Split pull-down



Operation Panel is a standard component

The Operation Panel integrates all the necessary controls (scan speed, auto brightness and contrast, focus, magnification, and image capture and save) into one convenient location on the SEM console.



“Video Maintenance Wizard Guide” provides accurate and easy to understand maintenance instruction

User maintenance can be done easily by following the video instructions.

Filament exchange



Condenser lens aperture exchange



Alignment



Stage Control

Eucentric 5-Axis Motorized Stage

1 X-Y, Tilting(T), Rotation(R), Height(Z) Control

By track ball (joystick as an option), a mouse control or numerical data input.

2 X-Y Step Move control

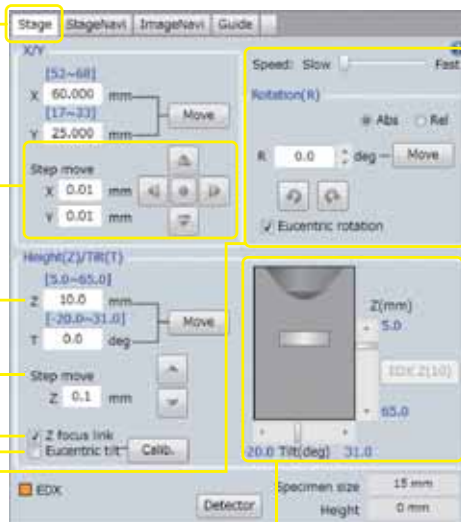
Stage movement by specified step distance at each click. Effective for repeated pattern observation.

3 Z focus link

The image is kept in focus while Z position is changed.

4 Programmed Eucentric Tilt/Rotation

The field of view is kept in screen without losing the view from the screen while the stage is tilted/rotated.



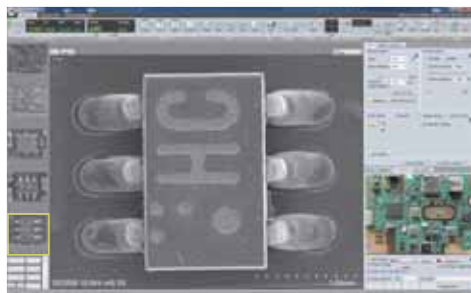
5 Graphic display of observation point

The relative position of the specimen and the objective lens is graphically displayed.

Locating area of interest

"Image Navigation Function"

"Image Navigation Function" enables the operator to find the observation target quickly by navigating the stage based on low magnification optical scope or digital camera image. The available file formats are BMP, JPEG, and TIFF.



Tracking Stage Positions

"Stage Navigation Function"

The "Stage Navigation Function" keeps track of X/Y stage coordinates and displays the current stage coordinates and previously visited coordinates. "Stage Navigation Function" allows the user to revisit previously visited positions quickly and easily.



Centering the Area of Interest

RISM and ZOOM Function

RISM (Rapid Image Shift Mode):

The area of interest is moved to the screen center by clicking the area of interest.



Click the area of interest to move it to the screen center



Drag the area of interest to move it to any screen position

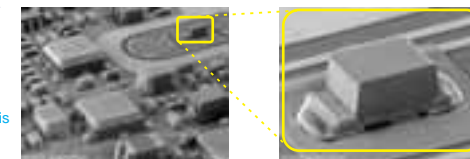


ZOOM:

The area of interest enclosed by mouse dragging is automatically centered and enlarged on the live image.



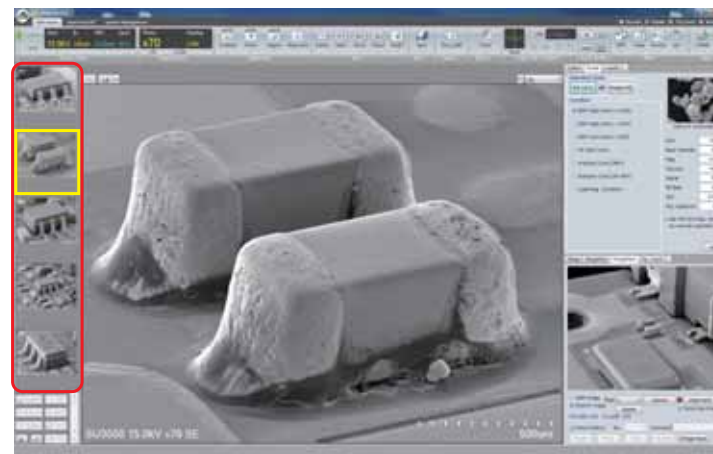
Dragged area is moved to the screen center and enlarged



Retrieving Stage Positions

Returning the stage to the previously image captured positions

The last 100 images captured are automatically saved with the stage coordinates. The stage is able to move to the coordinates previously visited once the image of interest is selected. (ex. The image outlined in yellow from the images outlined in red is selected to move the stage to the previous coordinates)



Variety of Specimen Holders /Evacuation system

SUB500

Wide range of specimen holders to support a variety of applications and specimens (optional)

Multi-specimen holders

Multi-specimen holders can accommodate multiple specimens at a time. The holders are supported by the stage control GUI. The specimen stub selected by the index number on the GUI screen moves to the beam center for imaging.



12.7mm dia. stub x 18 pcs



Special holders

Specimen holder



Specimen holders for resin embedded specimens



Specimen holder for EBSP



Automatic vacuum protection sequence for unexpected power failure

Pneumatic valves protect the system and maintain vacuum integrity in the event of a power interruption. This helps maintain the specimen chamber environment and minimize downtime. The SU3500 only requires one rotary/scroll pump*.

* Comparison S-3000N

Specifications

SUB500

Specifications

Items	Description
Resolution SE	3.0nm at 30kV (High vacuum mode)
	7.0nm at 30kV (High vacuum mode)
Resolution BSE	4.0nm at 30kV (Variable pressure mode)
	10.0nm at 5kV (High vacuum mode)
Magnification	x5 ~ x300,000 (on photo ¹)
	x7 ~ x800,000 (on display ²)
Accelerating voltage	0.3 ~ 30kV
Variable pressure range	6 ~ 650Pa
Image shift	±50μm(WD=10mm)
Maximum specimen size	200mm in diameter
Specimen stage	
X	0 ~ 100mm
Y	0 ~ 50mm
Z	5 ~ 65mm
R	360°
T	- 20 ~ 90°
Observation area	130mm in diameter (with rotation)
Maximum height	80mm (WD=10mm)
Stage control	Computer eucentric 5-axis motorization
Electron optics	
Electron gun	Pre-centered cartridge filament
Objective aperture	5-position, click stop objective aperture
Gun bias	Auto bias with variable bias control
Detectors	Everhart Thornley secondary electron detector
	High sensitivity semiconductor BSE detector
Analytical position	10mm (T.O.A=35°)
Display unit	
OS	Windows® 7 ³ (subject to change without notice)
Control	Mouse, Keyboard, Rotary knob, Track-ball
Monitor	24.1inch LCD or equivalent(subject to change without notice)
Auto alignment	Auto beam alignment
Auto image adjustment	Auto focus, auto stigmation/focus, Auto brightness & contrast Auto filament saturation, Auto start
Image data saving	640×480 pixels, 1,280×960 pixels, 2,560×1,920 pixels, 5,120×3,840 pixels
Filing format	BMP, TIFF, JPEG
Image display mode	Full screen display (1,280×960 pixels)
	Small screen display (800×600 pixels)
	Dual screen display (800×600 pixels)
	Quad screen display (640×480 pixels)
	Signal mixing
Evacuation system	
Operation	Fully automated vacuum sequence
Turbo molecular pump	210L / s x1
Rotary pump	135L/min (162L/min with 60Hz) x1
Protection	Power failure and vacuum failure
Auxiliary functions	Raster rotation
	Dynamic focus/tilt compensation
	Free layout print function, alphanumeric function
	Operated navigation
	Video maintenance
	Easy measurement

Optional accessories

Detector and analytical tool
Ultra Variable pressure Detector (UVD)
Energy dispersive X-ray spectrometer (EDX) made by third party vendor
Electro backscattered diffraction analyzer (EBSD) made by third party vendor
Specimen stage and holder
Multi-specimen holder
Specimen holders for resin embedded specimens
Specimen holders for EBSP
Software
Hi-Mouse (One keyboard, one mouse)
External communication interface, DBC

Dimensions & weight

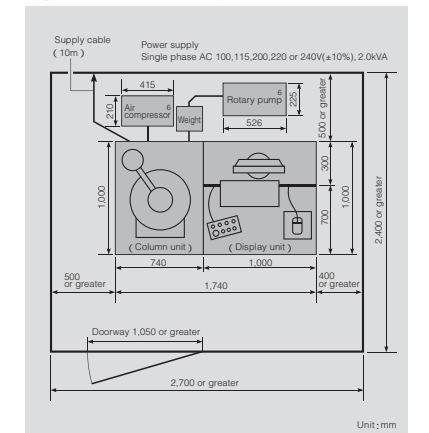
Items	Description
Column unit	740(W) x 1,000(D) x 1,550(H) mm, 450kg ⁴
Display unit	1,000(W) x 1,000(D) x 730(H) mm, 153kg ⁵
Rotary pump	520(W) x 220(D) x 300(H) mm, 28kg ⁶
Air compressor	410(W) x 210(D) x 510(H) mm, 18kg ⁶
Weight	200(W) x 180(D) x 160(H) mm, 40kg

Rotary pump and Air compressor are not included with main unit depending on its destination.

Installation requirement

Items	Description
Room temperature	15 ~ 30°C
Humidity	70%RH or less
Power supply	Single phase AC 100,115,200,220 or 240V(±10%), 2.0kVA
Power cable	10meters long with M5 crimp-type terminal
Grounding	100Ω or less

Typical installation room layout



1 : at 127mm×95mm (4"×5"Picture size)

2 : at 345mm×259mm (1,280×960 pixels)

3 : Windows® is a registered trademark of U.S.Microsoft Corp. in U.S.A. and other countries.

4 : Weight does not include supply cable and connector.

5 : Weight includes PC.

6 : Reference only.