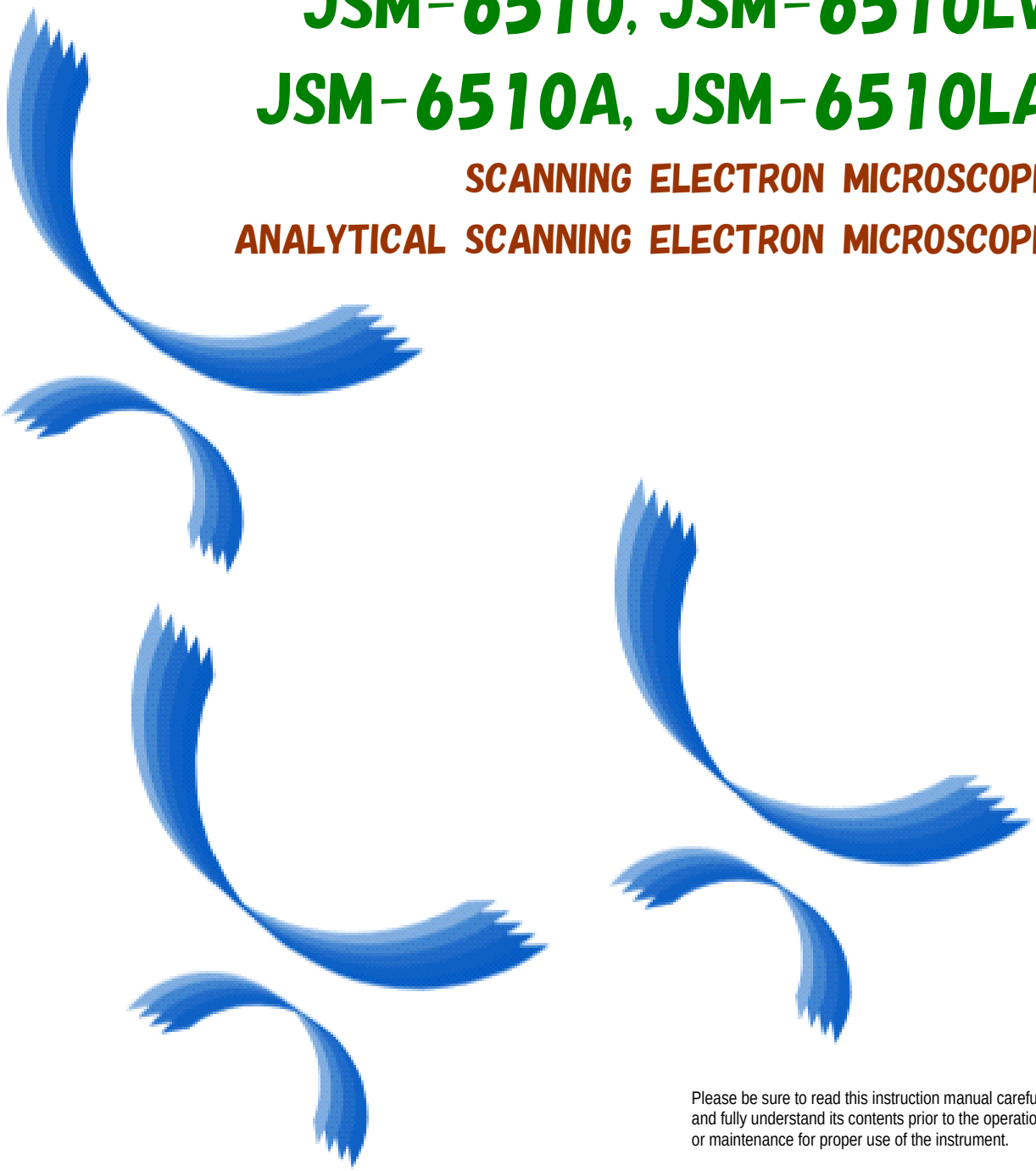
INSTRUCTIONS

JSM-6510, JSM-6510LV
JSM-6510A, JSM-6510LA

SCANNING ELECTRON MICROSCOPE
ANALYTICAL SCANNING ELECTRON MICROSCOPE



Please be sure to read this instruction manual carefully, and fully understand its contents prior to the operation or maintenance for proper use of the instrument.

No.ISM6510/6510LV/6510A/6510LA-2E
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NOTICE

- This instrument generates, uses, and can radiate the energy of radio frequency and, if not installed and used in accordance with the instruction manual, may cause harmful interference to the environment, especially radio communications.
- The following actions must be avoided without prior written permission from JEOL Ltd. or its subsidiary company responsible for the subject (hereinafter referred to as "JEOL"): modifying the instrument; attaching products other than those supplied by JEOL; repairing the instrument, components and parts that have failed, such as replacing pipes in the cooling water system, without consulting your JEOL service office; and adjusting the specified parts that only field service technicians employed or authorized by JEOL are allowed to adjust, such as bolts or regulators which need to be tightened with appropriate torque. Doing any of the above might result in instrument failure and/or a serious accident. If any such modification, attachment, replacement or adjustment is made, all the stipulated warranties and preventative maintenances and/or services contracted by JEOL or its affiliated company or authorized representative will be void.
- Replacement parts for maintenance of the instrument functionality and performance are retained and available for seven years from the date of installation. Thereafter, some of those parts may be available for a certain period of time, and in this case, an extra service charge may be applied for servicing with those parts. Please contact your JEOL service office for details before the period of retention has passed.
- In order to ensure safety in the use of this instrument, the customer is advised to attend to daily maintenance and inspection. In addition, JEOL strongly recommends that the customer have the instrument thoroughly checked up by field service technicians employed or authorized by JEOL, on the occasion of replacement of expendable parts, or at the proper time and interval for preventative maintenance of the instrument. Please note that JEOL will not be held responsible for any instrument failure and/or serious accident occurred with the instrument inappropriately controlled or managed for the maintenance.
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- The information described in this manual, and the specifications and contents of the software described in this manual are subject to change without prior notice due to the ongoing improvements made in the instrument.
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Note: For servicing and inquiries, please contact your JEOL service office.

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You shall keep confidential the content of the Licensed Software supplied hereunder by JEOL and the terms and conditions of this Agreement, and shall not divulge or disclose them to any third party without the prior written consent of JEOL.

Article 9. (Term of Validity)

1. This Agreement shall become effective as of the day you accept the terms hereof and so remain unless it is terminated pursuant to the next Article.
2. Notwithstanding the item above, the provisions set forth in the Article 8 (Confidentiality) shall remain effective even after the termination hereof.

Article 10. (Termination)

In any of the following event, JEOL may forthwith terminate this Agreement by so notifying you without any prior notification and may claim the damages incurred:

(1) Any breach on your part of any of the provisions hereof,

(2) Occurrence of seizure or provisional seizure or provisional injunction on your property; auctioning of your property; bankruptcy, corporate liquidation, and filing for corporate reorganization on your part; or proceedings taken against you for collection of tax delinquency.

Article 11. (Steps to Be Taken after Termination)

Upon the termination of this Agreement pursuant to the Item 1 of Article 9 and Article 10, you shall destroy the Licensed Software and notify JEOL of such destruction.

Article 12. (Discussion in Good Faith)

Matters not stipulated herein shall be discussed in good faith and settled between you and JEOL.

Safety Precautions

Although this instrument is protected with safety device which prevents the occurrence of accident that could result in an injury, harm, and damage to the users or instrument itself, the safety feature may not work properly if you use the instrument for the purpose of use not intended or in an improper usage. For the proper use of the instrument, please be sure to read all of the instructions, descriptions, notices, and precautions contained in this manual carefully to understand them fully prior to the operation or maintenance. This section, "Safety Precautions," contains important information related to safety for using of the instrument.

The safety indications and their meanings are as follows:

! WARNING :	***A potentially hazardous situation which, if not avoided, could result in death or serious injury.***
! CAUTION :	***A potentially hazardous situation which, if not avoided, may result in minor injury or material injury.***

Labels bearing the following symbols are attached to dangerous locations on the instrument. Do not touch any of these locations with your hands or anything else.

Examples of symbols

- Use the instrument properly within the scope of the purpose and usage described in its brochures and manuals.

- Never open/remove protective parts (exterior panels) and parts that can't be opened/removed without use of tool (including key), or disconnect/ connect the cables/connectors that are not described in this manual.

- Never attempt to do any works of disassembling/assembling the instrument other than those described in this manual.

- Never make modifications that include installing substitute parts and disabling safety devices or other safety features.

- Never disconnect the grounding wire or move it from the prescribed position. Failure to follow this instruction could result in electric shock.

- To avoid falling, do not climb onto the operation table and console during daily operation or during maintenance or inspection.

- When you dispose of the instrument or liquid or other waste, follow all applicable laws and regulations, and dispose of it in a proper manner without polluting the environment.

- Be sure to read the "Safety Precautions" section of the manuals for the accessories attached to or built into the instrument.

- If anything is unclear, please contact your JEOL service office.

! WARNING

General warnings

- Do not unlock or remove any covered parts, modify or remove component parts, or dismantle these parts in any way other than their intended use, due to a risk of thermal, electrical or emissive hazards taking place.
- Never removing the grounding wire or connect it to any other location than that specified, due to a risk of electric shock.
- Never remove the rear panel for maintenance such as replacement of fuses or any other electric parts; otherwise you may get an electric shock. Be sure to ask JEOL service personal for such work.
- When moving the instrument is required, various hazards are expected. Confirm the specifications and installation requirements for the instrument, check the state of the new installation site and contact tour local service center
- When performing maintenance, checks, or routine operations, never stand on the operation table, a stool or instrument frame.The instrument might fall over and cause damage.
- Do not remove the rear panel and replace electric parts (for example, fuse). These might cause electrical shock and harm you. Service staffs are the only ones who can remove the rear panel and replace electrical parts. No one else should do these.
- There are potential hazards, concerning the high voltage and magnetic field, which may take place while a service engineer is disassembling or replacing the instrument for maintenance. Keep well away from the instrument on such occasions.

Warning for oil diffusion pump

Be sure not to touch the boiler or cover of the oil diffusion pump immediately after its heater has broken, because these parts are very hot and you may receive a burn. Please, contact JEOL service office.

Warning for the filament

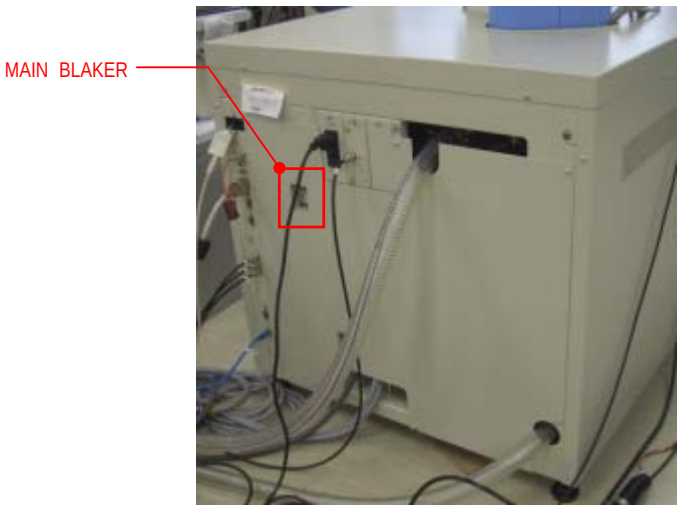
- The wehnelt is very hot immediately after the filament burnt out. Do not touch the wehnelt. Allow it to cool down sufficiently (about one hour), then replace the filament with the removal tool.
- Never remove the top of the EOS cover while supplying a high voltage (HT ON).

! CAUTION

General cautions

- If anything abnormal occurs with the instrument, immediately stop operation. Then, contact your local service center.
- When installing the specimen holder or inserting the objective lens aperture, take care not to get your fingers caught in the space between the specimen exchange chamber and the specimen exchange rod, and the space between the selecting knobs. And, since the EOS and IOS column is placed on the frame via the anti-vibration mount, the EOS and IOS column will sway a little even when you operate the knobs. Take care not to get your fingers caught in any space that results from this sway.
- An instrument that has been installed properly will usually not vibrate or give off annoying noises. Should this occur, stop the instrument immediately and contact your local service center.
- A person who wears a medical appliance such as a pacemaker may be affected by magnetic fields and must therefor keep well away from the instrument.
- Do not keep watching the CRT screen or continue keyboard operation for a long time. If you do so, disorder due to fatigue may result. Establish a health control standard or VDT work and make it a rule to conduct health check-up periodically.
- Only use a circuit breaker (over current and ground fault interrupters) in cases of emergencies. Do not touch the breaker unless you need to.

  If the breaker trips, it indicates a malfunction in the system and you must contact the JEOL service center immediately.



Column cabinet – Rear view

Cautions concerning oil rotary pump

- Be sure not to disconnect the rubber hose from the oil rotary pump during operation. If you do so, the oil in the oil diffusion pump will flow back to the electron optical column, causing serious damage to the instrument.
- Do not let the oil level of the oil rotary pump fall below the lower limit. If the pump operates with only a small quantity of oil, trouble may occur.
- Do not continue to run the oil rotary pump if the oil level has reached the lower limit. If you do, you might damage the pump.
- Replace the rotary pump oil with new oil once a year.
- Consult your JEOL service office for instructions for replacing the oil or the oil mist trap.
- When vacuum pump oil is replaced or vacuum pump is repaired, process the oil in the proper way.
- The instrument may not be started when the oil temperature of the oil rotary pump is low. The room temperature must be kept to 15℃ or more when you start the instrument.

Cautions concerning cooling water

The water leak sensor is not attached to this device.
The passage system might cause corrosion and damage and the water leak by the water quality and a pressure increase etc. in cooling water.
Please install the water leak sensor (option) in preparation for an emergency water leak. When the water leak is generated by installing this water leak sensor, a large amount of water leak can be prevented.
Please use the cooling water circulation device (option) when the water quality and the pressure of tap water are improper. (In the device that has Turbo Molecular Pump of the option, cooling water is not used.)

Cautions on the specimen stage movement (When using the motor drive stage)

Before moving the specimen stage, be sure to correctly select the specimen holder and input the specimen height. If you do not perform the setting of these parameters, the stage might move beyond the movement limitations, which can break the objective lens, the backscattered electron detector, or other components. When you install the specimen holder on the specimen stage, be sure to perform the selection of the specimen holder and inputting of the specimen height.

Warning for the filament

Never remove the top of the EOS cover while supplying a high voltage (HT ON).

Disassembly and cleaning

Do not disassemble or reassemble the EOS column. Such work requires great experience and skills. Contact your JEOL service office for assistance whenever such works are required.

Follow the precautions described below in order to carry out the cleaning

- Wear thin and lint-free gloves to handle any parts inside the column in order to prevent contamination by perspiration, etc., which could cause charging of electron beam due to oxidization of the parts.
- Complete the cleaning or cleaning of the parts inside the column as quickly as possible. Leaving the parts in the atmosphere oxidizes their surfaces.
- Use as a cleaning agent a nonflammable highly volatile highly efficient solvent that is free room impurities and is not harmful to the human body to clean the parts inside the column. Be sure to use the solvent in a location free from combustible material and sources of ignition and with open windows or proper ventilation, regardless of the quantity. When you use the cleaning agent, be sure to wear protective gloves that are resistant to the solvent.
- Keep the O-rings and the O-ring contact surfaces free room scratches, dust, lint, etc. Even a slight scratch, fine dust or lint may cause the poor vacuum. Also, be sure to use the specified vacuum grease.

Cautions concerning Personal Computer (PC)

Hardware

- Never modify the hardware settings and also never install additional boards. If you do, the PC or the SEM may not work normally.
- Never connect devices other than the recommended ones. If you do, the PC or the SEM may not work normally.
- Make sure not to locate a CRT monitor in the vicinity of the electron optical column. If you do, the fluctuation of stray magnetic fields may disturb SEM images.

Software

- Never install application software other than the recommended software. If you do, the PC or SEM may not work normally.
- Never delete application software or files, which have been installed. If you do, the control software may not work normally.
- When an error message appears while operating the control software, close Windows, switch off the PC and reset the OPERATION switch of the SEM, and then switch on the PC again.
- When the control software has not finished normally, the present data vanishes.
- When the other application is operated while the control software is being executed, the SEM may not work normally.

OS

- Never upgrade the OS or driver software. If you do, the PC or SEM may not work normally.
- Never change the settings of the Screen Resolution while the control software is being executed. If you do, the control software may not work normally.
- Never change the settings of the Dual monitor while the control software is being executed. If you do, the control software may not work normally.
- Never change the settings of Color quality and Font Size in the window that appears when you click the set button of the property display screen. If you do, the control software may not work normally.
- If the setting of Screen Resolution is changed, the settings of the Color and Refresh Frequency may vary automatically.
- If the setting of the Refresh frequency in the property display screen is changed, the image may be disturbed.
- Do not activate the screen saver. If the screen saver becomes active when the control software is being executed, the image may not be displayed and the PC may hang up.
- Do not set System Standby effectively. The personal computer may be hung-up when this setting operates while executing the control software.
- Do not set System hibernates effectively while the control software is being executed. The Windows screen may be distracted when this function operates while the control software is being executed. Moreover, it enters the state that the image is not displayed when the personal computer is restored from hibernate, and the reactivation of the personal computer is needed.
- Never change the "User" of the Windows while the control software is being executed. If you do, the Windows screen may be distracted. When changing the "User" of the Widows, execute it after the control software is exited.
- Never execute the "log off" of the user while the control software is being executed. If you do, the Windows screen may be distracted. When executing the "log off" of user, execute it after the control software is exited.
- Never validate the Windows Firewall and Automatic Updates functions. If you do, the SEM may not work normally. Set these functions in "Invalidity".

- Windows／display／Mouse is normally set as follows;
  (※ When the new user account is created, confirm the settings as follows;)

Screen resolution：	1280×1024 pixels
Color quality：	Highest (32-bit)
Font size：	Normal
Refresh frequency：	60 Hz
System Standby：	Invalidity
System hibernates：	Invalidity
Windows Firewall：	Invalidity
Automatic Updates：	Invalidity

EDS unit

Please note the following point when the device that uses the customer is JSM-6510A or JSM-6510LA model.

! WARNING

- A high bias voltage for the EDS detector is applied to the "HV OUT" connector on the DBVM board of the SSM sub-system, so do not carelessly touch this connector.
  If you touch this connector, you may receive an electric shock.
- A high bias voltage is supplied to the preamplifier of the EDS detector, so do not remove the case.
  If you remove the case and touch the circuit inside, you may receive an electric shock.

! CAUTION

- Never touch any of the switches, trimmers, connectors or cables at the rear of the SSM sub-system.
  If you inadvertently set or connect the SSM sub-system in an incorrect condition, a malfunction or a breakdown may occur.
- The window of each of the standard, Minicup, and Helicon EDS detectors is made of beryllium (Be), so Never touch the window. Also, do not heat the window or cause a chemical reaction to take place by exposing the window to a chemical reagent. Beryllium powder or vapor is harmful to the human body.
  If beryllium gets onto your clothing or skin, wash it off completely with soapy water, or the like. For the method of disposing of beryllium, consult with JEOL's serviceman.
- Be very careful of the following points when supplying liquid nitrogen to the Dewar vessel of the EDS detector.

  It is very dangerous to allow liquid nitrogen to penetrate your clothes or gloves, so avoid it as carefully as possible. If liquid nitrogen gets on your skin or clothes, it may cause frostbite.

  Do not use liquid nitrogen in an unventilated room. Be sure to ventilate the room to prevent suffocation by nitrogen gas resulting from the evaporation of liquid nitrogen.

  Take care that liquid nitrogen does not overflow from the EDS detector Dewar vessel. If liquid nitrogen gets onto a nearby unit such as the preamplifier, a breakdown may occur.

  If water has collected at the bottom of the inside of the EDS detector Dewar vessel, or if water droplets adhere to the outer cylinder, wipe the water away with a cloth, or the like, before adding liquid nitrogen.
  If you fill the Dewar vessel with liquid nitrogen without wiping away the water, the performance of the detector may fall, or the detector may break down.

  Do not use a refrigerant other than liquid nitrogen in the EDS detector Dewar vessel.

- Before supplying liquid nitrogen to a Minicup type EDS detector, be sure to evacuate the detector according to the instruction manual for the detector. If you supply liquid nitrogen using an incorrect method, the detector may be damaged.
- Ensure that the Dewar vessel of each of the standard and Super-Nine EDS detectors always contains liquid nitrogen. If the Dewar vessel runs out of liquid nitrogen, the detector may break down or its performance may be impaired.
- Be sure to keep the Dewar vessel of an EDS detector capped. If the Dewar vessel are not capped, ice will form on the filler hole, and also the consumption of liquid nitrogen will increase.
- The window of the EDS detector is extremely thin, and is likely to be damaged if touched by an object. If the detector window becomes damaged, liquid nitrogen will spurt out from the EDS detector Dewar vessel. Be very careful, therefore, not to damage the window.
- Be very careful of the following points when using a Helicon type EDS detector, in which liquid nitrogen is unnecessary.

  Before starting the detector, be sure to confirm that cooling water is flowing inside the refrigerator compressor, and should be fed continuously during operation. If you do not feed water, the safety unit will operate, and the refrigerator compressor will automatically stop. Once the compressor stops, it will take time to restart, even if you feed water again.

  The refrigerator is connected to the EDS detector by a high-pressure gas pipe, so take care not to touch or damage this pipe. If the pipe is damaged, the high-pressure gas, helium, will leak. Although it is not harmful to health, it will be necessary to replenish the gas before you can reuse the spectrometer.

  It is necessary to carry out periodic maintenance on the refrigerator used for cooling the EDS detector. If you fail to carry out periodic maintenance, the performance of the detector may deteriorate or a breakdown may occur.
- Regardless of the type of EDS detector, if a remote shutdown occurs, the following message will appear: “The detector cannot be used now. Refer to the instruction manual.”
- When the operating distance of the specimen stage is shorter than the specified analysis one, or when the EDS detector is not in use, put the EDS detector as far from the stage as possible.
  If you reduce the operating distance of the specimen stage while leaving the EDS detector inserted, you may damage the EDS detector.
- The preamplifier of the EDS detector contains a precision electronic circuit, so do not remove the case. Also, do not apply a large impact to the detector.
  Failure to observe the above precautions may result in a malfunction or a breakdown.
- If you wish to turn the power switch of the analyzer OFF then ON again, wait for at least 5 seconds after turning it OFF before turning it ON again.
  Turning the analyzer ON and OFF repeatedly may damage it.
- Before installing or removing a connector, board, and so on, turn OFF the power switch.
  If you carry out such work with the power switch left ON, a breakdown may occur.
- Never connect devices and also never install software to the PC. If you do, PC or the EDS (or SEM) may not work normally. Please, contact JEOL service office, if necessary.

1

General, specifications and composition

Specifications and composition guaranteed when no modification or addition is made, and subject to change without notice.

Refer to the EDS instruction manual for the specifications and composition of EDS unit.

1.1 General

This equipment features a new graphical user interface (GUI) with an improved operation, by using thanks to the newly enhanced display function of “Dual screen live image” and “Operation Navigator”.

- Observation, functional operation and maintenance work are easily performed by following the guide.
- In addition to the conventional display modes (Dual live image, Split live image, Flexible window display, Zoom screen display), Dual screen live image (640x480) is realized and depending on the purpose to observe among multiple users, selection of optimum, display mode from them becomes possible.
- Image of the sample even with unknown observation conditions can be easily obtained by only selecting sample category.
- Resolution of 3.0nm is guaranteed, and at low accelerating voltages it realizes 8 nm at 3.0kV and 15 nm at 1kV, which are extremely high for microscopes of this class.
- Thanks to the observation at minimum magnification ×5 and Stage Navigation system (option), to find the image field becomes easier.
- The chamber design is optimized to equip with EDS, WDS, EBSP and related options.
- The analysis position of the energy-dispersive spectrometer (EDS) has a WD of 10mm and a take-off angle of 35° for X-ray signals, which makes possible efficient analysis and low-magnification mapping analysis under the same conditions as high-resolution SEI observation.
- The EDS, an energy-dispersive X-ray analyzer is provided with a high-performance PTTD (Position and Time Tagged Data) function, whose digital electronics makes rapid high-precision analysis possible.
- Smile Shot enables you to obtain an image by merely selecting the type of specimen.
- By saving moving images, you can record the observation history and the dynamic behavior of the specimen.
- You can observe a nonconductive specimen as it is, in the low-vacuum mode.
- The extremely small cabinet for microscopes of this class permits you to install the instrument in a small space.

JSM-6510, JSM-6510LV

JSM-6510A, JSM-6510LA

1.2 Specifications

1.2.1 Performance

1.2.1.a Resolution

High-vacuum mode (HV mode)

3.0nm	Acc V 30kV, WD 8mm, SEI
8.0nm	Acc V 3kV, WD 6mm, SEI
15.0nm	Acc V 1kV, WD 6mm, SEI

Low-vacuum mode (LV-mode)

4.0nm	Acc V 30kV, WD 5mm, BEI

1.2.1.b Image mode

High-vacuum mode (HV mode)

SEI（E.T detector）
BEI（E.T detector）
BEI（Composition image, Topographic and stereoscopic images by semiconductor detector）

Low-vacuum mode (LV-mode)

BEI（Composition image, Topographic and stereoscopic images by semiconductor detector）
Low-vacuum SEI（optional）

1.2.1.c Magnification

×5 to 300,000（149 steps）
（×5 to ×8：WD46mm or longer and Acc.V 10kV or less）

1.2.1.d Probe current

1pA to 1 μ A

1.2.1.e Vacuum pressure in the specimen chamber

Adjustable pressure 10 to 270Pa

SEI：Secondary electron image
BEI：Backscattered electron image
Acc.V：Accelerating voltage
WD：Working distance
E.T：Everhart-Thornley

1.2.2 Electron optical system (EOS)

Except the automatic gun control, applicable to both LV and HV modes.

1.2.2.a Electron gun

Accelerating voltage	0.5 to 30kV (53 steps) 0.5 to 3kV : 100V steps 3 to 30kV : 1kV steps
Filament	Precentered tungsten hairpin filament
Bias voltage	Seamless automatic bias (linked to Acc.V)
Alignment	Electromagnetic 2-stage deflection
Automatic gun control	Filament-heating current setting and alignment (possible only at HV mode)
Beam blanking	Preventing the specimen damage from the irradiation of the electron beam

1.2.2.b Lens system

Condenser lens (CL)	Electromagnetic 2-stage zoom condenser lens system
Objective lens (OL)	Conical mini-lens
Lens reset	Provided for CL and OL (for hysteresis elimination)
Focusing	Automatic or manual focusing possible
Automatic focus tracer	Linked to WD
Dynamic focusing	Linked to Acc.V. and magnification
Wobbler	Provided for objective-lens aperture alignment, Linked to magnification
Objective-lens aperture	Optionally selectable from the following two types : MAP3 : 3-step selectable with click-stops, fine X-Y adjustment possible MAP1 : Single aperture, fine X-Y adjustment possible
Stigmator (astigmatism correction)	Electromagnetic 8-pole X-Y adjustment
Stigma Preset	Setting the preset data into the Stigma data
Scanning coil	Electromagnetic 2-stage deflection
Image fine shift	Electromagnetic Approximately ±50 μm in X and Y directions (at Acc.V. 30kV, WD : 10mm)
Automatic magnification correction	Linked to Acc.V. and WD
Preset magnification	Five different magnifications can be set

1.2.3 Specimen stage

1.2.3.a LGS

Type	Eucentric stage
Specimen movement	5 axes （X,Y,Z,R,T）, manual movement
Specimen movement ranges	X movement： 80mm
	Y movement： 40mm
	Z movement： Eucentric movement range for WD of 5 to 48mm
	Focusing range for WD of 5 to 48mm
	Tilt (T)： －10 to ＋90°
	（Tilt range might differ depending on the specimen holder size）
	Rotation(R)： 360° endless
Specimen holders	For 32mm diameter×10mm thick
	（with an adapter for mounting four 10 mm diameter specimens）
Maximum specimen size	Possible to mount a 150mm diameter specimen
	Possible to observe the entire 125mm diameter region （using R axis）
Specimen exchange	Stage draw type （Specimen holder slides in/out）
	（Optional for air-lock type）

1.2.3.b GS

Type	Eucentric stage
Specimen movement	5 axes （X,Y,Z,R,T）, manual movement
Specimen movement ranges	X movement： 20mm
	Y movement： 10mm
	Z movement： Eucentric movement range for WD of 5 to 48mm
	Focusing range for WD of 5 to 48mm
	Tilt (T)： －10 to ＋90°
	（Tilt range might differ depending on the specimen holder size）
	Rotation (R)： 360° endless
Specimen holders	For 32mm diameter×10mm thick
	（with an adapter for mounting four 10 mm diameter specimens）
Maximum specimen size	Possible to mount a 32mm diameter specimen
	Possible to observe the entire 32mm diameter （using R axis）
Specimen exchange	Specimen exchange Stage draw type （Specimen holder slides in/out）

1.2.4 Specimen chamber（Attachment port）

Energy Dispersive Spectrometer (EDS) port	1
Electron Backscattered Diffraction (EBSD) port	1
Wavelength dispersive spectrometer (WDS)／Specimen Cooling Unit (SCU)／	
Specimen Holder image for IC (SHIC) port	1
Backscattered Electron image Detector (BEIW) port	1
Low Vacuum Secondary Electron detector (LVSE) port（installed on the side of the LGS） ＊	1
Specimen chamber scope (SCS)／Airlock chamber (ALC) port（installed on the front of LGS） ＊	1
Specimen absorption current terminal (ACT) port（installed on the side of the GS and LGS stage）	1
Probe current detector（PCD）port（installed on the column）	1

＊ LGS requires these options

1.2.5 Detector

High-vacuum mode (HV mode)

Secondary electron detector	E.T (Everhart-Thornley) detector (consisting of collector, scintillator, light guide and photomultiplier tube)

Low-vacuum mode (LV mode)

Backscattered-electron detector	Semiconductor (P-N junction) detector（can also be used in the HV mode）

1.2.6 Display system

1.2.6.a Display

Liquid crystal display（19-inch type） 1 set

1.2.6.b Scan system

Scanning mode Full frame scan (640×480 pixels)

Scan speed

	Horizontal (ms)	Vertical(s)	Pixels
SCAN1 (Selectable)	0.284	0.075	320×240
	1.137	0.258	
	2.048	0.512	
SCAN2 (Selectable)	0.284	0.150	640×480
	1.137	0.576	
	2.048	1.024	
SCAN3 (Selectable)	20(16.67)	10(8.33)	640×480
	20(16.67)	20(16.67)	1280×960
	40(33.33)	40(33.33)	
SCAN4 (Selectable)	80(66.67)	80(66.67)	1280×960
	160(133.3)	160(133.3)	
	80(66.67)	160(133.3)	2560×1920

Power frequency 50Hz, Values in parentheses: 60 Hz

1.2.6.c Frame memory

Capacity 2560×1920×8 bits 1

Number of pixels 640×480、1280×960、2560×1920

1.2.6.d Saved image processing

Look-up table Linear, Contrast increase/decrease, γ -correction, Multiple-level coding, Partial enhancement, Inverse video

Pseudo color image 16 colors

Multiple display Display of 2 or 4 images in one frame

Digital zoom Display of an arbitrary area at 2× or 4×

Dual magnification Display of an enlarged image of the left side in the right side

Full screen display Display of a saved images on the entire monitor screen

1.2.6.e Live image processing

Image display function

Averaging	Accumulation of 1 to 255 images
Dual live display	You can display two live images of the same image field with different signals simultaneously by vertically or horizontally dividing the main screen into two.
Split live display	By dividing an image field using a vertical or horizontal partition line, you can display two live images of both sections with different signals
Flexible window display	You can display any rectangular area in an image field with different signals. You can display the live image for both original image and the rectangular areas.
Zoom screen display	Display of a live 640×480 pixel image on the entire monitor screen
Dual screen live image	Display of a two live screen images at each 640×480 pixels
Signal addition	Display of the image with two signals mixed for one image

Measurement functions

Two points measurement (such as line, free)	Measurement of the distance between any two points
Circle measurement(such as diameter)	Measurement of the circumference and distance between the two centers.
Line-width measurement (parallel X/Y, diagonal)	Measurement of the distance between two parallel horizontal or vertical line segments. If you surround a region with horizontal and vertical lines, the length of the diagonal is also measured.
Angle measurement (angle)	Measurement of the angle between two line segments that extend from a center point
Area measurement (polygon, circle)	Measurement of the polygon and the area surrounded by the circle
Counting (count)	Measurement of the numbers of the click on the image

Text display

Display position	Displayed on the image
Text	Alphanumeric characters and symbols
Character kind	Any PC fonts can be selected
Background	You can select black or an image for the background
Text-entry device	Keyboard

1.2.6.f Data display

Display position	Horizontal at the bottom of the screen
Contents	
High-vacuum mode	Image mode, Acc.V、WD、Spotsize、Magnification、Scale bar with micron value, User name、Lavel、Film number（4 digits）、Date、Time（the actual time which you are saving recorded）
Low-vacuum mode	The specimen-chamber pressure (in Pa unit) appears in the section where the image kind is shown in the H-Vac mode.
Background	You can select black or an image for the background

1.2.6.g File saving

Format	BMP、TIFF or JPEG

1.2.7 Operating system

This item applies for both high and low vacuum modes except for the automatic gun control.

1.2.7.a Basic System

Computer	IBM PC／AT compatible computer
Operating System (OS)	Windows ® Vista ＊
	＊ Windows ® Vista is a trademark of Microsoft Corp

1.2.7.b Operation

Operation method	Graphical user interface, mouse and operation keyboard （Operation keyboard is available as an option）

1.2.7.c Operating guide

The guide is composed from the individual job and such procedure as the observation, functional operation and maintenance etc., is displayed. If you follow the observation procedure and operate SEM, you can easily get the image.

1.2.7.d Recipe function

Various conditions of the electron beam illumination system, stage position and vacuum system mode can be set in a recipe file.
Custom recipes which can be recorded for individual users, and standard recipes which can be used in common, are provided.
Number of custom recipes is limited only by hard-disk space

1.2.7.e Automatic functions

Automatic gun control	Temperature setting of the filament heat and the alignment setting are automatically adjusted.
Automatic focusing (AF)	Adjusts the focus automatically.
Automatic astigmatism correction (AS)	Corrects the astigmatism automatically
Automatic contrast/brightness (ACB)	Adjusts the contrast and brightness automatically.

1.2.7.f Image observation support functions

Click centering	Double-clicking centers any image position inside image-display area（A similar operation is possible in Snapshot）
Click center zoom	Centers and zooms until the image is magnified up to about three times (15 steps) on the spot the user clicks (A similar operation is possible in Snapshot)
Drag	Dragging the mouse moves the point under the mouse cursor to any desired position.
Frame shift	Moves an image by a specified rate (MS must be used)
Snap shot	Pastes two image screens (frozen images) at the side of the image-display area, and carries out stage position control on images.
Moving image save	You can save moving images in the AVI format. The maximum recording time depends on the capacity of the hard disk of the PC. (Guideline: 280 MB is required for saving a 60 s image.)
Mag/Tilt correction	Magnification is corrected when the specimen is tilted.

1.2.7.g User's settings

Mouse control selection	Can restrict mouse cursor to up/down or right/left movement
Changing of stage-movement direction	Switching of stage-movement direction when operating stage on image-display area
Icon user setting	Can select or set the icons on the Graphic User Interface
Eco mode	Can set the energy-saving mode

1.2.8 Operation table

Choose an operation table from the following options, or provide the similar commercial table at the customer's site.

MP-48020TBL：900（W）×900（D）×750（H）mm
EM-02540FTBL：750（W）×900（D）×750（H）mm
These tables can store the PC and a small EDS (only JED).

1.2.9 Evacuation system

Control	Fully automatic	
Ultimate pressure (in gun chamber)	HV mode 0.1mPa order LV mode 1mPa order （when the pressure in the specimen chamber is about 27 Pa）	
Required time for evacuation	HV mode About 2 min LV mode About 1 min 30 s	
Oil rotary pump	100L/min	2
Oil diffusion pump	4 type 420L/s （with water baffle）	1
Orifice	Removable type (always mounted)	
Control valve	Fine metering valve type	
Specimen chamber pressure gauge	Pirani gauge	

1.2.10 Safety devices

Devices to protect against failures of power supply, water supply, vacuum (pressure increase), and ground fault, are provided.

A mechanism for adjusting the flow rate of cooling-water is built in.
An optional water leakage sensor can be built in.

1.2.11 Eco mode

If you do not operate the PC or other devices for a certain time, the device enters the energy-saving mode (you can set the time until the Eco mode turns on). You can turn the energy-saving mode on or off on the Graphic User Interface.

1.2.12 Others

BNC output	BNC-R connector (one for video printer connector)	4
Service receptacles	100VAC、8A	1

1.3 Specifications of an options

The options of the normal constitution are different by the instrument (Bu, LV, A or LA).

For specifications of Personal computer and LCD, refer to the maker's instruction manual.
Refer to the EDS instruction manual for the specifications and composition of EDS unit.

1.3.1 EDS INTEGRATION SOFTWARE(EDSI)

General

This software is used for a scanning electron microscope (SEM) equipped with an energy dispersive X-ray spectrometer (EDS) to control some functions of the SEM from the EDS side.

Specifications

Communication protocol	TCP/IP, original protocol
Control method	Conversation type control by commands from the EDS side
Controlled functions	Accelerating voltage (AccV)、Working distance (WD)、Magnification (MAG)、High tension (HT:ON/OFF)、Objective lens current (OL-Coarse, OL-Fine)、Condenser lens current (CL)、Reset (OL,CL)、Probe current detector (PCD: ON/OFF)、Stage control、Automatic focus (AFD)、Automatic contrast/brightness (ACB)、Automatic stigmator (ASD)

Configuration

CD-ROM for installation	1 set

1.3.2 EXTERNAL SCAN INTERFACE (ESIF)

General

This interface is installed in the operation console of the Scanning Electron Microscope (SEM) to scan the electron beam by the control signal sent from an external instrument such as an energy dispersive X–ray spectrometer (EDS).

Specifications

Input signal	Internal/external switching signal、Horizontal/vertical scanning signal 3 input channels provided on the connector panel
Output signal	Secondary electron image signal or backscattered electron image signal in slow scan 3 output channels provided on the connector panel

Configuration

Interface unit （including a connector panel）	1 set

1.3.3 VACUUM STATE INTERFACE (VSIF)

General

This interface is used for communication between an SEM basic unit and an energy dispersive X–ray spectrometer (EDS) or a wavelength dispersive X–ray spectrometer (WDS). The SEM basic unit sends the HT–READY signal to the EDS or WDS, and the EDS or WDS sends the VENT–LOCK signal to the SEM basic unit.

Specifications

Output signal	HT–READY signal (SEM to EDS or WDS) 2 output channels provided
Input signal	VENT–LOCK signal (EDS or WDS to SEM) 2 input channels provided

Configuration

Vacuum state interface unit	1 set
Short connector	2

1.3.4 EXTERNAL CONTROL SOFTWARE (EXCS)

General

This MP-46020 External Control Software is used for controlling a scanning electron microscope (SEM) from an external energy dispersive X-ray analyzer consisting of an EDS and WebSEM Client PC. It is to be installed in the SEM-side PC.

The software makes possible EDS specimen analysis and SEM remote control through LAN or the public communication network.

Specifications

Basic functions

Communication between the SEM-side (server) PC and client-side PC

Communication protocol: TCP/IP

Configuration

Installation disk	1 set

1.3.5 SIGNAL SWITCHING UNIT (SSU)

General

This unit selects signals from various detectors (signal sources) and outputs them to the signal processing display system.

Specifications

Input channels	7CH (Analog signal input channels : 3CH、 Input impedance 75 Ω) (PMT signal input channels : 4CH、 Input impedance : 1.8 kΩ)
Output channel	1CH (Output impedance : 1.8 kΩ)

Configuration

Signal switching unit	1 set

1.3.6 TABLE (TBL)

General

TBL is a table with an original design that can accommodate two 19 inch LCD monitors with an abundance of space for the monitor footing. The table can hold the DPP unit of a JEOL Energy Dispersive X-ray Analyzer, the Mini Cup Evacuation Controller 2 and a personal computer.

Specifications

Dimensions	900 mm(W)×900 mm(D)×750 mm(H)
Color of top of table	Same color as the column rack

Configuration

Table	1 set

1.3.7 BACKSCATTERED ELECTRON DETECTOR (BEIW)

General

This detector is placed under the bottom plane of the lower-pole of the objective lens of the EOS, and detects electrons that are backscattered from the specimen surface. The detector consists of a split semiconductor detector and a semiconductor detector that is used to produce shadows in images. The signals that are detected separately by the detectors are processed to produce three types of images: solid image (Shadow), composition image (Compo) and topographic image (Topo). All operations can be carried out on the monitor screen of the computer.

Specifications

Photodiode	Silicon P-N junction semiconductors
Types of images	Solid image (Shadow), Composition image (Compo), Topographic image (Topo)
Amplifiers	Preamplifier, operational amplifier
Video outputs	Shadow, Compo, Topo
Bandwidth	Approximately 500 kHz
Working distance	5 to 48 mm
Automatic functions:	Automatic focusing, Automatic contrast/brightness adjustment, Automatic stigmator

Configuration

Backscattered electron detector unit (includes detectors and parts for mounting them)	1 set
Amplifier (includes a circuit board, flange, cable)	1 set

1.3.8 OPERATION KEYBOARD (OKB)

General

Scanning electron microscopes are basically operated using a mouse. This Operation Keyboard is provided to enable an operator who is not familiar with mouse operation to operate the microscope, carrying out tasks such as focusing in a high-magnification range and astigmatism correction with ease.

Specifications

Scanning mode selection (acquire)	Button switch (PHOTO)
Contrast adjustment	Rotary knob
Brightness adjustment	Rotary knob
Astigmatism correction	Rotary knob
Magnification selection	Rotary knob
Focusing	Rotary knob with COARSE/FINE selection button (Button switch)
Automatic functions	Button switches (ACB, AUTO FOCUS, AUTO STIG)

Configuration

Operation keyboard (with USB cable)	1 set

1.4 Installation requirements

1.4.1 Power

Single phase AC 100 V ±10%, 50/60 Hz,
3.0 kVA (Voltage drop should be 3% or less at 3.0 kVA.)

1.4.2 Grounding terminal

100 Ω or less 1

1.4.3 Cooling water

Faucet	l4 mm outside diameter or	
	JIS B0203 Rc 1/4 (ISO 7/1 Rc1/4)	1
Drain	At least 25 mm inside diameter or	
	JIS B0203 Rc 1/4 (ISO 7/1 Rc1/4)	1
Flow rate	2L／min	
Pressure	0.05 to 0.2MPa (gauge)	
Temperature	15 to 25℃	

1.4.4 Installation room

Temperature	15 to 25℃
Humidity	60% or less
Stray magnetic fields	0.3 μ T（p-p） or less, for 50/60 Hz sine wave (WD 15 mm, Acc.V. 30 kV)
Space required for instrument	2,000 mm（W） ×2,500mm（D） ×1,800mm（H） or more
Door width	850 mm or more

Dimensions and masses

	Width(mm)	Depth(mm)	Height(mm)	Mass(kg)
EOS column unit	750	1000	1445	About 325
Table（MP-48020TBL）	900	900	750	About 40
EDS unit	—	—	—	About 25
Oil rotary pump（one）	460	175	255	A bout 23
Vibration isolator	270	200	200	About 10

1.4.5 Cautions on installation requirements

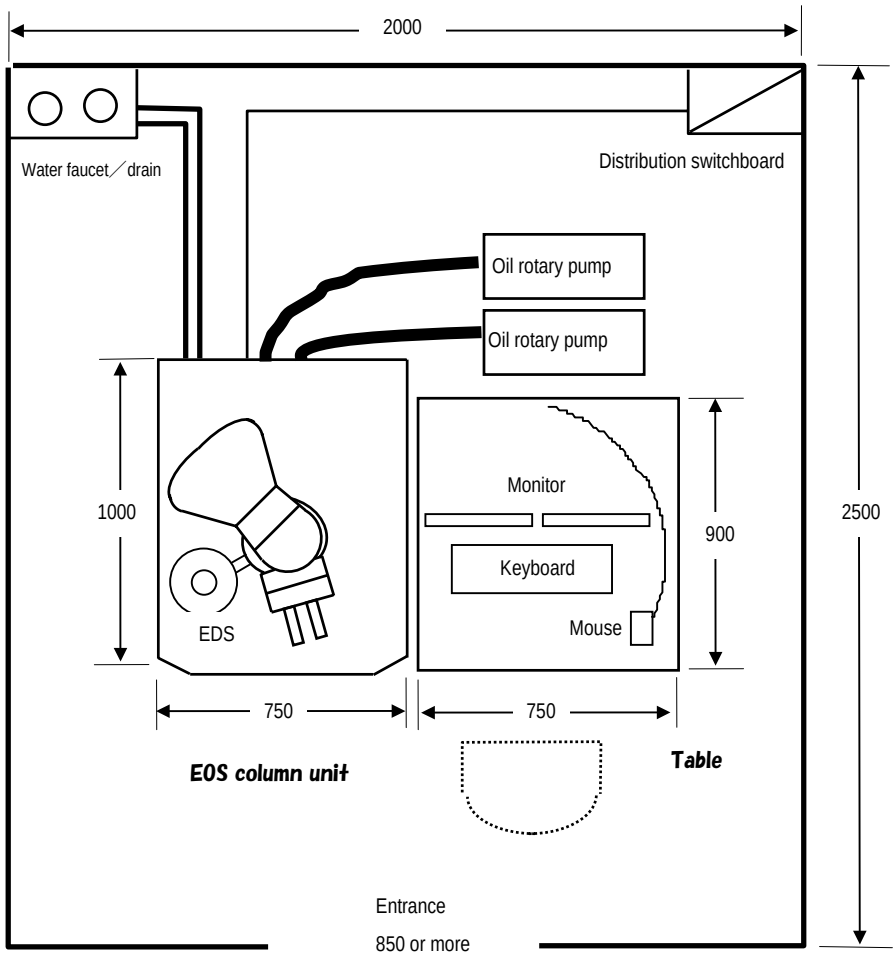
Installing JSM-6510 series in the following place may disturb the image

- On soft ground (reclaimed ground, lakeshore, riverside, seashore, etc.)
- Less than 50 m from a highway
- Less than 100 m from the railway
- Within 15 m of elevators
- Within 10 m of electric motors (10kW or more))
- Within 10 m of large transformers (10kVA or more)
- Within 3 m of interior wiring (100A or more)
- Within 20 m of factory high-voltage transmission lines.
- Within 30 m of the transformer room
- Within 150 m of high-voltage transmission lines of electric power company
- Within 1 km of transmitting antennas
- Within 2 m of computers such as personal computers
- Where a high-power transceiver or wireless phone is used in the vicinity
- Where noise is at an unusually high level

* Upon receipt of order, a JEOL engineer will visit your site to measure floor vibration and stray magnetic field in your installation room.
* If the above requirements are not met, additional measures are necessary. Contact your JEOL service office.

1.4.6 Layout example

Example; JSM-6510LA



Unit : mm

- This above figure shows a typical installation layout. Be sure to maintain service areas at the left and right sides and to the rear of the microscope even if only a small installation area is available.
- Install the microscope well apart from facilities producing vibrations or electromagnetic waves such as roads, busy passages, railroads, elevators, air conditioners and their air outlets, and power transmission lines.
- This microscope does not require any darkroom facilities such as blackout curtain.
- This device does not include a water-leakage sensor. Bad quality or pressure increase of the cooling water might corrode or erode the water circulation system and cause water leakage. Install the optional water-leakage sensor preparing for the worst. By installing this water-leakage sensor, you can prevent the instrument from leaking a large amount of water when water leakage occurs. Moreover, if the water quality or pressure is inappropriate, use the optional cooling water circulation unit.

1.5 Composition

JSM-6510

- Basic unit ····· 1 set
  Including the Software, Tool box (including the accessory, tools),
  Parts for installation and transportation (including the power cable, water hose)
  Oil rotary pump （1 set） , Instruction manual
- Specimen stage ····· 1 set
- Movable aperture ····· 1 set
- Personal computer unit （Including the mouse, keyboard, etc.） ····· 1 set
- Liquid crystal display ····· 1 set

JSM-6510LV

- Basic unit ····· 1 set
  Including the Software, Tool box (including the accessory, tools),
  Parts for installation and transportation (including the power cable, water hose)
  Oil rotary pump （2 set） , Instruction manual Specimen stage ····· 1 set
- Specimen stage ····· 1 set
- Movable aperture ····· 1 set
- Personal computer unit （Including the mouse, keyboard, etc.） ····· 1 set
- Liquid crystal display ····· 1 set
- Backscattered electron detector ····· 1 set

JSM-6510A

- Basic unit ····· 1 set
  Including the Software, Tool box (including the accessory, tools),
  Parts for installation and transportation (including the power cable, water hose)
  Oil rotary pump （1 set）, Instruction manual
- Specimen stage ····· 1 set
- Movable aperture ····· 1 set
- Personal computer unit （Including the mouse, keyboard, etc.） ····· 1 set
- Liquid crystal display ····· 2 set
- EDS integration software ····· 1 set
- External control software ····· 1 set
- External scan interface ····· 1 set
- Vacuum state interface ····· 1 set

JSM-6510LA

- Basic unit ····· 1 set
  Including the Software, Tool box (including the accessory, tools),
  Parts for installation and transportation (including the power cable, water hose)
  Oil rotary pump （2 set）, Instruction manual
- Specimen stage ····· 1 set
- Movable aperture ····· 1 set
- Personal computer unit （Including the mouse, keyboard, etc.） ····· 1 set
- Liquid crystal display ····· 2 set
- EDS integration software ····· 1 set
- External control software ····· 1 set
- External scan interface ····· 1 set
- Vacuum state interface ····· 1 set
- Backscattered electron detector ····· 1 set

1.6 Instrument warranty

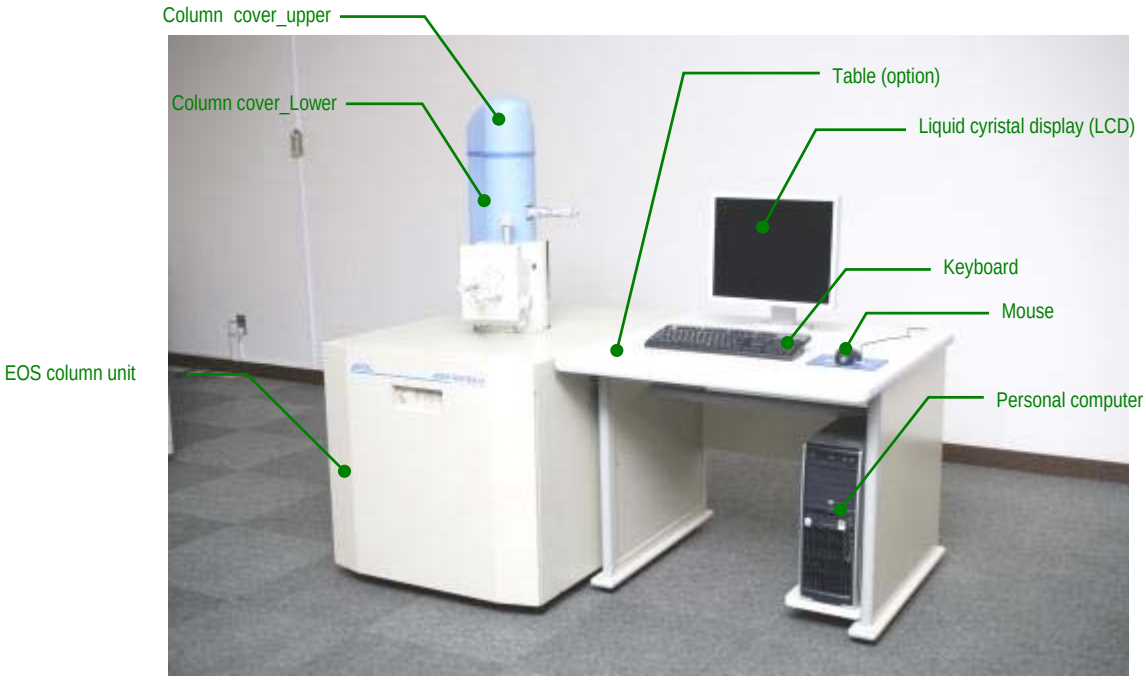
This instrument is guaranteed for one year from the date of installation. We undertake to repair it free of change in the event that it breaks down within this period, except in cases where the breakdown is the result of a force majeure or careless handling.

2

Name and explanation of each part

Refer to the EDS instruction manual for the name and explanation of EDS unit.(When the instrument is A／LA model)

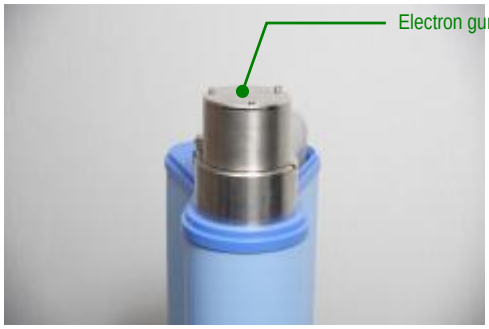
2.1 Exterior of instrument



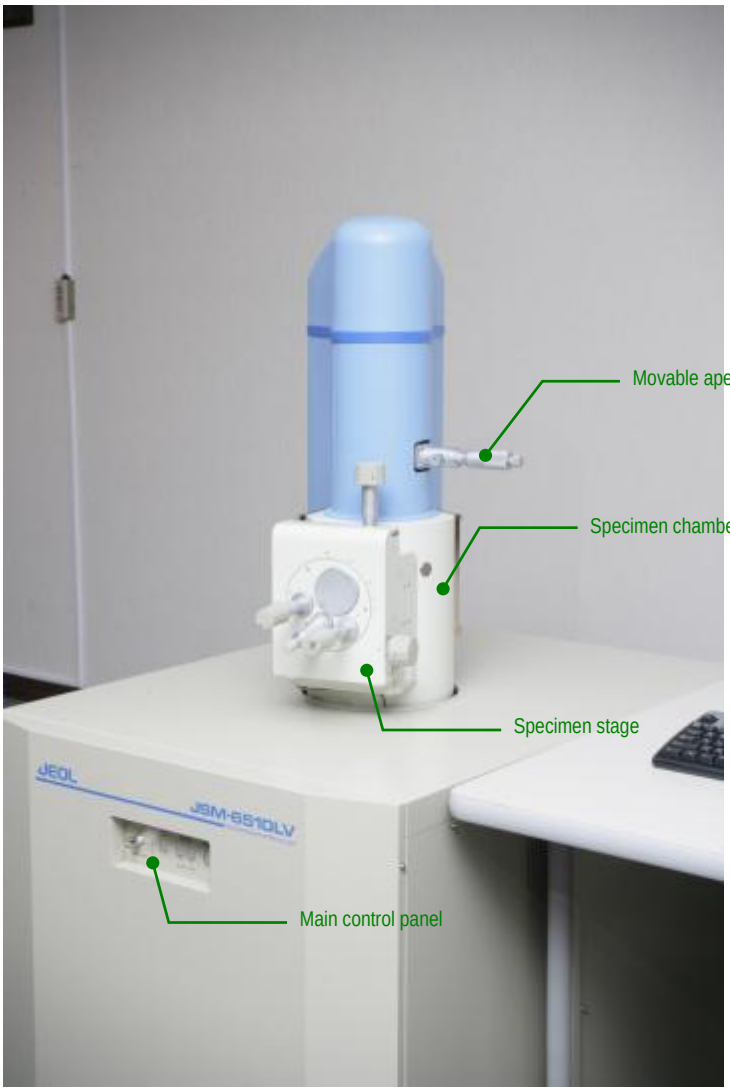
JSM-6510、JSM-6510LV

JSM-6510A、JSM-6510LA

2.2 EOS column unit



Top of the EOS cover was removed

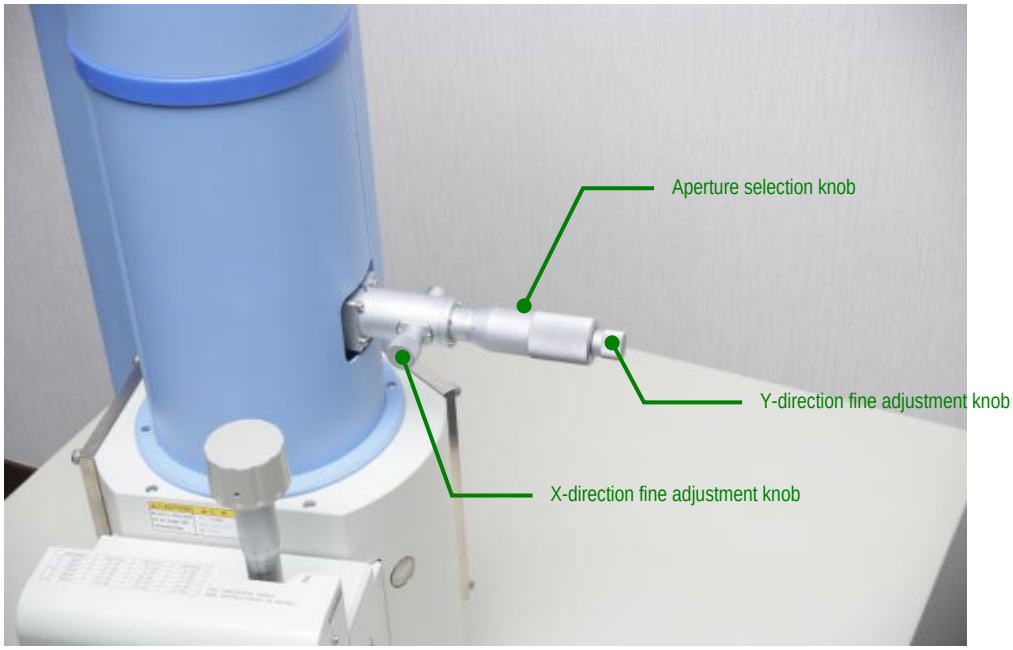


2.2.1 Movable aperture

! CAYTION

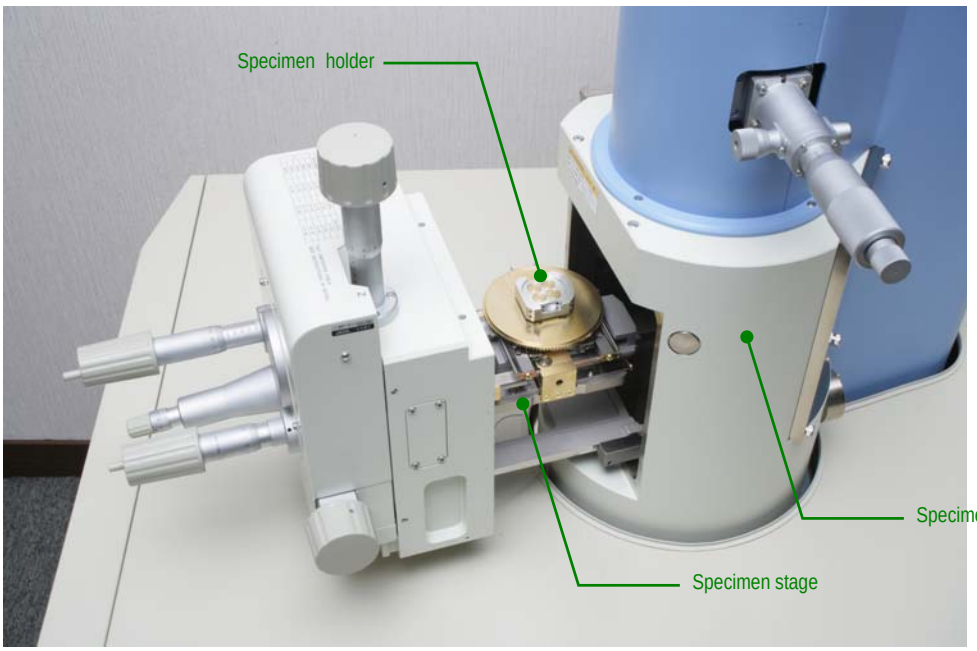
When selecting the aperture of the movable aperture, be careful not to get your fingers caught in the grip.

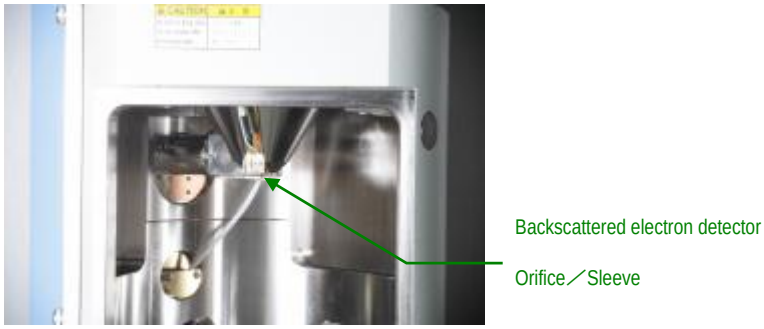
- By rotating the aperture selection knob clockwise through the 0→1→2→3 positions, you can select an aperture that corresponds to the scale.
- If you wish to switch the aperture in the sequence 3→2→1→0, pull the aperture selection knob forward, rotate it counterclockwise until it stops, then turn it one step at a time.
- X and Y direction fine adjustment knobs used for adjusting the movable aperture.



Scale	Aperture (μmdia.)	Purpose of use
3	100	Use when a large current is necessary such as using WDS.
2	30	Used for normal observation, EDS analysis, and etc.
1	20	Used for high resolution observation
0	None	Use for maintenance work

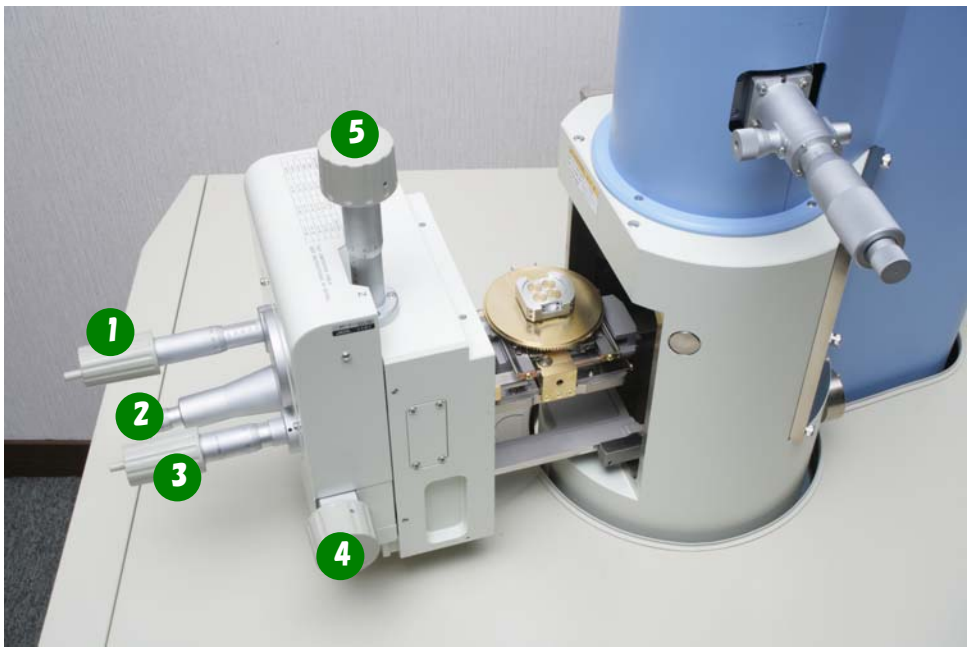
2.2.2 Specimen chamber





Interior of the specimen chamber(Front view)

2.2.3 Specimen stage



	Name	Explanation
1	X axis knob	The stage moves to this side and the interior The image moves left and right.
2	R axis knob	The stage rotates
3	Y axis knob	The stage moves left and right The image moves up and down
4	T axis knob	The stage inclines
5	Z axis knob	The stage moves up and down

2.2.3.a Stage movement range

! CAUTION

- **Be sure to move the stage within the movement range.**
  When it exceeds a range, the stage or holder touches the bottom of objective lens, and it is likely to be damaged.
- **The following movement range does not taken sample size into consideration.**
  The following movement range is based on a sample is not protruded above the holder surface. If a sample protrudes above the holder surface, the following movement range does not secure.

10mm diameter specimen holder (X and Y axes movable range)

○ : Movable with whole range (X=0 to 80mm and Y= 0 to 40mm)
× : Movable regardless of position of X and Y axes

Z (mm) / T (°)	8	10	15	20	30	40	48
0	○	○	○	○	○	○	○
10	○	○	○	○	○	○	○
20	○	○	○	○	○	○	○
30	X=0 to 80 Y=0 to 23	○	○	○	○	○	○
40	X=7 to 80 Y=0 to 21	X=7 to 80 Y=0 to 23	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40
50	X=7 to 80 Y=0 to 20	X=7 to 80 Y=0 to 21	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40
60	X=7 to 80 Y=0 to 19	X=7 to 80 Y=0 to 21	X=7 to 80 Y=0 to 27	X=7 to 80 Y=0 to 30	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40
70	×	×	X=8 to 80 Y=0 to 10	X=8 to 80 Y=0 to 25	X=8 to 80 Y=0 to 40	X=8 to 80 Y=0 to 40	X=8 to 80 Y=0 to 40
80	×	×	×	X=8 to 80 Y=0 to 3	X=8 to 80 Y=0 to 15	X=8 to 80 Y=0 to 40	X=8 to 80 Y=0 to 40
90	×	×	×	×	X=8 to 80 Y=0 to 7	X=8 to 80 Y=0 to 17	X=8 to 80 Y=0 to 35

When the stage is set in accordance with the table, the distance between the bottom of OL (objective lens) and the specimen holder surface is coming to be kept to 3 to 5mm.

※ The stage movement range described to this manul is range of the movement of LGS.
When you install stages (GS, MS) other than LGS, refer to the movement range of a stage described in each instruction manual.

32mm dimater specimen holder （X and Y axes movable range）

○ : Movable with whole range (X=0 to 80mm and Y= 0 to 40mm)

× : Not movable regardless of position of X and Y axes

Z (mm) / T (°)	8	10	15	20	30	40	48
0	○	○	○	○	○	○	○
10	○	○	○	○	○	○	○
20	○	○	○	○	○	○	○
30	X=0 to 80 Y=0 to 6	○	○	○	○	○	○
40	X=7 to 80 Y=0 to 6	X=7 to 80 Y=0 to 7	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=10 to 40
50	X=7 to 80 Y=0 to 4	X=7 to 80 Y=0 to 6	X=7 to 80 Y=0 to 13	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=10 to 40
60	X=7 to 80 Y=0 to 6	X=7 to 80 Y=0 to 8	X=7 to 80 Y=0 to 14	X=7 to 80 Y=0 to 17	X=7 to 80 Y=0 to 40	X=7 to 80 Y=0 to 40	X=7 to 80 Y=10 to 40
70	×	×	X=8 to 80 Y=0 to 10	X=8 to 80 Y=0 to 18	X=8 to 80 Y=0 to 26	X=8 to 80 Y=0 to 40	X=8 to 80 Y=10 to 40
80	×	×	×	X=8 to 80 Y=0 to 3	X=8 to 80 Y=0 to 15	X=8 to 80 Y=5 to 40	X=7 to 80 Y=10 to 40
90	×	×	×	×	X=8 to 80 Y=0 to 7	X=8 to 80 Y=0 to 17	X=7 to 80 Y=10 to 40

When the stage is set in accordance with the table, the distance between the bottom of OL (objective lens) and the specimen holder surface is coming to be kept to 3 to 5mm.

Limit range of Tilt

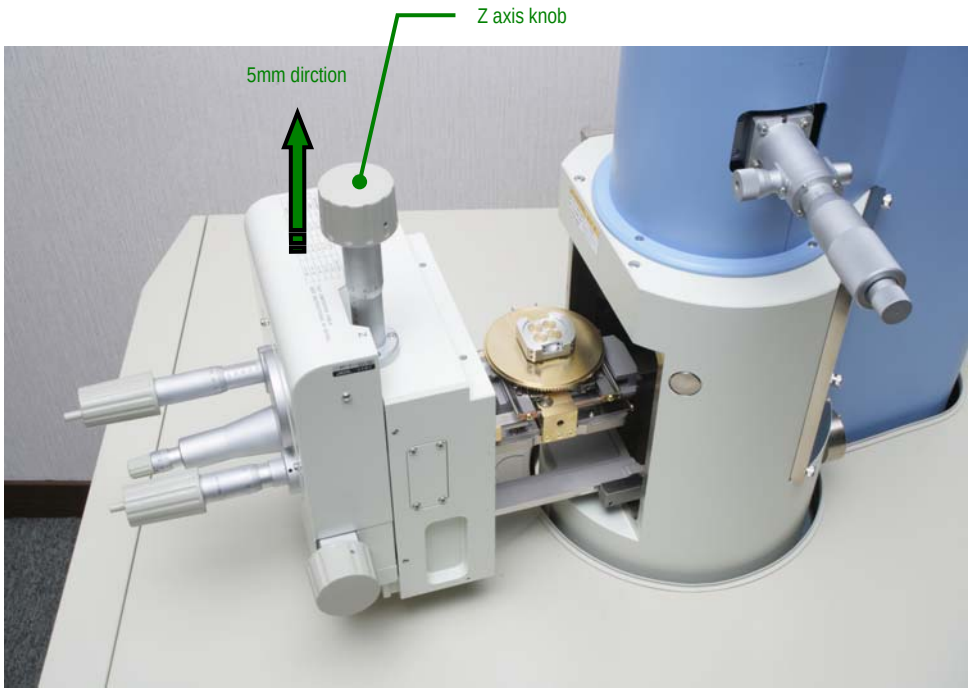
Holder size / Z (mm)	10mmϕ	32mmϕ	76mmϕ
8	0° to 20°	0° to 20°	0° to 20°
10	−2° to 30°	−2° to 30°	0° to 20°
15	−10° to 35°	−10° to 35°	−2° to 35°
20	−10° to 35°	−10° to 35°	−10° to 35°

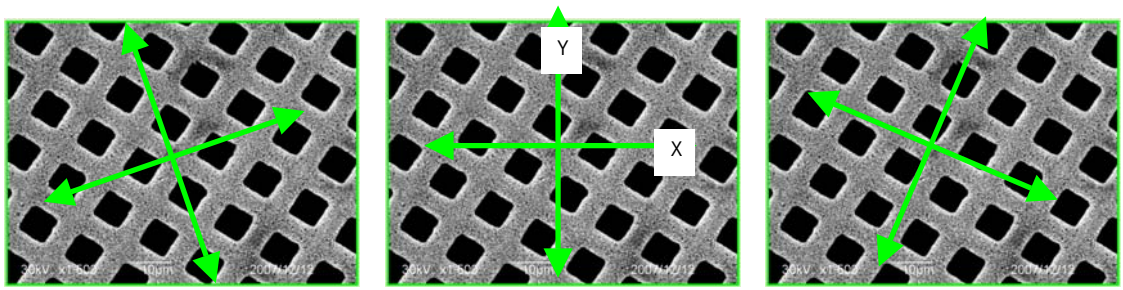
When the specimen holder except the above followings is used, see to the instruction manual of an optional specimen holder to move the stage.

2.2.3.b Moving an image on the screen

If you change the WD using the Z axis knob, the visual field on the image rotates, and the shift direction differs slightly.

A Y-direction is moved in the WD 10mm neighborhood through the X direction to top and bottom right and left.
It is taken in becoming shorter WD (8mm direction) than WD10mm, and view turns...to the counterclockwise direction a little.
It is taken in becoming longer WD (48mm direction) than WD10mm, and view turns...to the clockwise direction a little.



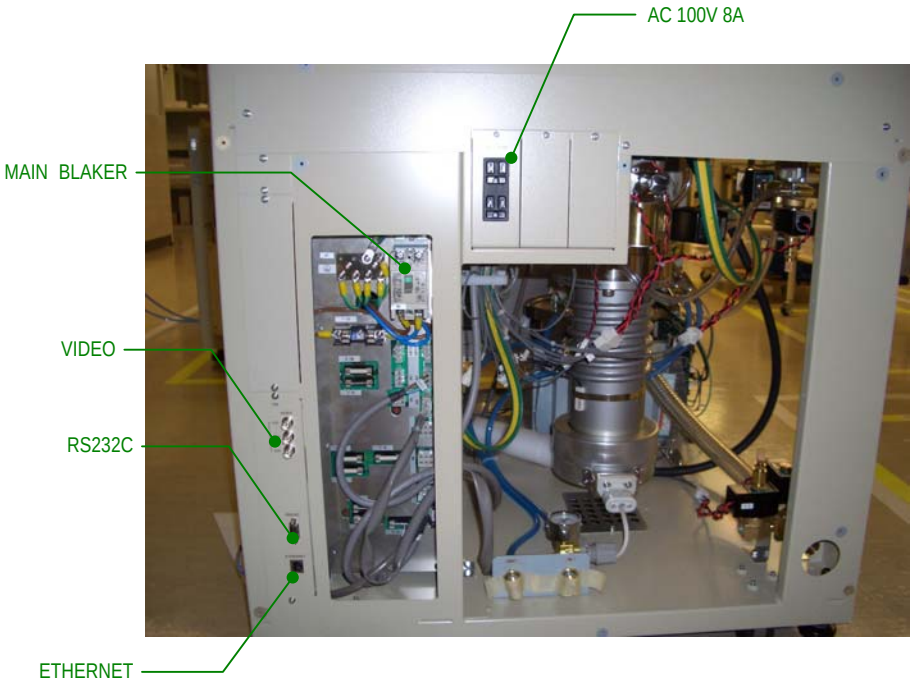


WD5mm direction WD10mm neighborhood WD48mm direction

2.2.4 Main control panel

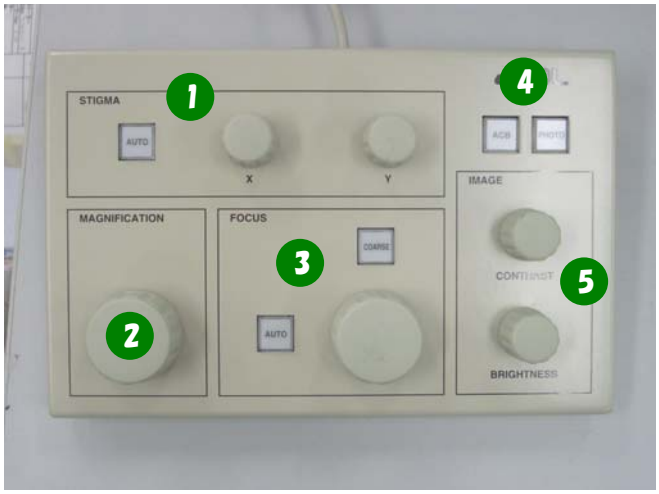
	Name	Explanation	Remarks
1	MAIN POWER key switch	Key switch used to set the status of the main power supply to OFF (○) or ON (I)	
2	VACUUM MODE LV	Switch used for changing over the active data display HV or LV. When this switch is ON (switch lamp is lit), the Vac. mode is set to LV. When this switch is OFF, the Vac. mode is set to HV.	It is effective with 6510LV／LA.
3	SPECIMEN CHAMBER VENT	Switch used for the specimen chamber and the electron optical column to atmosphere. When this switch is pressed for vent, the switch lamp flashes. When the specimen chamber and electron optical column becomes atmosphere pressure, the VENT switch lamp lights.	
4	SPECIMEN CHAMBER EVAC	Switch used for evacuating the specimen chamber and the electron optical column. When this switch is pressed for evac, the switch lamp flashes. When the evacuation is completed, the switch lamp lights.	
5	AIRLOCK CHAMBER ALC	Switch used for evacuating the airlock chamber It is effective when opening the GUI	It is effective with airlock chamber is attached

2.2.5 Rear panel



Name	Explanation	Remarks
AC100V 8A	Service outlet	
MAIN BLAKER	The blaker shut down the power suuply when an overcurrent flows in the system. **CAUTION !** Only use the circuit braker in cases of emergencies If the Braker trips, it indicates a malfunction in the system and you must contact the JEOL service center immediately.	Use the braker in case of emergencies.
VIDEO CH1	Connect to CH1 on the Video Capture Card of the PC.	For displaying the Upper-side of the Sub screen of the SEM-GUI
CH2	Connect to CH2 on the Video Capture Card of the PC.	For displaying the Lower-side of the Sub screen of the SEM-GUI
CH3	Connect to CH3 on the Video Capture Card of the PC.	For displaying the SEM-GUI Main screen
	 Rear side of the PC	
RS232C		
ETHERNET	Connect to the LAN Card of the PC.	

2.3 OPERATION KEYBOARD (OKB)

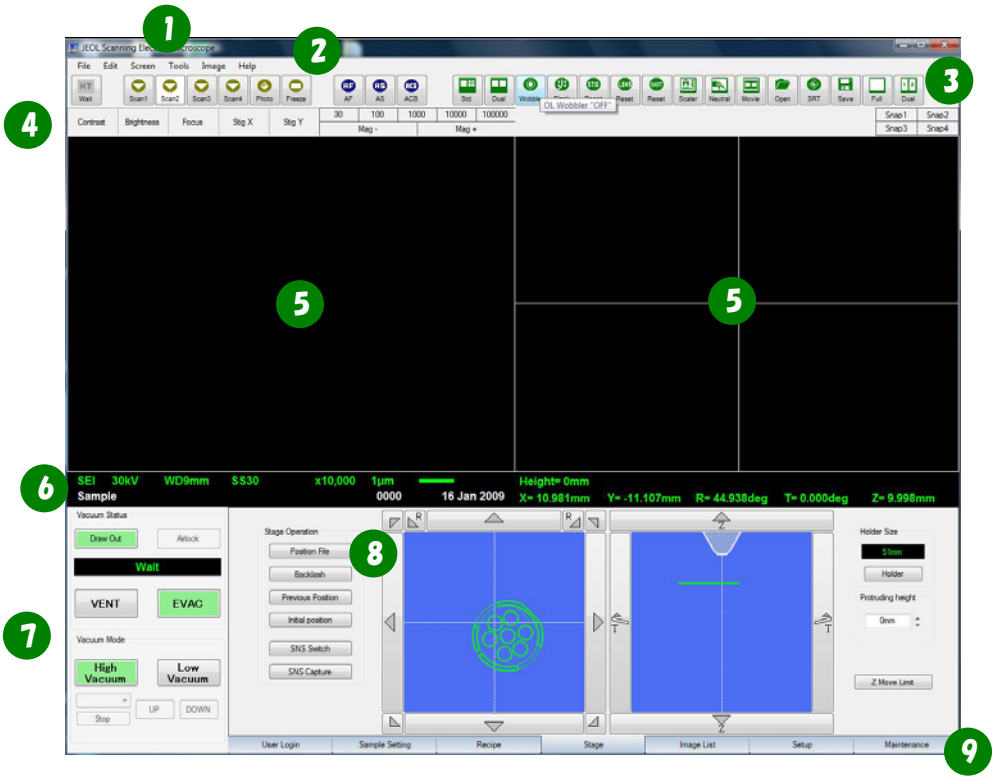


	Name		Explanation
1	STIGMA	X and Y knobs	Correct the astigmatism of the image using the X and Y knobs. The X knob corrects astigmatism X, and the Y knob corrects astigmatism Y
		AUTO switch	When this switch is ON (green), Auto stigma starts and stigmator corrected of astigmatism image appears for a several second later.
2	MAGNIFICATION	MAGNIFICATION knob	The magnification changes. Turning this knob counterclockwise lowers the magnification, while turning it clockwise raises the magnification.
3	FOCUS	COARSE switch, FOCUS knob	Adjusting the image focus When the COARSE switch is ON, you can carry out rough focusing using the FOCUS knob. When the COARSE switch is OFF, you can carry out fine focusing using the FOCUS knob. Tuning the FOCUS knob counterclockwise results in under-focusing, and turning it clockwise results in over-focusing.
		AUTO switch	When this switch is ON (green), Auto focus starts and focused image appears for a several second later.
4	ACB		When this switch is ON (green), ACB (auto contrast and brightness) starts and optimum image of contrast and brightness appears for a several second later.
	PHOTO		When this switch is ON (green), perform the acquisition action of the image is performed. It is possible to save automatically when Auto Save has been checked with ***Setup –Scan and AutoSave***". If you press the PHOTO switch, click  (on the GUI) during saving the image, it is canceled.
5	IMAGE	CONTRAST knob	Adjusting the image contrast Turning this knob counterclockwise reduces the contrast, and turning it clockwise increases the contrast.
		BRIGHTNESS knob	Adjusting the image brightness Turning this knob counterclockwise makes the image dark, and turning it clockwise makes the image bright.

3

Explanation of GUI

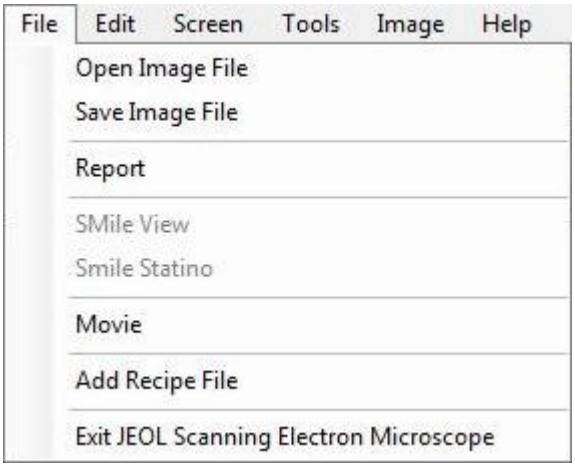
3.1 Main window



No.	Items	Explanation
1	Title bar	Click the button, the GUI size can minimized. Click the button, the exit message appears and the GUI can be closed. ＊ Gray-out display always, it is not possible to use it.
2	Menu bar	The pull down menu of the various functions are arranged.
3	Icon area	HT ON／OFF、Scan mode changing buttons and etc. are arranged.
4	Image adjustment button	Manual adjusting buttons and magnification changing buttons are arranged. Adjust the image contrast and brightness, focus manually, and switches the magnification.
5	Image area	Left screen ： A live image or freeze image of 640×480 pixels is displayed Right screen ： A live image (freeze image) of 640×480 pixels, four-freeze image of 320×240 pixels are displayed. And, various indications are possible depending on the other display mode.
6	Operation navigation area	The operation navigation and operation panel appears depending on the menu selection button.
7	Vacuum control panel	Vacuum sytem is controlled on this panel.
8	Operation navigation	A navigation and menu of the various operations are displayed by opening the operation menu tab.
9	Operation menu tab	User Login, Sample Setting, Recipe, Stage (If motorized stage is installed), Image list, Setup, Maintenance

3.2 Menu bar

3.2.1 File



Open Image File

Image opening window opens.

Save Image File

Image saving window opens.

Report

Starts the DTP program software. (For details, refer to the Chapter 4_4.21.1)

SMile View (An optional Smile View is necessary.)

Smile View is the software for displaying the index image of image data on the personal computer for easy layout and printing. (For details, refer to the Chapter 4_4.21.2)

Smile Station (An optional Smile Station is necessary.)

The program has a wide-area navigation function which can move the stage (an optional motorized stage is necessary) so that the position specified on the navigation image comes to the observation center.

Movie

The recording/playing of a live image is possible.

Add Recipe File

Open the Add Recipe File window. (For details, refer to the 3.5.4.b)
An observation condition can be saved to the Recipe file.

Exit JEOL Scanning Electron Microscope

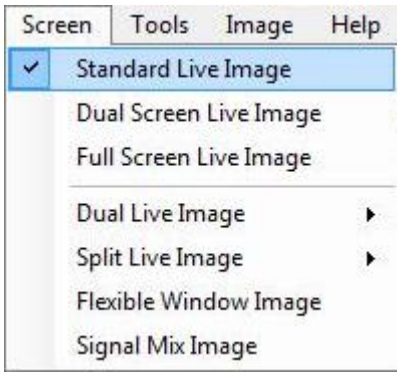
The end procedure of the instrument is displayed.

3.2.2 Edit

Image Clip

You can copy an image to the Windows clipboard. Then you can paste the image into an application such as Word.

3.2.3 Screen



Standard Live Image

The image area is changes to standard (Left：one、Right：4-division)

Dual Screen Live Image

The image area is changes to dual screen (Left：one、Right：one).

Full Screen Live Image

Displays the enlarged live image at the full size of the monitor. The image area is changed to enlarged image at the full size

Dual Live Image

A same field of a live image can be shown with two different signals.

LR The image area is changed to DualLive-Left/Right

UD The image area is changed to DualLive-Up/Down

Split Live Image

Splits one field of view, a live image can be displayed with two different signals. It is possible to change the division range.

LR The image area is changed to SplitLive-Left/Right

UD The image area is changed to SplitLive-Up/Down

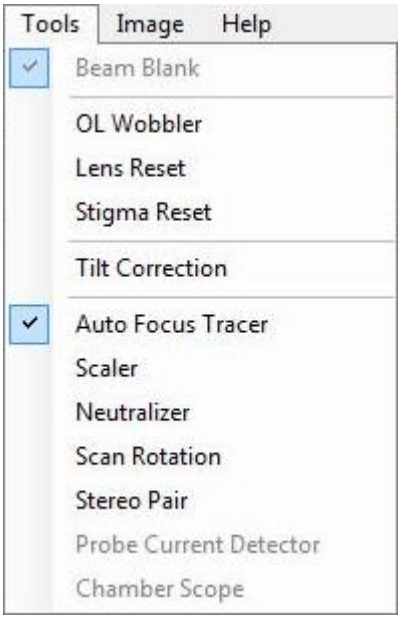
Flexible Window Image

An arbitrary rectangle area is placed within the main screen, and the rectangle area can be displayed by another signal. It is possible to change the position and a size of the rectangle area.

Signal Mix Image

The image which mixed two kinds of signals is displayed on the main screen.

3.2.4 Tools



Beam Blank

Activates the Beam Blank.
When the Beam Blank is activated, the specimen is not irradiated by the electron beam, and specimen damage is prevented.

When a Freeze image is displayed, the Beam Blank is activated automatically to prevent specimen damage. The Beam Blank automatically cancels when a live image is displayed.

OL Wobbler

To adjust the OL (objective lens) aperture, the OL current is changed periodically. If the electron beam deviates from the optical axis, the image oscillates in any direction with high amplitude.

Lens Reset

Activates Lens Reset to remove the hysteresis of the lens to ensure optimum operation condition of the SEM. (It is not necessary by the usual observation)

Stigma Reset

Sets the stored astigmatism condition (the factory installed optimum condition). Use it in case that the image drifts diagonally even if the focus is properly adjusted.

Tilt Correction

Opens the Tilt Correction menu. (For details, refer to the Chapter 4_4.12)
This menu is used to correct focus (Dynamic focus) and the magnification (Mag correction) when the specimen is tilted.

Auto Focus Tracer

Automatically focusing the image when the Z-axis of the stage (only when the motorized stage is installed) is moved

Scaler

Opens the scaler menu.
A “distance between the two points”, “angle”, etc. can be measured. The measured data is pasted on the image.

Neutralizer

It is effective in reducing halation (the image be veiled in haze of white) of the image.

Scan Rotation (An optional Scan Rotation is necessary)

Opens the Scan Rotation menu. (For details, refer to the Chapter 4_4.13)
Rotates the image by rotating the scan direction.

Stereo Pair

Opens the Stereo Pair menu. (For details, refer to the Chapter 4_4.14)
You can save two images in the same field of view at a different angle. For creating and analyzing three-dimension images, please refer to the user manual of THREE-DIMENSION IMAGE SOFTWARE

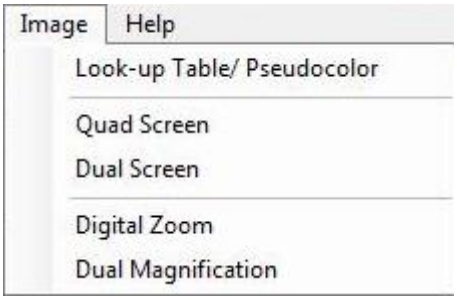
Probe Current Detector (An optional Probe Current Detector is necessary)

This detector (PCD) is used to measure the irradiation electron beam current.

Chamber Scope (An optional Chamber Scope is necessary)

Activates the chamber scope (color CCD camera) and enables you to observe inside the specimen chamber.

3.2.5 Image



Look-up Table/PseudoColor

The brightness of the freeze image on the main screen can be corrected by the grey level data.

Quad Screen

The main screen is divided to four and it can synthesize four image files.

Dual Screen

The main screen is divided to two and it can synthesize two image files.

Digital Zoom

It is possible to display by expanding a part of the frozen image.

Dual Magnification

It is possible to display it on the right-side screen by expanding a part of the frozen image.

3.2.6 Analysis

（Standard built-in : JSM-6510A, JSM-6510LA）

Acquisition Condition

Displays the Acquisition Condition menu.

Periodic Table

Displays the Periodi Table.

Send Image to Analysis Station

A live image or a freeze image is sent to the Analysis Sation (software for analyzing).

X-ray Mapping

Performs all the elements mappling in the whole area of the image display area.

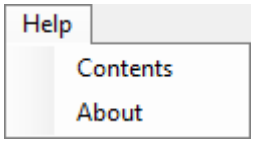
Sequential Analysis

Perform sequentially the spectrum acquisition of the point reserved with ***Spot analysis*** or ***Area analysis***.

Clear Analysis History

Erases the cross-marker, line or rectangle area, which show an analysis position

3.2.7 Help



Contents

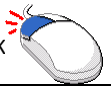
Opens the PC-SEM Help window.

About

Opens the SEM program version information window.

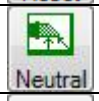
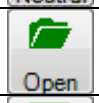
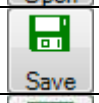
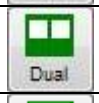
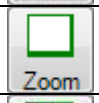
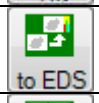
3.3 Icon area

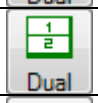
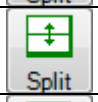
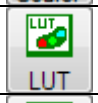
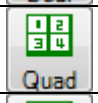
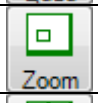
3.3.1 Fixation icons

Items	Icon	Explanation
HT		Observation is being prepareted（except HT Ready）It is not possible to accept
		Image observation is possible （HT Ready） When you left-click  at this icon, the HT is turned ON and image can be observed.
		Image is being observed （HT ON） When you left-click  at this icon, the HT is turned OFF.
＊ Scan1		This button is suitable to adjust the image quality.
＊ Scan 2		This button is suitable to search for field of view.
＊ Scan 3		This button is suitable to check the image quality and to observe the detail.
＊ Scan 4		This button is suitable to observe and acquire the precise image.
＊ Photo		This button is suitable to acquire the checked image and to save the image automatically. ＊ The image quality cannot be adjusted.
Freeze		An observation image becomes the freeze image.
ACB		Click this button to carry out the automatic contrast/brightness adjustment.
AF		Click this button to carry out the automatic focusing
AS		Click this button to carry out the automatic astigmatism correction

＊ If you click one of any scan icons while pressing the right mouse button  , a pop-up menu is displayed and you can change the scan speed.（except  ）

3.3.2 Custmaize icon list

Command	Icon	Explanation
Save Movie		Opens the Movie record menu.
OL Wobbler		To adjust the OL (Objective Lens) aperture, the OL current is changed periodically. If the electron beam deviates from the optical axis, the image oscillates in any deirection with high amplitude.
Beam Blank		Activates the Beam Blank. When the Beam Blank is activated, thespecimen is not irradiated by the electron beam, and specimen damage is prevented. When Freeze image is displayed, the Beam Blank is activated automatically toprevent specimen damage.
Stigma Reset		Sets the stored astigmatism condition (the factory installed optimum condition). Use it in case that the image drifts diagonally even if the focus is adjusted properly
Lens Reset		Activates Lens Reset to remove thehysteresis of the lens to ensure optimum operation condition of the SEM. It is not necessary by the usual observation
Image Shift Reset		Brings the image to the center of the electrical Shift.
Neutralizer		Neutral is effective in reducing the effect of detector saturation (the image veiled in white). It can only be used for “SEI” signals. Neutral cannot be activated in case of “REF” signal mode or Low Vacuum mode “LV”
Open Image File		Opens the Open window (adhere to Windows).
Save Image File		Opens the Save window (adhere toWindows).
Add Recipe file		Opens the Add Recipe File window
Standard live image		Click this button to change to the standard screen. （Left：one、Right：4-division）
Dual screen live image		Click this button to change to the dual screen. （Left：one、Right：one）
Full Screen Live Image		Displays the enlarged live image at the full size of the monitor.
Stereo pair		Open the Stereo Pair menu
Tilt correction		Opens the Tilt Correction menu.
Send the current image to EDS		Sends a live image or a Freeze image to the Analysis Station.
X-ray Mapping		Performs the All Elements Mapping in the whole area of the displayed image.
Sequential Analysis		Opens the Sequential Analysis dialog. This is used when ***Spot Analysis*** and ***Area Analysis*** is sequentially carried out.

Command	Icon	Explanation
Dual Live Image (Right/Left)		Displays the Dual Live image (Right / Left)..
Dual Live Image (Top/Bottom)		Displays the Dual Live image (Top / Bottom).
Split Live Image (Right/Left)		Displays the Split Live image (Right /Left).
Split Live Image (Top/Bottom)		Displays the Split Live image (Top /Bottom).
Flexible Window Image		Displays the Flexible Window image
Signal Mix Image		Opens the Mix Image window.
Scaler		Opens the Scaler menu.
Look-up Table/Pseudo Color		Opens the Look-up Table window.
Dual Screen		Opens the Dual Screen menu.
Quad Screen		Opens the Quad Screen menu.
Digital Zoom		Open the Digital Zoom menu.
Dual Magnification		Opens the Dual Magnification menu.
Report		Starts the DTP program software, and opens the DTP window.

Attachments

Items	Icons	Explanation
Probe Current Detector		PCD is used to measure the irradiation electron beam current. PCD is useful for X-ray analysis (EDS / WDS), where it is essential to regulate the beam current to reproduce a specific condition.
Chamber Scope		Activates the Chamber Scope.
Scan Rotation		Opens the Scan Rotation menu.
SMV		Starts the Smile View program.
SMS		Starts the SMile Station program.
Frame Shift		The image can be moved by a specified fraction of the field (10 to 100, 200 percents). If 50% is specified as the frame moving range, the field of view will move half way, and if 100% is specified, it will fully move to the adjacent field.

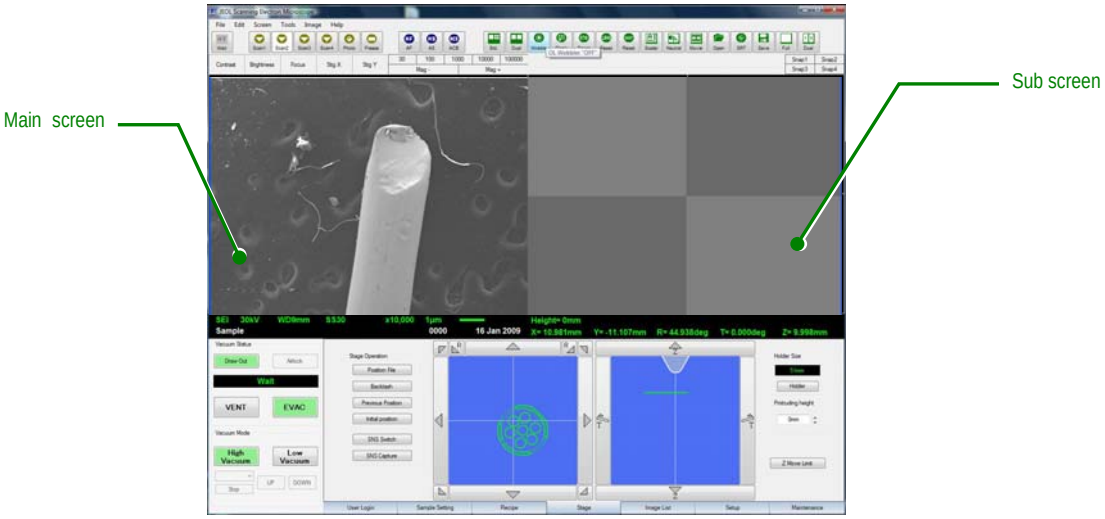
3.4 Image area

3.4.1 Selection of the screen

3.4.1.a Standard Live Image

Click the Std. Icon 

, or select menu bar ***Screen*** ⇒ ***Standard Live Image***.



Items	Explanation
Main screen	Display size：640×480 dots（one image） The observation image（Live or Freeze image） is displayed
Sub screen	Display size：320×240 dots（four images） The motor drive stage can control with the image file and/or snap shot image. ＊ Displays only frozen image

3.4.1.b Dual Screen Live Image

Click the Dual icon 

, or select menu bar ***Screen*** ⇒ ***Dual Screen Live Image***.

Items	Explanation
Screen1	Display size : 640×480 dots (one image) The observation image (Live or Freeze image) and/or image file is displayed
Screen 2	Display size : 640×480 dots (one image) The observation image (Live or Freeze image) and/or image file is displayed
Screen selection frame	The active screen is displayed with the blue frame. The operation of the image adjustment (contrast, brightness, etc.) can be performed only on the active screen. By clicking the screen having no frame, the clicked screen becomes active.
Freeze Icon	Screen 1 and Screen 2 become Freeze at the same time by clicking the Freeze icon. When the Freeze is released, both screens are simultaneously released. When the Screen 2 is Freeze beforehand, only Screen1 becomes Freeze.
Freeze button	By clicking the Freeze button, a live image or a Freezel image is displayed alternately in the Screen 2 only. The ***Freeze*** button can be used when you select the Screen 2

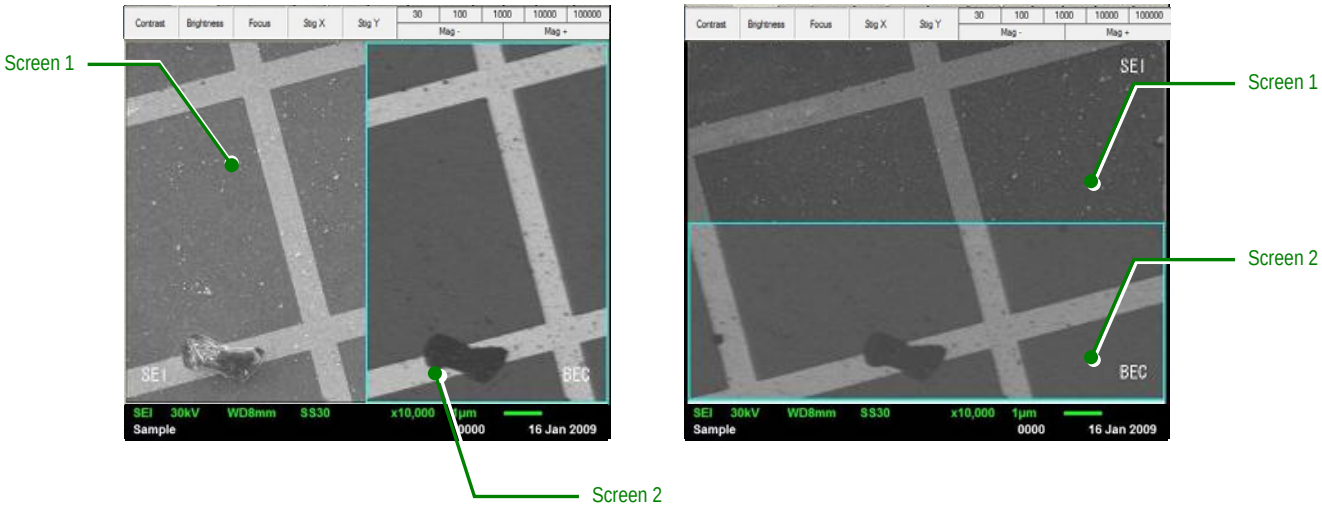
In case of “Dual screen Live Image”, you cannot use a “Scan1”, “Wobbler”, “Edit” and “Image”.

3.4.1.c Dual Live Image

Click the split live icon 

(left/right)／ 

(top/bottom) or select Menu bar **Screen** ⇒ **Dual Live Image** ⇒ **LR／UD**



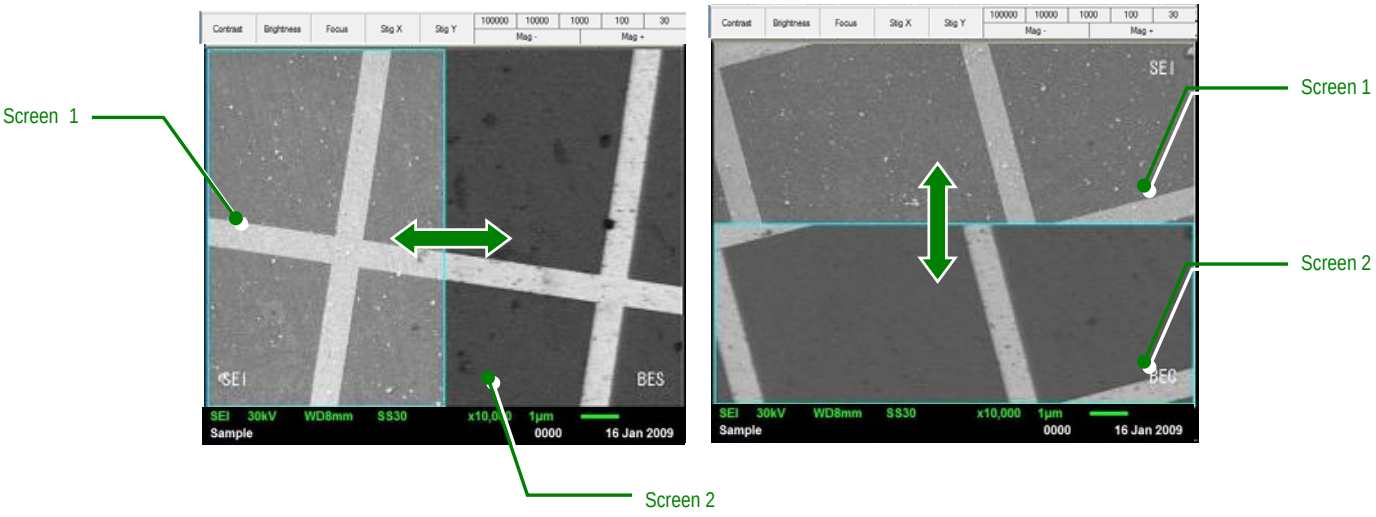
Items	Explanation
Screen1	Display size：320×480 pixels（Horizontal division） Display size：640×240 pixels（Vertical division） The observation image（Live or Freeze image） and/or image file is displayed
Screen2	Display size：320×480 pixels（Horizontal division） Display size：640×240 pixels（Vertical division） The observation image（Live or Freeze image） and/or image file is displayed
Screen selection frame	The active screen is displayed with the blue frame. The operation of the image adjustment (contrast, brightness, etc.) can be performed only on the active screen. By clicking the screen having no frame, the clicked screen becomes active.

3.4.1.d Split Live Image

Click the split live icon 

(left/right)／ 

(top/bottom), or select Menu bar ***Screen*** ⇒ ***Split Live Image*** ⇒ ***LR／UD***.

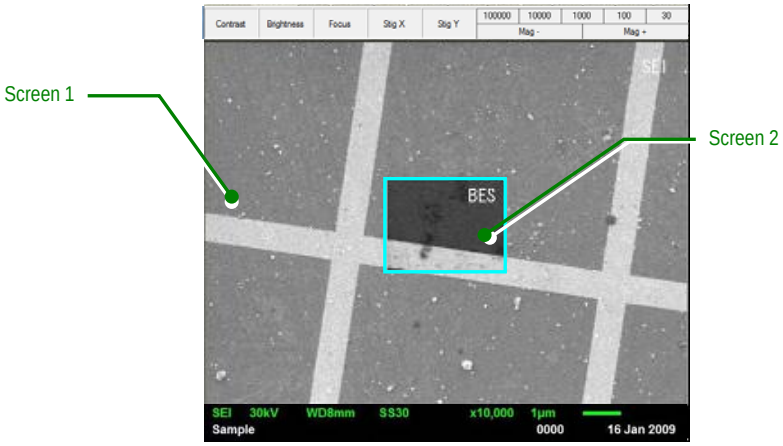


Items	Explanation
Display method	When you change the screen to ***Split Live Image*** from the ***Standard Live Image*** ; Screen1 : The present signal on the main screen (Standard Live Image) is displayed Screen2 : Display a previous signal. ＊Default : SEI-SEI
Screen selection frame	The active screen is displayed with the blue frame. The operation of the image adjustment (contrast, brightness, etc.) can be performed only on the active screen. By clicking the screen having no frame, the clicked screen becomes active.
Horizontal division	By dragging the blue frame, you can change the frame rate.
Vertical division	By dragging the blue frame, you can change the frame rate.

3.4.1.e Flexible Window Image

Click the Flexible window icon 

, or select Menu bar ***Screen*** ⇒ ***Flexible Window Image***.

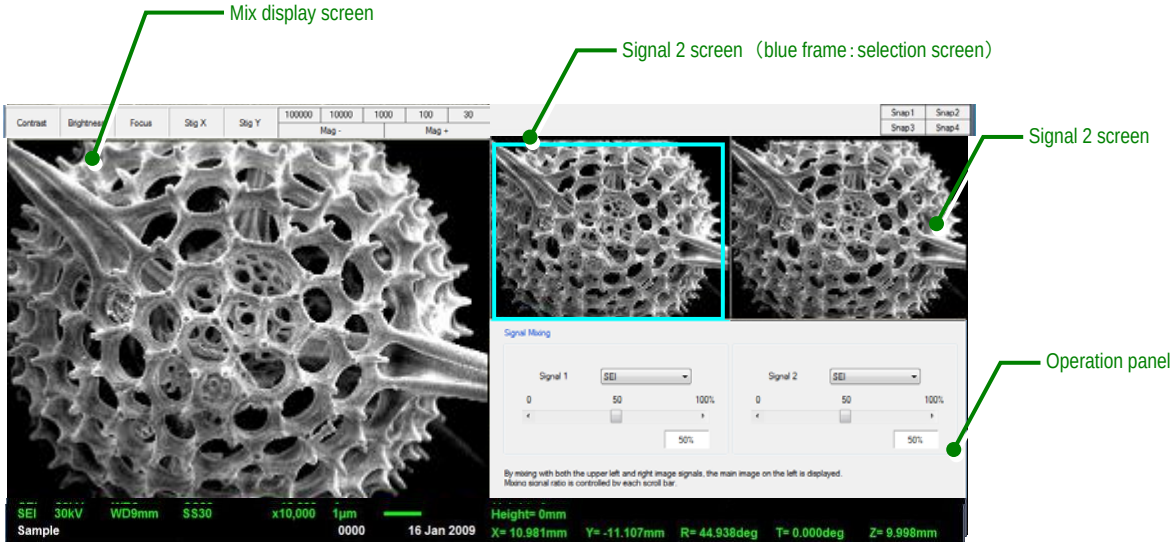


Items	Explanation
Display method	When you change the screen to ***Flexible Window Image*** from the ***Standard Live Image*** ; Screen1 : The present signal on the main screen (Standard Live Image) is displayed Screen2 : Display a previous signal. ✻Default : SEI-SEI
Screen selection frame	Displays the active screen with the blue frame. The operation of the image adjustment (contrast, brightness, etc.) can be performed only on the active screen. By clicking the screen having no frame, the clicked screen becomes active.
Changing a frame rate	By dragging and dropping the edge of the blue frame, you can change the frame rate.
Moving a frame position	The frame can move anywhere in the main screen by dragging. ✻ The motorized stage cannot be moved within the frame (screen2) by dragging.

3.4.1.f Signal Mixing Image

Click the Mix icon 

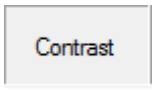
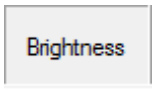
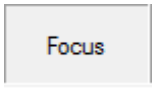
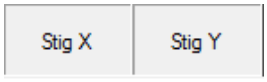
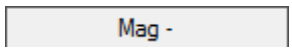
, or select Menu bar ***Screen*** ⇒ ***Signal Mixing Image***.



Items	Explanation
Signal mixing screen	Display size：640×480 pixels（one image） The observation image（Live or Freeze image） is dispayed
Signal 1 screen	Display size：320×240 pixels The observation image（Live image） is dispayed
Signal 2 screen	Display size：320×240 pixels The observation image（Live image） is dispayed
Screen selection frame	The active screen is displayed with the blue frame. The operation of the image adjustment (contrast, brightness, etc.) can be performed only on the active screen. By clicking the screen having no frame, the clicked screen becomes active.
Signal1	Changing the signal to display is possible.
Signal2	Changing the signal to display is possible.
Scroll bar	Changing the mixture rate is possible using the scroll bar. Memorizes the previous mixture rate.

3.4.2 Image adjustment button

Adjusts the image quality and focus, etc.

Items	Icon	Explanation
Contrast		Adjusts the image contrast manually. Rough (Fine) adjustment is possible by dragging the right (left) mouse button on the image.
Brightness		Adjusts the image brightness manually. Rough (Fine) adjustment is possible by dragging the mouse right (left) button on the image.
Focus		Adjusts the image focusing manually. Rough (Fine) adjustment is possible by dragging the right (left) mouse button on the image.
StigmaX, StigmaY		Adjusts the image stigmatism manually. Rough (Fine) adjustment is possible by dragging the right (left) mouse button on the image.
Mag －		When the left mouse button is clicked once, the magnification decreases by one step. When keep pressing it, the magnification increases until the lowest magnification.
Mag ＋		When the left mouse button is clicked once, the magnification increases by one step. When keep pressing it, the magnification increases until the highest magnification.
Preset Magnification		The present magnification switches to the "Preset magnification" by clicking the button. The "Preset magnification" can be changed by using the ***Setting*** in the Operation menu tab.

3.4.3 Image data display

The image data can be displayed on the bottom of the main screen shown to the below. The ON/OFF of the image data and the background of the image data can perform by the Setup of the operation navigation area.

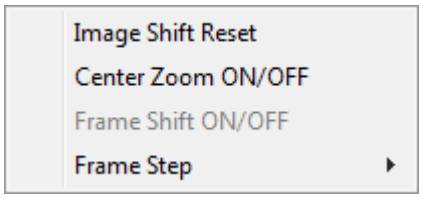
Items	Explanation
SEI	The detected signal is displayed, and it changes by changing the signal.
30kV	The accelerating voltage is displayed. (It changes depending on the selected accelerating voltage)
WD8mm	The WD (working distance) is displayed by converting the Objective lens current. (It changes depending on the focusing value)
SS30	The Spot size is displayed. (It changes by increasing or decreasing the spot size value.)
30Pa	The specimen chamber pressure is displayed. (It changes by setting the pressure.) ＊ The specimen chamber pressure is displayed only when the vacuum mode was set to Low Vacuum mode.
×10,000	The magnification is displayed. (It changes by enlarging or reducing the magnification.)
Micron value and micron marker 	The bar and the distance value corresponding to a present magnification are displayed. (It changes by increasing or decreasing the magnification.) ＊ Micron bar: It can be displayed on the screen by dragging it with the left mouse button click, and it will turn out if you release the button.
Sample	The label entered by ***Setup*** in the Operation menu tab is displayed.
0000	The number of counter entered by ***Setup*** in the Operation menu tab is displayed.
16 Jan 2009	The current day/month/year are displayed.

Signal	Data display
SEI	SEI （Secondary electron image）
BEIW	BEC（Backscattered electron – composition image）
	BET（Backscattered electron – Topographic image）
	BES （Backscattered electron – shadow image）
LVSE	LVSE （Low vacuum secondary electron image）
EMF	EMF （Electromotive force image）
CLD	CLI （Cathodeluminescence image）
CLDIR	CLI
AUX	AUX
REF	REF （Refrected electron mage）
Dual	DLI （Dual image）
Split	SPI （Split image）
Flexible	FXI （Flexible window image）
Signal mixture	MIX （The mixture image of two kind of signals）

3.4.4 Right-click menu

3.4.4.a Main screen

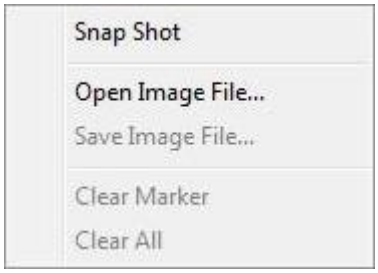
When you click the right mouse button  in the main screen, the pop-up menu appears.



Items	Explnation
Spot Analysis	The spot analysis on the position where the right mouse is clicked on the image can be performed. (For A/LA model)
Line Analysis	The line analysis analysis on the position where the right mouse is clicked on the image can be performed. (For A/LA model)
Reserve a spot analysis	The reservation on the positions where the right mouse is clicked on the image can be performed. (For A/LA model)
Image Shift Reset	The image can be returned to the original position after being moved.
Center Zoom ON/OFF	Switchs the function to Click center or Click center zoom.
Frame Shift ON/OFF	Switches the function to Frame shift or Image shift.
Frame Step	The image can be moved by a specified fraction of the filed (10 to 100, 200 percents). If 50% is specified as the frame moving amount, the field of view will move half way, and if 100% is specified, it will move all way to the adjacent field.

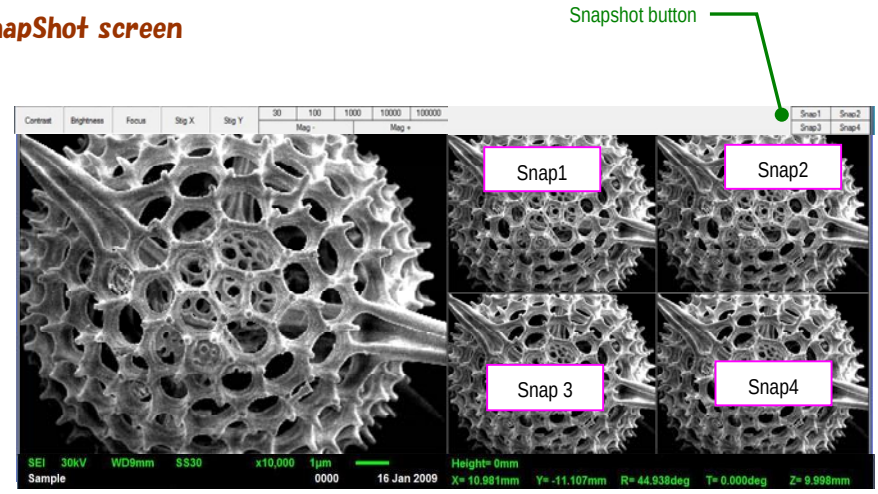
3.4.4.b Sub-screen

If you click the right mouse button  in the sub-screen at the “Standard Live Image” , the pop-up menu will appear.



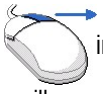
Items	Explnation
Snap shot	The image of the main screen is displayed on the sub-screen as a snap shot image. The motorized stage can control using the frozen image.
Open Image File	Displays the “File Open window”.
Save Image File	Displays the “Save as window”.
Clear Marker	The specified marker on the snap shot screen is cleared.
Clear All	An all image on the snap shot screen is deleted.

SnapShot screen



Items	Explanation
Right-click, Snapshot button	If you select the ***Snap Shot*** in the pop-up menu or click the “Snapshot” button, the sub screen image will display the image on the main screen as a snap shot image. * Snap shot function cannot be used with the Scan1

3.4.5 Right-dragging menu

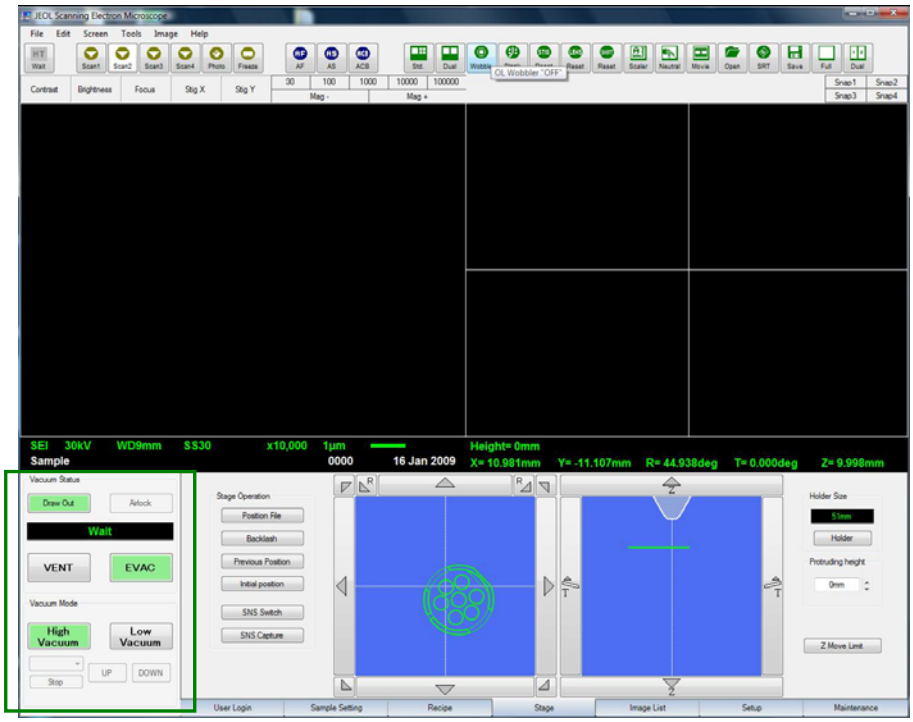
If you drag  in the main screen with the right mouse button, the rectangle frame will be drawn and a pop-up menu will appear. (It is effective when an EDS is installed)

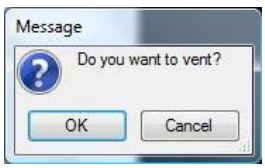
Items	Explanation
Area analysis	The area analysis of the rectangle area drawn by dragging the right mouse button can be performed.
Reserve an area analysis.	The reservation of the rectangle area drawn by dragging the right mouse button can be performed.
Zoom	The image in the rectangle area is moved to the center of the image display area, and it can be displayed with full size

3.5 Operation navigation

3.5.1 Vacuum menu

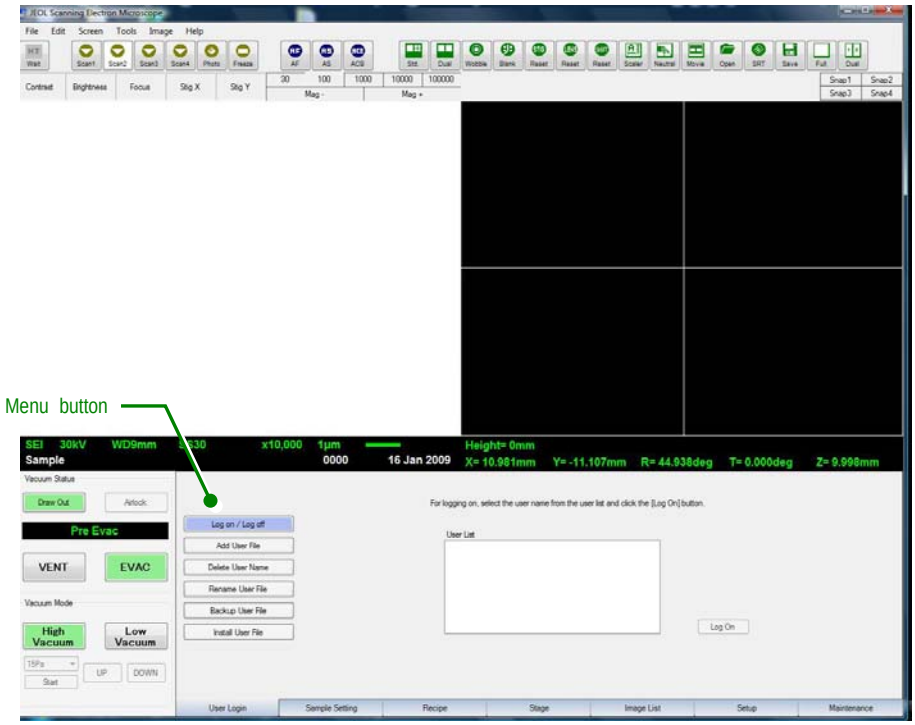
The vacuum control menu is always displayed.



Items	Explanation
Draw Out	Click the **Draw Out** button to switch the evacuation control at the draw out.
Airlock	Click the **Airlock** button to switch the evacuation control at the airclok. ＊ An optional ALC/ALS is necessary.
Vacuum status display	Displays the vacuum status in the specimen chamber.
VENT	Click the **VENT** button to start the venting the specimen chamber. During VENT：The button lights flashing.（button color：orange） After VENT is ended：The button lights.（button color：orange）
EVAC	Click the **EVAC** button to start the evacuating the specimen chamber After EVAC is ended： The button lights.（button color：green）
	When you click the VENT／EVAC button, the message dialog is displayed. Click the **OK** button to start the vacuum operation. 

Items	Explanation
High Vacuum	When you click the **High Vacuum** button, the message dialog is displayed. Click the **OK** button to set the vacuum mode to High Vacuum.
Low Vaccum	When you click the **Low Vacuum** button, the message dialog is displayed. Click the **OK** button to set the vacuum mode to Low Vacuum.
Vacuum Mode	The following operation menus can be used by switching the vacuum mode to the low vacuum mode.（It is effective with LV／LA model）
Pressure adjustment	UP button： The pressure value decreases（specimen chamber pressure goes low） DOWN button： The pressure value increases（specimen chamber pressure goes high）
Combo box	10 - 270Pa（5Pa step：10 - 130Pa、10Pa step：130 - 270Pa） When you select a desired pressure in the combo box, the pressure adjustment is performed automatically. The pressure value to use well is displayed on the first. ＊ Default value：30,50,70,100Pa
Srart	Select a desired pressure in the combo box, and click the **Start** button. The pressure adjustment is started.
Stop	Click the **Stop** button to stop the pressure adjustment.

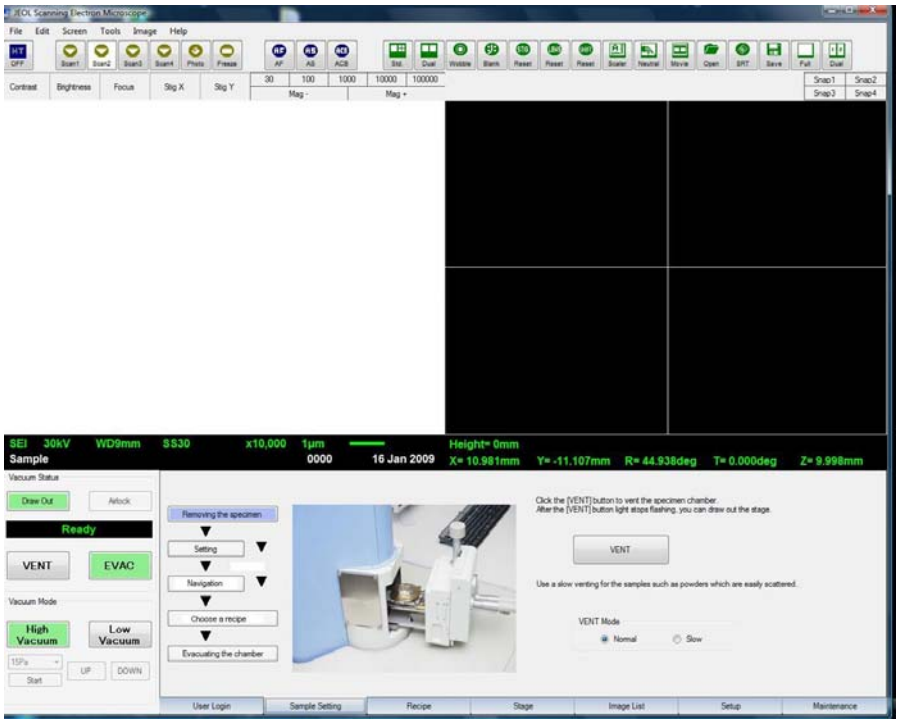
3.5.2 User Login



Items		Operation/Explanation
Menu button	Log on/Log off	Displays the operation menu of the "Logon/Logoff". The operation menu of the "Logon" is displayed when starting the SEM program.
	Add User File	Displays the operation menu of "Add User File".
	Delete User file	Displays the operation menu of "Delete User File".
	Edit User File	Displays the operation menu of the "Rename User File".
	Backup User File	Displays the operation menu of the "Backup User File".
	Install User File	Displays the operation menu of the "Install User File".
Log on	User list	The registered user name is displayed.
	Log on	Select the user name from the user list and click the **Log On** button
Log off	User logged on	Displays the "User logged on"
	Log off	Check the user name and click the **Log Off** button. A message of " Do you really want to log off ? " is displayed, and click the OK button.
Add User File	User Name	Enter the user name.
	Add	A new user is registered by clicking the **Add** button, and the "User Login" operation navigation closes.

Items		Operation/Explanation
Delete User File	User list	The saved user list is displayed. Click the user name to delete from the combo box.
	Delete	The selected user is deleted by clicking the **Delete** button.
Edit User File	User list	The saved user is displayed. Click the user name to edit from the combo box.
	New User Name	Enter a new user name.
	Rename	The user name is changed to a new name by clicking the **Rename** button.
Backup User File	Refer	The destination of the media and the directory is displayed by clicking **Refer** button.
	Backup	The user file is saved to the specified media by clicking the **Backup** button.
Install User File	Refer	The destination of the media and the directory is displayed by clicking the **Refer** button.
	Install	The user file is installed to the PC by clicking the **Install** button.

3.5.3 Sample setting

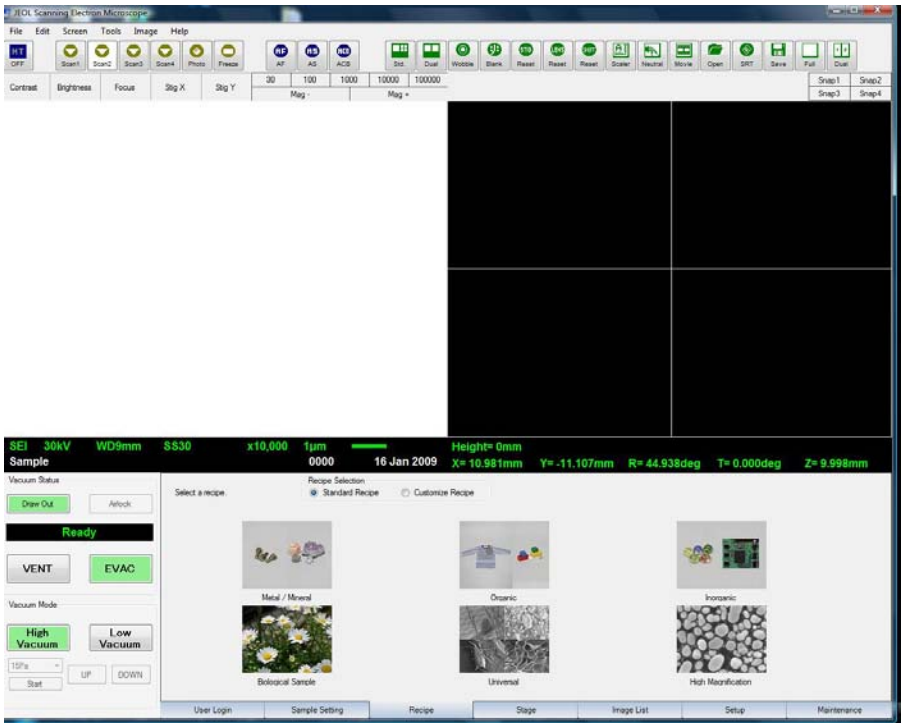


Items			Operation/Explanation
Operation flow button (For draw out)	Removing the specimen		The " Removing the specimen " procedure is displayed by clicking the ***Removing the specimen*** button.
	Setting		The setting the specimen procedure is displayed by clicking the ***Setting*** button.
	Navigation		The "Navigation Image Acquisition" procedure is displayed by clicking the ***Navigation*** button. The Stage Navigation System will start. ＊ An optional motorized stage and SNS are necessary.
	Choose a recipe		The " Choose a recipe " is is displayed by clicking the ***Choose a recipe*** bottun.
	Evacuating the chamber		The "Evacuating the specimen chamber" procedure is displayed by clicking the ***Evacuating the specimen chamber*** button.
Operation flow button (For airlock)	Removing the specimen		The "Removing the specimen" procedure is displayed by clicking the ***Removing the specimen*** button.
	Evacuating the chamber		The "Evacuating the specoimen chamber" procedure is displayed by clicking the ***Evacuating the specimen chamber*** button.
	Choose a recipe		The " Choose a recipe " is is displayed by clicking the ***Choose a recipe*** bottun.
Removing the specimen	VENT Mode	Standard	Completely venting the specimen chamber. ＊ Bu／A model：gary-out
		Slow	Gradually venting the specimen chamber. Use a "Slow" for samples such as powders which are easily scattered.＊ Bu／A model：gary-out
	VENT		Click the VENT button to start the venting in the specimen chamber. During VENT：The button flasing lights.（button color：orange） After VENT is ended：The button lights.（button color：orange）

Items		Operation/Explanation
Setting	Holder selection	The specmen hlder is selected by clicking the holder graphic display. The holder graphic display scrolls using the slide bar. Kind of holder： 10mm dia. (10mm dia.×5mmh or 10mmh) 32mm dia. (32mm dia.×5mmh or 10mmh) 51mm dia. (51mm dia.×5mmh or 10mmh)、 76mm dia. (76mm dia.×5mmh or 10mmh)、 SEMpore32mm dia. SEMpore51mm dia. Wafer 102mm dia. 127mm dia. 152mm dia. SHX ＊ When an optional motor drive stage is installed
	Enter the protruding height	When the specimen protrudes above the holder top, make sure to input the specimen protruding height. The stage moving range (Z axis) is calculated automatically base on this input. This can prevent the specimen from contacting the detector, or other components. **Example**) If you input **20mm** as a protruding height, the Z axis moving range displays from WD5mm to WD28mm, and the actual Z axis can be moved between 25mm and 48mm.

Items		Operation/Explanation
Navigation	Capture	The navigation image is displayed on the navigation screen by clicking the **Capture** button. Also, the navigation image is displayed at the stage of the operation navigation area in the **Stage** tub. If you click the **Capture** button while the navigation image is displayed, the previous image is replaced to the captured image.
	Capture position	Stage type： 2-axes (X, Y)：X=Automatic、Y= Automatic、Z=10mm、T=0° 、R=0° 3-axes (X, Y, R)：X= Automatic、Y= Automatic、Z=10mm、T=0° 、R= Automatic 3-axes (X, Y, Z)：X= Automatic、Y= Automatic、Z= Automatic 、T=0° 、R=0° 5-axes (X, Y, R, T, Z)：X= Automatic、Y= Automatic、Z= Automatic 、T= Automatic、R= Automatic
	Save	The navigation image can be saved by clicking the **Save** button.
	Display	The navigation image is displayed at color on the main screen.
Choose a recipe		Refer to the “3.5.4 Recipe”
Evacuating the chamber	EVAC	Starts the evacuation in the specimen chamber by clicking the EVAC button. During EVAC：The button flashing lights.（color：green） After EVAC is ended：The button lights（color：green）
		☐ The image appears automatically after complete evacuation Tick：The image appears automatically after complete evacuation Non-tick：After complete evacuation, HT keeps OFF and the image does not appear.
	Vac Mode	High Vacuum Mode A message appears by selecting **High Vacuum Mode**. The vacuum mode is switched to “High vacuum” by clicking the OK button in the message. ＊ BU／A model：gray-out
		Low Vacuum Mode A message appears by selecting **Low Vacuum Mode**. The vacuum mode is switched to “Low vacuum” by clicking the OK button in the message. ＊ BU／A model：gray-out

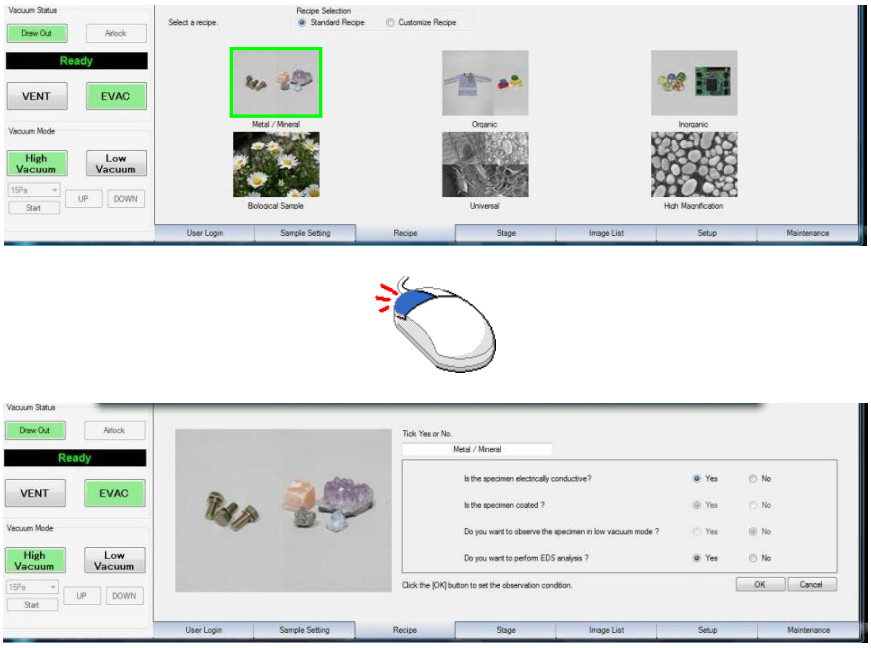
3.5.4 Recipe



Items		Operation/Explanation
Recipe Selection	Standard Recipe	The list of the standard recipe is displayed.
	Customize Recipe	The list of the custom recipe is displayed.

3.5.4.a Standard

When you observe a sample to observe for the first time, and the sample which do not understand the observation condition, the "Standard" can set automatically to the most suitable observation condition by only selecting the type of the sample.



Items	Operation/Explanation
Thumbnail list	The image is displayed according to the specimen classification. Metal/Mineral, Organic （Textile・Polymer）, Inorganic （Glass・semiconductor）, Biological Sample、Universal, High magnification
Condition	Is the specimen electrically conductive? Yes：The specimen with coating is selected. See Table of Observation conditions next page. No：Proceed to the next question.
	Is the specimen coated? Yes：" With coating" condition is selected. See Table of Observation next page. No：" Without coating " condition is selected.
	Do you want to observe the specimen in the low vacuum mode? Yes：" Low –Vacuum Observation " condition is selected. See Table of Observation next page. No：" Low-Voltage Observation " condition is selected.
	Do you want to perform EDS analysis? Yes：" EDS " is selected. See Table of Observation next page. No：" Observation" is selected.
OK	By clicking the **OK** button, the observation condition is set according to the sample classification.
Cancel	The thurmbnail list (Image list) is displayed.

Table of Observation Conditions

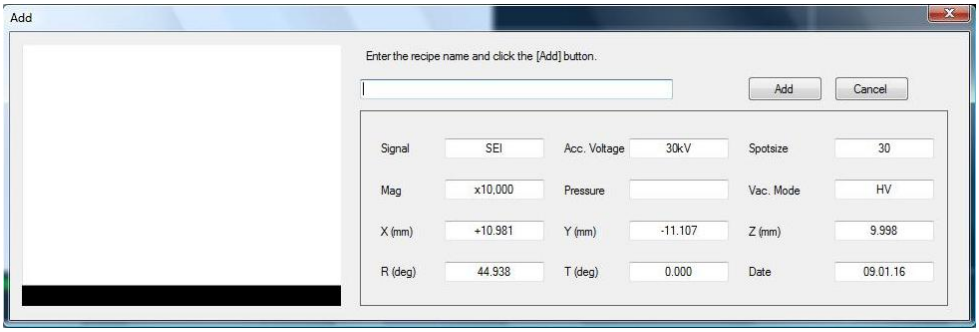
Standard Sample	Mag.	With Coating			Without Coating					
			Low-Voltage Observation				Low-Vacuum Observation			
			S.S			S.S		S.S		Specimen Chamber Press. Pa
		AccV	Observation	EDS	AccV	Observation	AccV	Observation	EDS	
Metal · Mineral	Minimum Magnification	20	50	60	1.5	50	15	50	50	30
Organic (Textile · Polymer)		10	50	60	1.0	50	10	60	65	40
Inorganic (Glass · Semiconductor)		15	50	60	1.0	50	15	60	65	40
Plant · Biological sample		10	50	60	1.0	50	10	60	65	50
Univarsal		15	50	60	1.0	50	15	60	65	30
High magnification		20	35	-	-	-	-	-	-	-

3.5.4.b Custom

Add

Click Recipe icon 

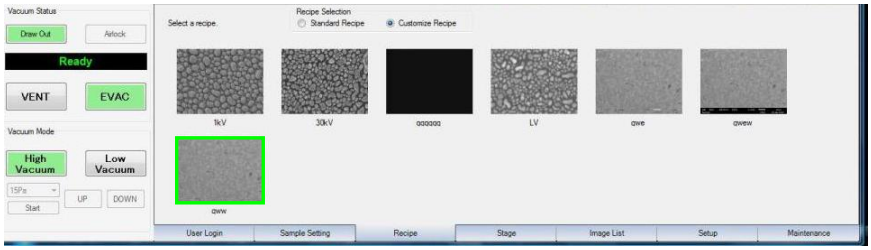
or select Menu bar ***File⇒Add Recipe File***.

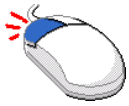


Items	Operation/Explanation
Image	The image on the main screen is displayed
Condition	The present observation condition is displayed. Signal、Acc. Voltage、Spot size、Magnification、Pressure、Vacuum mode X（mm）、Y（mm）、Z（mm）、R（deg）、T（deg）、Date（yy.mm.dd）
Add	Click the ***Add*** button to save the image on the main screen in the custom recipe. Thumbnail list：the image is added sequentially on the left top.
Cancel	Click the ***Cancel*** button to return to thumbnail list.

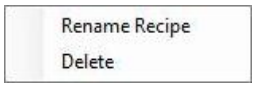
Using

Performs the call of the observation condition that a user set. Click the left mouse button on the thumbnail.





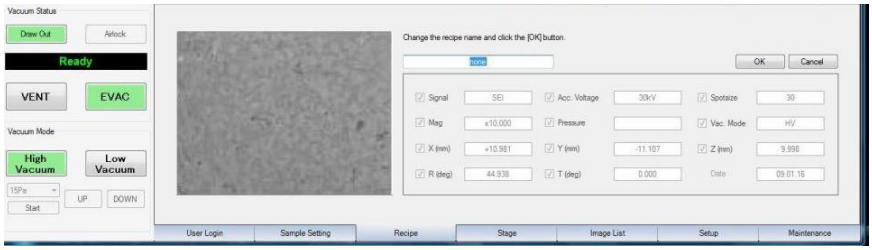
Items	Operation/Explanation
Tumbnail	The added recipes are displayed with the thumbnail list. If there are many-added recipes, the recipes (thumbnail) can be scrolled by the slide bar.
Condition	When you click the thumbnail image, the observation condition is displayed. Signal、Acc. Voltage、Spot size、Magnification、Pressure、Vacuum mode、X（mm）、Y（mm）、Z（mm）、R（deg）、T（deg）、Date（yy.mm.dd）
Move the stage to the saved image position	Tick：The motorized stage is moved to the saved image position. Non-tick：The motor drive stage is not moved. (It is effective when the optinal motorized stage is installed.)
OK	Click the **OK** button to set the observation condition.
Cancel	Click the **Cancel** button to return to the thumbnail list


When the right mouse button is clicked  on the thumbnail, the pop-up menu 

is displayed and the following operation can be performed.

Rename Recipe

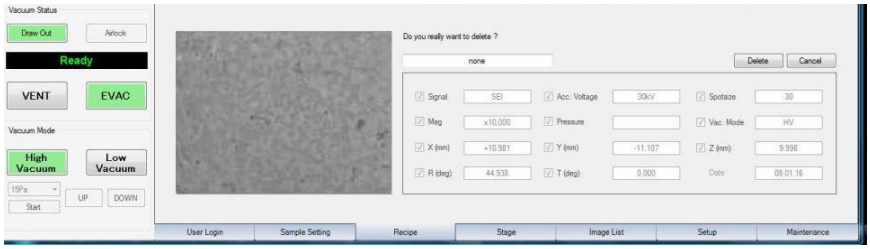
Select ***Rename Recipe*** from the pop-up menu.



Items	Operation/Explanation
Image	The selected image is displayed.
Recipe name input box	Change the recipe name.
Condition	The observation condition is displayed. Signal、Acc. Voltage、Spot size、Magnification、Pressure、Vacuum mode X（mm）、Y（mm）、Z（mm）、R（deg）、T（deg）、Date（yy.mm.dd）
OK	Click the ***OK*** button to rename the recipe.
Cancel	Click the ***Cancel*** button to return to thumbnail list.

Delete

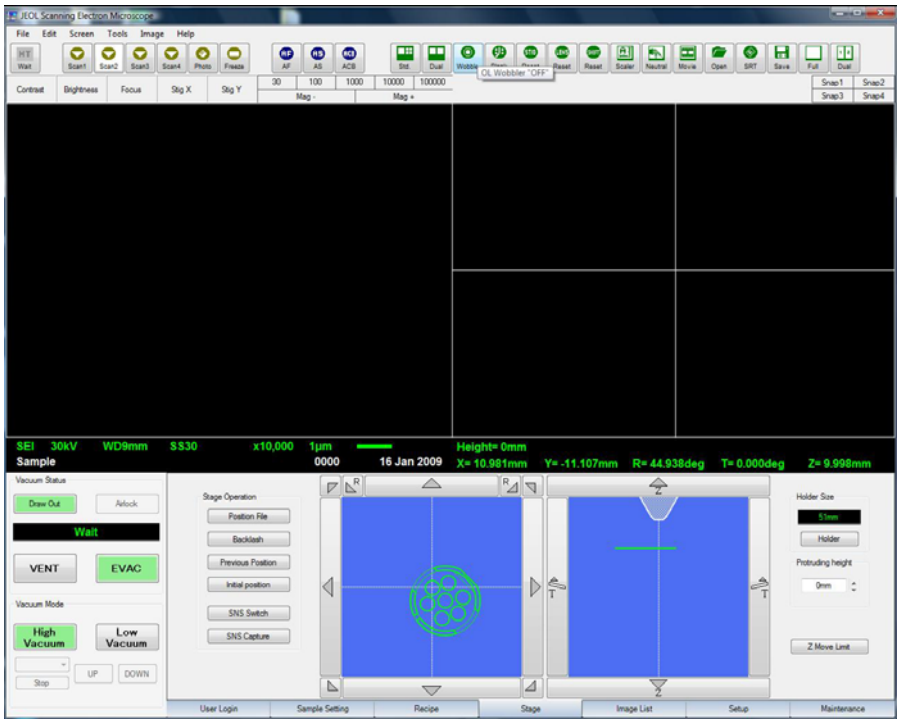
Select ***Delete*** from the pop-up menu..



Items	Operation/Explanation
Image	The selected image and observation condition are displayed.
Delete	Click the ***Delete*** button to delete the selected recipe.
Cancel	Click the ***Cancel*** button to return to thumbnail list.

3.5.5 Stage

This command is used to move the stage to search the field of view.



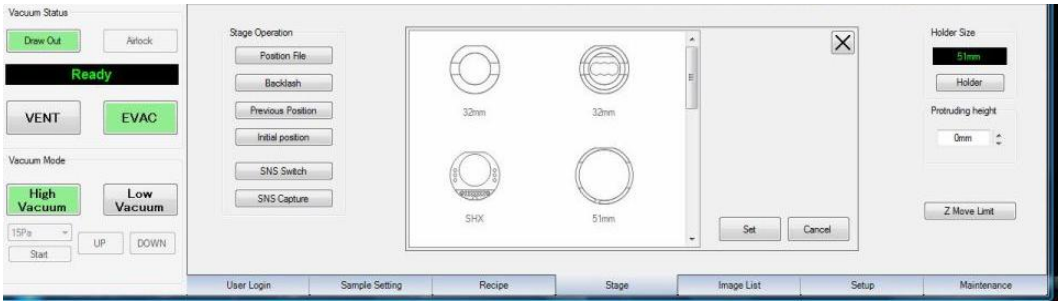
Items	Operation/Explanation
Position File	Click the **Position File** button to display the position file. (For details, refer to the 3.5.5.a)
Previous Position	If you click the Previous Position button, the graphic display and the coordinates are changed to the previous ones where the stage has moved by such as Position File, Enter Coordinates, Initial Position、Previous Position or Moving by the ＋marker. And the message is displayed. Click the **Yes** button to move the stage to the previous position.
Backlash	When the **Backlash** button is clicked, the stage will move by -0.1mm from the present position and return to the previous position before Backlash starts.
Initial Position	If the **Initial Position** button is clicked, the message " Confirm your move ? " is displayed. When the **Yes** button is clicked, the stage is moved to the following positions. X=0.0mm、Y=0.0mm、T=0.0° 、R=0.0°
SNS Switch	Click the **SNS Switch** button to chage the navigation image on the holder graphic display. ＊ An optional stage navigation system is necessary.
SNS Capture	Click the **SNS Capture** button to capture the navigation image. ＊ An optional stage navigation system is necessary.

Items	Operation/Explanation
Holder selection	Click the **Holder selection** button to display the holder selection menu. (For details, refer to the 3.5.5.b)
Protruding heigh	If the specimen protrudes above the holder top, be sure to input the specimen height. That is, when the specimen protrudes above the holder top, inputting the specimen height (H=0 to 43 mm) before moving the stage makes it possible to appropriately limit the specimen-movement range (Z direction). This can prevent the specimen from contacting the detector, or other components. **Example**) A set height (input the protruding height) is protruding height above the holder top. If you input **20mm**, it is a range that can be moved from WD5mm to WD28mm, and the height of the stage becomes a moving range from 25mm to 48mm.
Z Axis Moving Limit	Click the **Z Move Limit** button to display the Z axis moving limit menu. (For details, refer to the 3.5.5.c)
Graphic display	Left display : The specimen chamber as viewed from the top Right display : The specimen chamber as viewed from horizontal direction.

3.5.5.a Position File

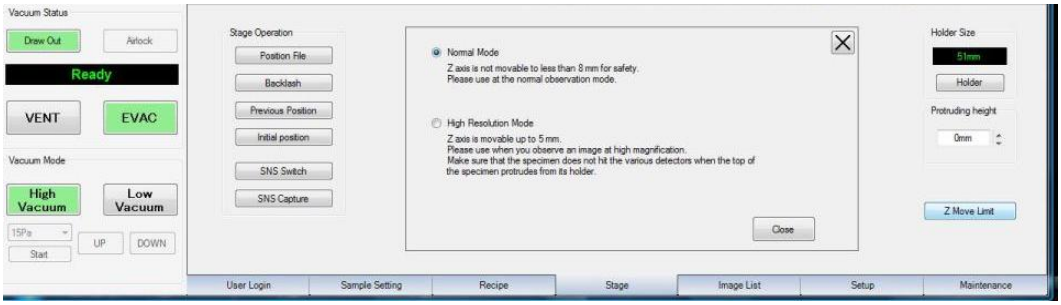
Items		Operation/Explanation
Position file list		The added position file is displayed.
Add Position File	Add	To add the current position in the Position File, click the Add button.
	Delete	To delete the selected file in the Position File, select the file to delete and click the Delete button.
	Number	If you tick the counter, the counter is displayed below the file name. The seqentiall adding the files are possible with the same file name. Example) Sample001
Stage position	Coodinates display	The stage coordinates are displayed.
	Move	If you select the coordinate file in the list and click the Move button, then the stage moves to the selected coordidnates.
	Cancel	Click the Cancel button to return to the stage menue.

3.5.5.b Holder Selection



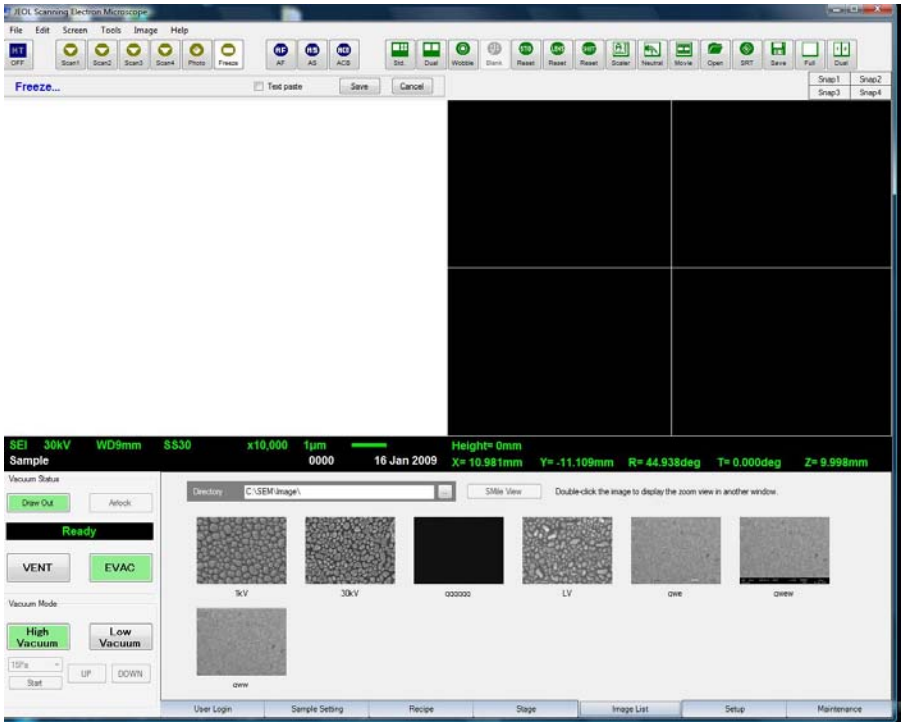
Items	Operation/Explanation
Holder list	The holder list is displayed.
OK	Click the **OK** button to display the selected holder on the graphic display. The movement of the stage is limited corresponding to the selected holder.
Cancel	Click the **Cancel** button to return to the stage menu.

3.5.5.c Z Axis Moving Limit



Items	Operation/Explanation
Normal Mode	Z axis of the motorized stage can not be moved to less than 8 mm to prevent collision. Please use at the normal observation mode.
High Resolution Mode	Z axis of the motorized stage is movable up to 5mm. Please use when you observe an image at high magnification. ＊ ***Note that the specimen may damage the various detectors if the specimen protrudes above its holder.***
Close	Click the **Close** button to set the Normal Mode or High Resolution Mode.

3.5.6 Image List



Items	Operation/Explanation
Directory	Open the saved image from the combo box.
SMile View	The **SMile View** button becomes active if an optional SMile View is installed.
Thumbnail Image list	The saved image files are displayed with the thumbnail list. If there are many saved image files, it can be scroledl with the slide bar.

Duble-click the left mouse button on the thumbnail image to display the zoom view in another window (Default : 640×480), and following buttons are displayed.

Items	Operation/Explanation
Original size	The image is displayed with the pixels of the image file. (The button name changes to “Window size”.)
Window size	The image size is matched to the window. (The button name changes to “Original size”.)

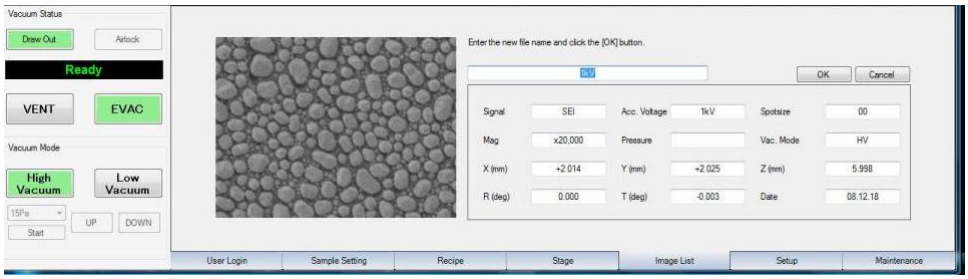

When the right mouse button is clicked  on the thumbnail, the pop-up menu is displayed and the following operation can be performed.

Move the stage

The stage is moved according to the stage information of the stored image.

Rename File Name

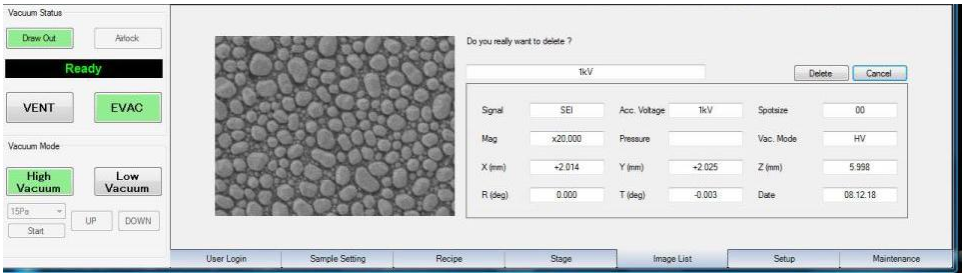
Seelct ***Rename File Name*** from the pop-up menu.



Items	Operation/Explanation
Image	The selected image is displayed.
File name input box	Change the file name.
OK	Click the ***OK*** button to change the file name.
Cancel	Click the ***Cancel*** button to return the thumbnail list.

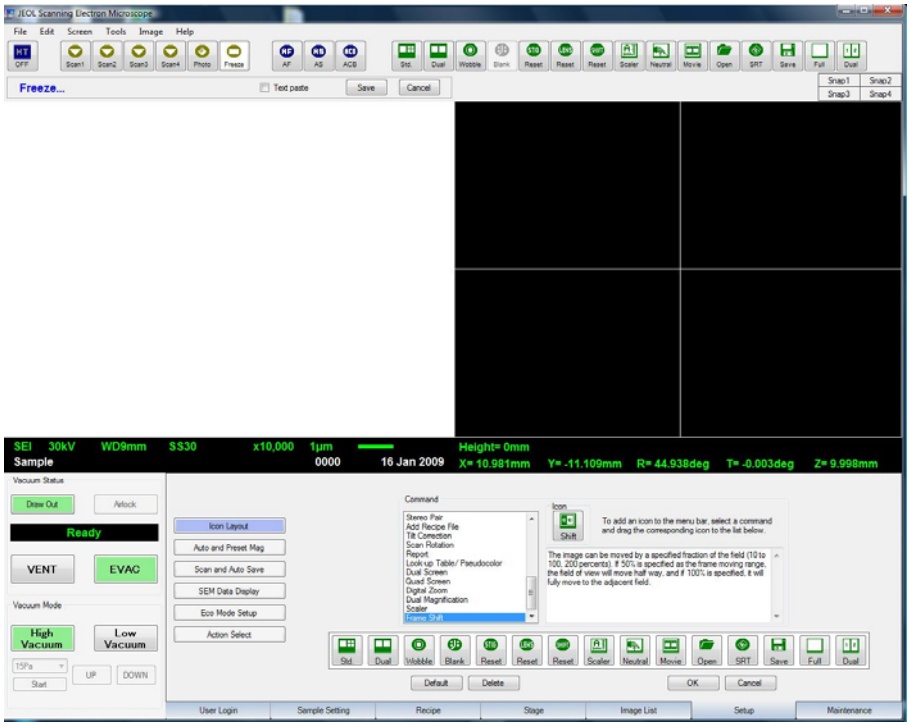
Delete

Select ***Delete*** from the pop-up menu.



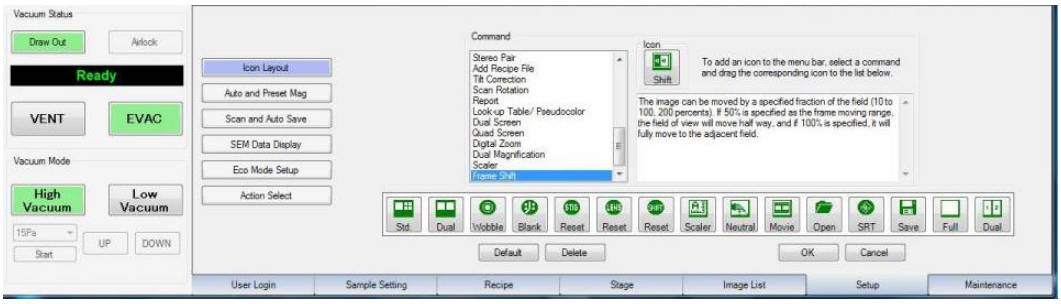
Items	OPeration/Explanation
Image	The selected image is displayed.
Delete	Click the ***Delete*** button to delete the selected image
Cancel	Click the ***Cancel*** button to return to thumbnail list.

3.5.7 Setup



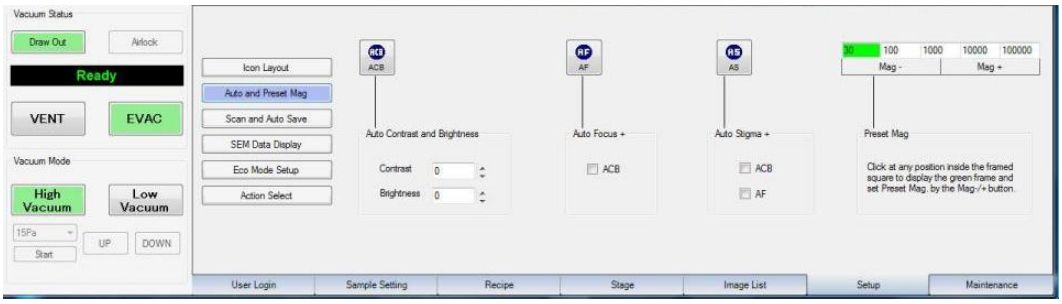
Items	Operation/Explanation
Icon Layout	The “Icon layout” panel is displayed by clicking the **Icon Layout** button. (For details, refer to 3.5.7.a)
Auto and Preset Mag.	The “Auto and Preset Mag.” panel is displayed by clicking the **Auto and Preset Mag.** button. (For details, refer to 3.5.7.b)
Scan and Auto Save	The “Scan and Auto Save” panel is displayed by clicking the **Scan and Auto Save** button. (For details, refer to 3.5.7.c)
SEM DataDisplay	The “SEM data display” panel is displayed by clicking the **SEM data display** button. (For details, refer to 3.5.7.d)
Eco Mode Setup	The “Set Wait mode” panel is displayed by clicking the **Eco Mode Setup** button. (For details, refer to 3.5.7.e)
Action Select	The “Define the mouse operation” panel is displayed by clicking the **Action Select** button. (For details, refer to 3.5.7.f)

3.5.7.a Icon Layout



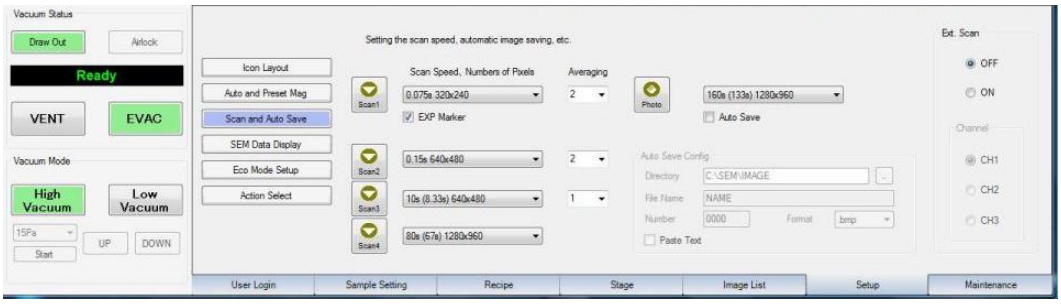
Items		Operation/Explanation
Command		All icon names of the standard and/or optional attachment are displayed.
Icon	Dislay	The selected icon from command list is displayed.
	Explanation	The explanation of function of the icon is displayed.
Selection frame		When you click the icon in the icon layout, a selection frame appears. ＊ The selection frame is erased when the icon is swapped or deleted.
Add		Drag the selected icon with the left mouse button, and drop between the icons. The selected icon is added to the icon layout.
Default		The icon layout is returned to default.
Delete		When the selection frame is appeared, the ***Delete*** button will active. Click the ***Delete*** button to delete the selected icon in the icon layout from the layout. ＊ The deleted icon area remains as a blank.
OK		Click the ***OK*** button to fix the icon layout, and it is reflected on GUI.
Cancel		Click the Cancel button to return the previous icon layout.

3.5.7.b Auto and Preset Mag.



Items	Operation/Explanation
Auto contrast and brightness	Contrast：Set the contrast level of ACB (Auto contrast and brightness). Range:±4. Brightness：Set the brightness level of ACB (Auto contrast and brightness) Range: ±4.
Auto Focus＋	If you tick the ACB check box, AF+ ACB are activated when AF is started.
Auto Stigma＋	If you tick the ACB check box, AS+ ACB are activated when AS is started. If you tick the AF check box, AS+ AFare activated when AS is started. If you tick the ACB and AF check box, AS+ ACB+ AF are activated when AS is started.
Preset Mag.	The "Preset Magnification" can be saved. Click any button, and set the magnification with the **Mag＋**/**Mag－** buttons. Keeping the left mouse button held down can change the magnification continuously. If you click the Preset Mag button, the numerical value can be entered directly.

3.5.7.c Scan and Auto Save



Items	Operation/Explanation
Scan speed, Numbers of pixels	Setting the scan speed and an automatic image saving etc. are possible.
Averaging coefficient	The averaging coefficient at each scan speed is settable between 1and 255.
EXP marker	The exposure marker is displayed at the Scan1 mode if you tick the Exposure box. The exposure marker is not displayed if you don't tick the box.
Auto save	If it is ticked, the image is saved automatically in the specified file after acquiring the image by **Photo** icon.
Directory	If the ... button is clicked, the directory list is displayed and, it is possible to specify the directory.
File name	The auto save file name can be set. ＊ Default : Image
Number	The serial number starting from 001 is added following the file name.
Format	The image format to save can be set. (BMP, JPEG, TIF)
Text paste	If you tick the check box, the SEM data is pasted in the image and the image is saved in the file.
Ext scan	ON : External scan is activated. OFF : External scan is off CH1,2,3 : Switches the external scan channel ＊ An optional ESIF is necessary. (A/LA model : initial option)

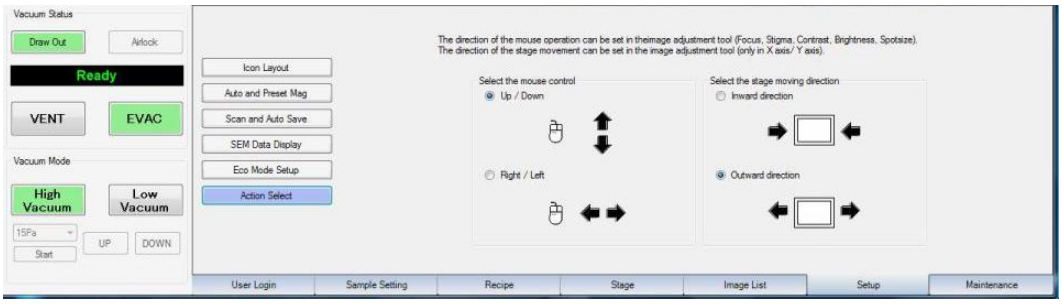
3.5.7.d SEM data display

Items	Operation/Explanation
Photo data	If you tick the box, the SEM data are displayed on the Freeze image.
Signal	Signal name
Acc. Voltage	Accelerating voltage
WD	Working distance
Spoit size	Spotsize
Vacuum	Vacuum （Low vacuum pressure display：10 - 270Pa）
Magnification	Magnification
Micron bar	Micron bar and micron value
Label	Label
Number	Number （0000-9999）：If you tick the check box, the number is automatically counted up each time after saving the image.
Date	DD/MM/YY
Background	Select the background for data display Black：SEM data is displayed in white on a black background. Image：SEM data is displayed in white superimposed on the image.
Text Paste	If you tick the check box, the SEM data (and entered texts on the image) is pasted in the image file and the image is saved.

3.5.7.e Eco mode Setup

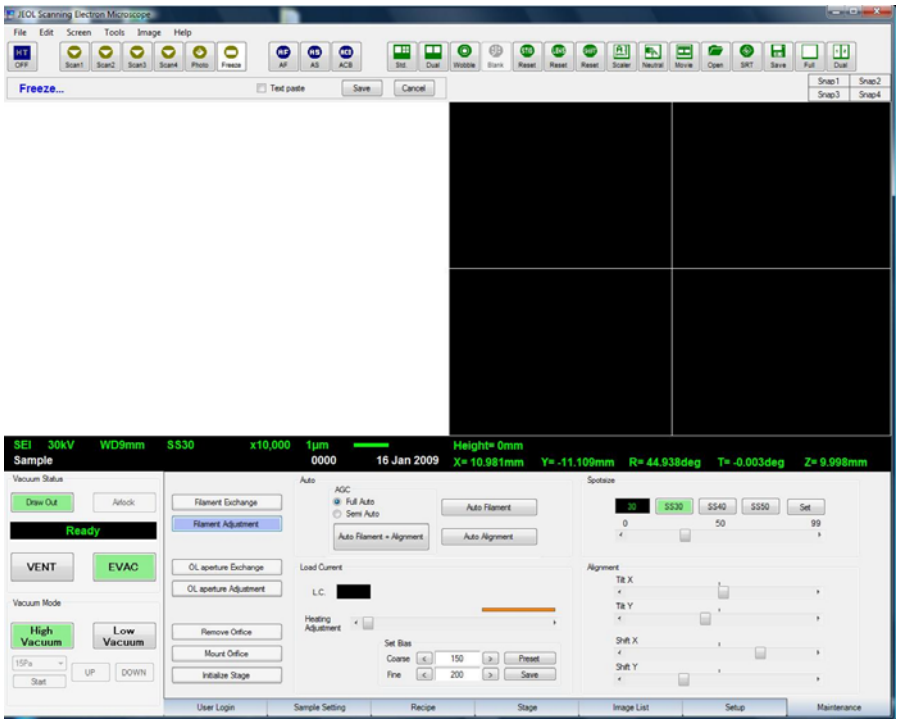
Items	Operation/Explanation
ON/OFF	Switches the ON/OFF of the Eco mode (energy saving mode)
Preset Time	Set the time to start the Eco mode when either the mouse, keyboard or the operation keyboard is not used over the preset time. ＊ Default : 240 minutes
Start Eco Mode	By clicking the Start Eco Mode button, the energy saving mode is started. (A message is displayed.)

3.5.7.f Action Select



Items		Operation/Explanation
Select the mouse control		The direction of the mouse operation can be set in the image adjustment tool (Focus, Stigma, Contrast, Brightness, Spotsize). ＊Default： Up / Down
	Up / Down	Activates the mouse moving in the up or down direction on the screen. The pointer appears by the left center of the screen
	Right / Left	Activates the mouse moving in the right or left direction on the screen. The pointer appears by the top center of the screen
Selecting the stage moving direction		The stage moving direction can be set. (only in X axis/Y axis) It cannot be set if the motorized stage is not installed. The operation in the stage graphic is similarly set. ＊Default：Outward direction
	Inward direction	The motorized stage can be controlled to the inward direction by clicking the triangle icon.
	Outward direction	The motor drive stage can be controlled to the outward direction by clicking the triangle icon.

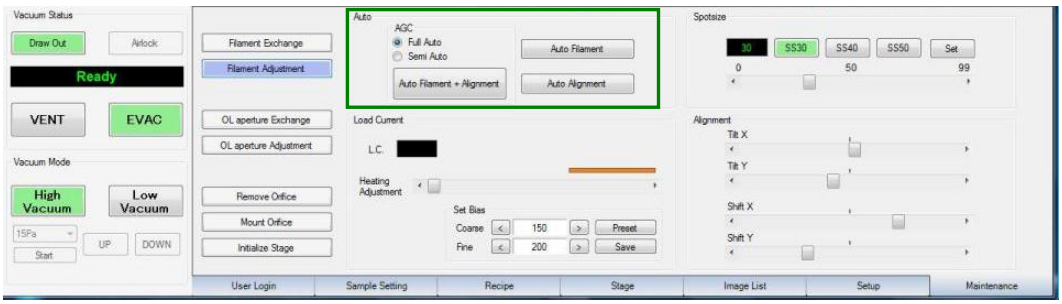
3.5.8 Maintenance



Items	Operation/Explanation
Exchanging a filament	The “Exchanging a filament” procedure is displayed by clicking the **Filament Exchange** button. (For details, refer to 3.5.8.c)
Adjusting a filament	The “Adjusting a filament” panel is displayed by clicking the **Filament Adjustment** button. (For details, refer to 3.5.8.a)
Exchanging an OL aperture	The “Exchanging a filament” procedure is displayed by clicking the **OL aperture Exchange** button. (For details, refer to 3.5.8.c)
Adjusting an OL aperture	The “Exchanging a filament” procedure is displayed by clicking the **OL aperture Adjustment** button (For details, refer to 3.5.8.c)
Removing an orifice	The “Removing an orifice” procedure is displayed by clicking the **Removing Orifice** button. (For details, refer to 3.5.8.c)
Mounting an orifice	The “Mounting an orifice” procedure is displayed by clicking the **Mount Orifice** button. (For details, refer to 3.5.8.c)
Initialiging a stage	The “Initializing a stage” panel is displayed by clicking the **Initialize Stage** button. (For details, refer to 3.5.8.b)

3.5.8.a Adjusting a filament

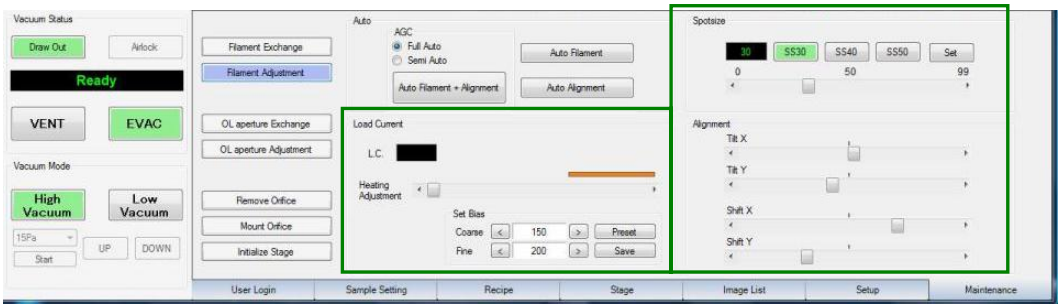
By using this function, the filament heat and alignment-Tilt and Shift will be adjusted automatically.
There are combinations as shown below. After the action is completed, the accelerating voltage is restored to the original value.
When the present accelerating voltage is below 5kV, automatic adjustment is carried out at 5kV.
And, after the action is completed, the accelerating voltage is restored to the original value.



Combination of the automatic operation

	Auto Filament+Alignment	Auto Alignment	Auto Filament
Full Auto	The filament heating and filament alignment (Tilt and Shift) will be adjusted automatically after setting the accelerating voltage to 30kV.		
Semi Auto	The filament heating and filament alignment (Tilt and Shift) will be adjusted automatically at the present accelerating voltage.	The filament alignment (Tilt and Shift) will be adjusted automatically at the present accelerating voltage.	The filament heating will be adjusted automatically at the present accelerating voltage.

＊ The BEI signal shall not be used for the automatic operation. Please change to SEI signal when you perform the automatic operation.



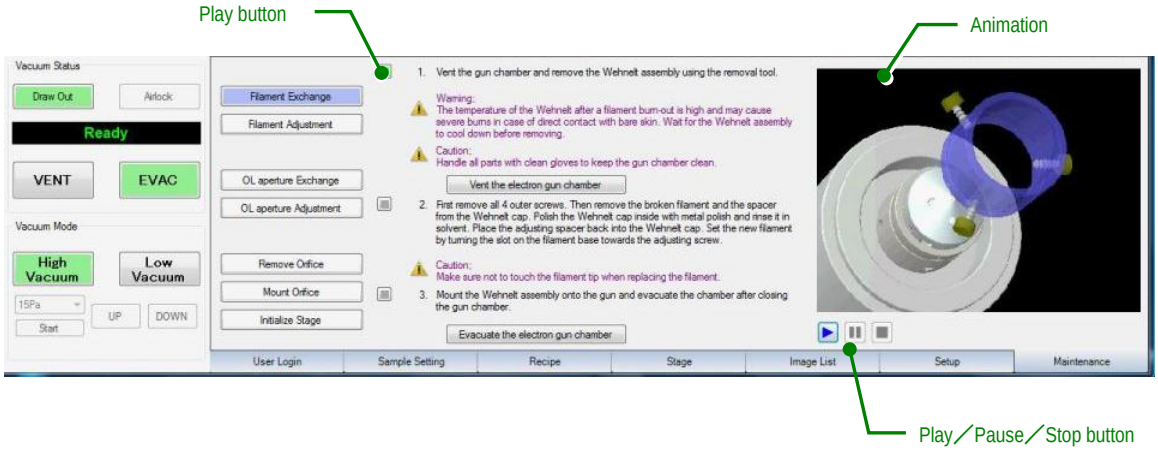
Items		Operation/Explanation
Loard current	L.C	Displays the load current (unit; μ A)
	Heat setting	Adjusts the filament heating current. A button is usually set near the orange zone. If you set the button within the orange-colored zone, sometimes it may cause filament abnormal.
Set bias	Digital display of coarse adjustment value／Coarse adjustment button	The coarse adjustment value of the filament heating current is displayed in decimal digits. (0 to 255) When the < button is clicked, the digital value is decremented by 1 step. When you keep pressing the button, the digital value goes down sequentially. When the > button is clicked, the digital value is incremented by 1 step. When you keep pressing the button, the digital value goes up sequentially
	Digital display of fine adjustment value ／ Fine adjustent button	The fine adjustment value of the filament heating current is displayed in decimal digits. (0 to 255) When the < button is clicked, the digital value is decremented by 1 step. When you keep pressing the button, the digital value goes down sequentially. When the > button is clicked, the digital value is incremented by 1 step. When you keep pressing the button, the digital value goes up sequentially
	Preset	The bias adjustment value is restored to the previous value by clicking the ***Preset*** button.
	Store	The bias adjustment value is stored by clicking the ***Store*** button.
Spot size	Spotsize value	Displays the current spotsize value (ss)
	30, 40, 50 button	Default value : ss 30(on), ss 40, ss 50 Select the value to change the spotsize. Adjust the spotsize, and click the ***Set*** button. The numerical value is changed to the adjusted value.
	Preset	The spotsize value is restored to the previous value by clicking the ***Preset*** button.
	Scroll bar	Adjusts the spotsize value. Range : 0 - 99
Alignment	Tilt X, Y	The tilt of the electron beam can be adjusted with the scroll bar.
	Shift X, Y	The shift of the electron beam can be adjusted with the scroll bar.

3.5.8.b Initializing a Stage

Items		Operation/Explanation
Initializing a stage	Vent the specimen chamber	Click the **Vent the specimen chamber** button to vent the specimen chamber.
	X Y T Z R All axes	When **X** is selected, the initialize of X-axis can be performed. When **Y** is selected, the initialize of Y-axis can be performed. When **T** is selected, the initialize of T-axis can be performed. When **Z** is selected, the initialize of Z-axis can be performed. When **R** is selected, the initialize of R-axis can be performed. When **All axes** s selected, the initialize of all-axes can be performed.
	Start	Before initializing the stage, make sure to remove the specimen holder. Click the **Start** button to initialize the stage position. **Note) If the Specimen Height has been entered, reset to 0mm and then, initialize the stage.**
	Stop	Stop the initializig operation
	Evacuate the specimen chamber	Click the **Evac the specimen chamber** button to evacuate the specimen chamber.
Stage mode	Normal Mode	Z (WD)-axis of the motor stage can be moved up to 8mm. ＊ Default is “Normal Mode”
	High Resolution Mode	Z (WD)-axis of the motor stage can be moved up to 5mm.

3.5.8.c Exchanging a filament, Exchanging/Adjusting an OL aperture, Removing/Mounting an orifice

Click the corresponding operation menu button (Filament Exchange, OL aperture Exchange, OL aperture Adjustment, RemoveOrifice, Mount Orifice) to display an animation and an operation procedure as shown below.



Items		Operation/Explanation
Menu buttons	Filament Exchange	The "Exchanging a filament" procedure is displayed by clicking the **Filament Exchange** button.
		Vent the electron gun chamber by clicking the **Vent the electron gun chamber** button
		Evacuate the electron gun chamber by clicking the **Evacuate the electron gun chamber** button.
	OL aperture Exchange	The "Exchanging an OL aperture" procedure is displayed by clicking the **OL Aperture Exchange** button.
		Vent the electron gun chamber by clicking the **Vent the EOS** button
		Evacuate the electron gun chamber by clicking the **Evacuate the EOS** button.

Items		Operation/Explanation
	OL aperture adjustment	The “Adjusting an OL aperture” panel is displayed by clicking the **OL Aperture Adjustment** button.
		The magnification is switched to the lowest magnification by clicking the **Wobbler ON** button.
		The Wobbler function performs by clicking the **Wobbler ON** button.
		The Wobbler function ends by clicking the **Wobbler OFF** button.
	Remove orifice	The “Removing an orifice” procedure is displayed by clicking the **Remove Orifice** button.
		Vent the specimen chamber by clicking the **Vent the specimen chamber** button.
	Mount orifice	The “Mounting an orifice” procedure is displayed by clicking the **Mount Orifice** button.
		Vent the specimen chamber by clicking the **Vent the specimen chamber** button.
Movie	Switch button	Click a box () beside an explanation to play an animation. ＊ It keeps playing until switching to the other buttons.
	Play ()	The animation is played by clicking the side button (play button) of an explanation. The animation is played continuously until switching to the other buttons.
	Pause ()	Pause：Animation is stopped temporarily.
	Stop ()	Stop：Animation is stopped

4

Operation

Refer to the EDS instruction manual for the operation of EDS unit

4.1 Starting and Shutting Down the Instrument

CAUTION !

Before starting the instrument, make sure that the room temperature is within the installation requirements (15 to 25°C).

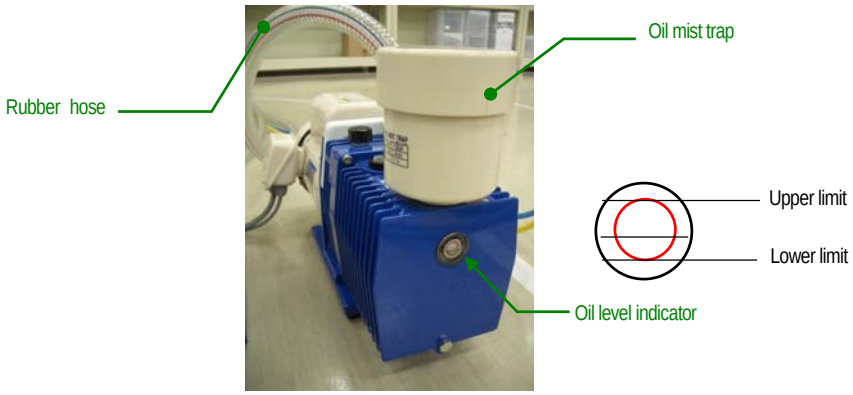
If the room temperature does not satisfy the installation requirements, set the temperature within the installation requirements using a cooling or a heating facility, and then start the instrument.

4.1.1 Inspection Before Starting the Instrument

CAUTION !

Make sure that the oil level is not below the lower limit.

If you start the instrument in insufficient RP oil quantity, you might damage the pump. Make sure the oil level and contamination (coloring) at the oil level indicator on the RP (rotary pump) (about once a three months).
If you use the instrument frequently, shorten the interval of the inspection period.
If you need to replenish or replace the oil, please contact your local JEOL service office.



4.1.2 Starting the Instrument

1. Run cooling water through the system. (Flow rate; 2.0L／min)

   When an optional TMP is attached, cooling water is not used.

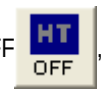
2. Turn **ON** the power switch on the distribution board.
3. Check that the **MAIN BREAKER** at the main console rear is set to **ON**.
4. Set the MAIN POWER key switch on the main control panel to | (ON).
   Insert the key, and when you turn it to START, release your hand from the key. The key returns to | (ON) position.

Main control panel (Main console front view)

5. After about 10 seconds, turn on the peripheral devices (such as monitor and printer) of the computer.
6. Turn on the computer.
7. Click **Start** in the Windows desktop screen.
8. Select **All Programs** ⇒ **JEOL SEM** ⇒ **SEM Main Menu** in the pull-up menu.

   The starting screen appears, and when the software starts running, the screen changes over to SEM-GUI.

   The system logon appears to GENERAL.

9. When the HT icon become the OFF 

, you can observe the image.

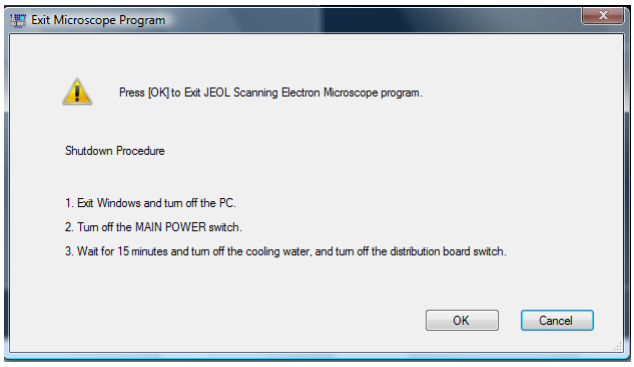
4.1.3 Shutting down the Instrument

Caution !

Before shutting down the instrument, save the data of such as images in files.

Be careful that unless you do not save the data in files, they will be deleted.

1. Select ***File*** ⇒ ***Exit JEOL Scanning Electron Microscope*** from the menu bar.



2. Click ***OK*** button to exit JEOL Scanning Electron Microscope program.
3. Click ***Start*** in the Windows desktop screen.
4. Select ***Shutdown*** ⇒ ***Windows shutdown*** ⇒ ***Shutdown*** ⇒ ***Yes*** from the pull-up menu of Start.
5. Turn ○ (OFF) the peripheral devices (such as monitor and printer) of the computer.
6. Set the MAIN POWER key switch on the main control panel to ○ (OFF).

7. Turn off the power switch on the distribution board.
8. After waiting for about 15 minutes, turn off the cooling water.

   In case an optional TMP is installed, cooling water is not used.

4.1.4 Treatment in an Emergency

4.1.4.a Measures in an emergency

1. Set the MAIN POWER key switch on the main control panel to O (OFF).

2. Turn off the power switch on the distribution board.
3. Close the main cock of cooling water.

   When an optional TMP is attached, the main cock of cooling water need not be shut.

4.1.4.b Resuming operation after shutting down the instrument in an emergency

To start the instrument after shutting down the instrument in an emergency, perform the procedure of Section 4.1.2, “Starting the instrument.”

4.1.4.c Measures when a power failure occurs

When a power failure occurs, the instrument stops in the safe state, but the main cock of cooling water remains open.
If the power failure continues for a long time, be sure to close the main cock of cooling water.

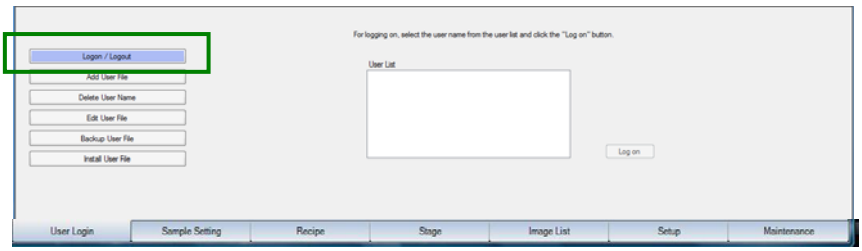
To start the instrument after recovering the power failure, perform the procedure of Section 4.1.2, “Starting the instrument.”

! CAUTION

When cooling water is left running without power supply under high humidity, it may damage the Diffusion Heater due to condensation.
If the power failure continues for a long time, be sure to close the main cock of cooling water.

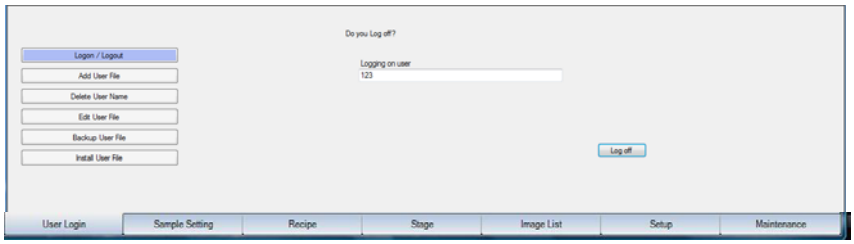
4.2 User Login

1. Click the ***User Login*** of the operation menu tab.
2. Click the ***Log on／Log off*** button.
3. Select a user name from the user list, and click the ***Log On*** button.



User Log on

When you log off, click ***Log Off*** button after checking the log on user name.

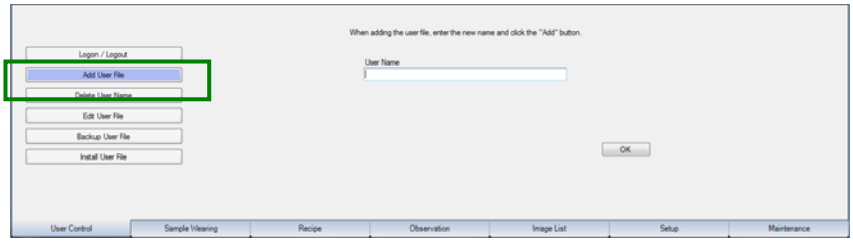


User Log off

When you want to add a new user, rename the user and delete the user, proceed as follows.

Adding a New User file

Select ***Add User File***, enter a user name and click the ***OK*** button.

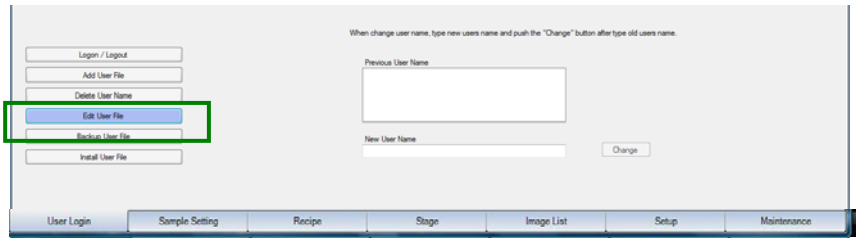


Deleting a User file

Select ***Delete User File***, select the user name to delete and click the ***Delete*** button.

Renaming a User file

Select ***Rename User File***, enter a new user name after selecting the previous user name and click the ***Change*** button.



4.3 Specimen Exchange

CAUTION!

- ***Be sure to set the specimen not to protrude above the specimen holder.***
  If the specimen protrudes from the holder top and even the stage is moved within its movement limit range, the specimen might contact and damage the objective lens or the backscattered electron detector.
- ***Ensure to select the specimen holder you are using in the specimen holder dialog box.***
  If you do not select a correct specimen holder, the specimen stage might move beyond the stage movement limit range and thus the specimen stage contacts and damages the objective lens or the backscattered electron detector. （In case the motorized stage is installed）

4.3.1 Preparing the Specimen setting

Prepare a specimen.
Set the specimen on the specimen support, and adjust the specimen support so that the top of the specimen surface becomes in a same level with holder top.
Be sure to fasten the specimen so that the top of the specimen surface does not protrude above the holder top.
For such specimen as not electrically conductive, use a conductive paint to prevent the specimen from charging.
Avoid setting the specimen containing unnecessarily water or oil, because it will contaminate inside the column.

4.3.2 Changing the Specimen

4.3.2.a Draw out

1. **Vent the specimen chamber.**

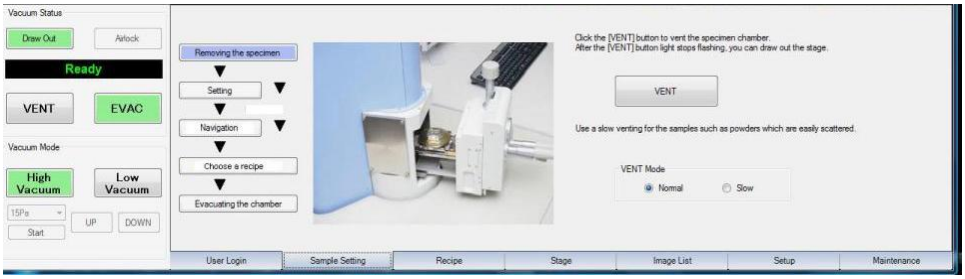
   a. Click the HT icon 

to get HT OFF 

.

   b. Click the **Sample Setting** of the operation menu tab.

   c. Click the **Removing the specimen** button.



   d. Click the **VENT** button.
   Use slow venting for samples such as powders which are easily scattered. First select **Slow** and then click the **VENT** button.

   e. The pressure in the specimen chamber becomes atmospheric pressure in 50 seconds. After the light of the **VENT** button turns ON, the stage can be withdrawn to remove the specimen holder.

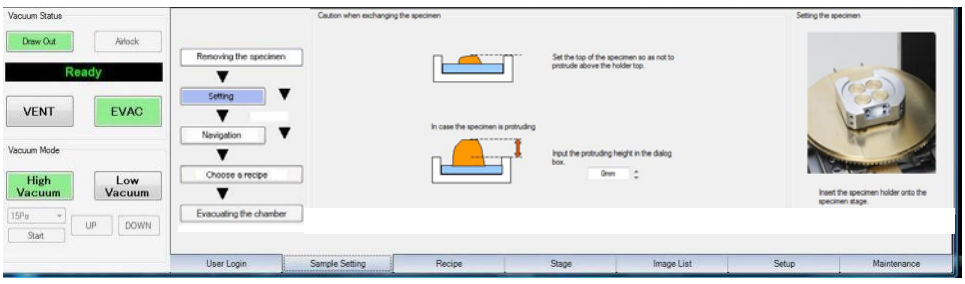
2. **Setting the specimen**

   Click the **Setting** button.

When the motor drive stage is not installed

   a. If the specimen protrudes above the holder, make sure to input the protruding sample height above the holder in the dialog box.

   b. Set the specimen holder onto the specimen stage.



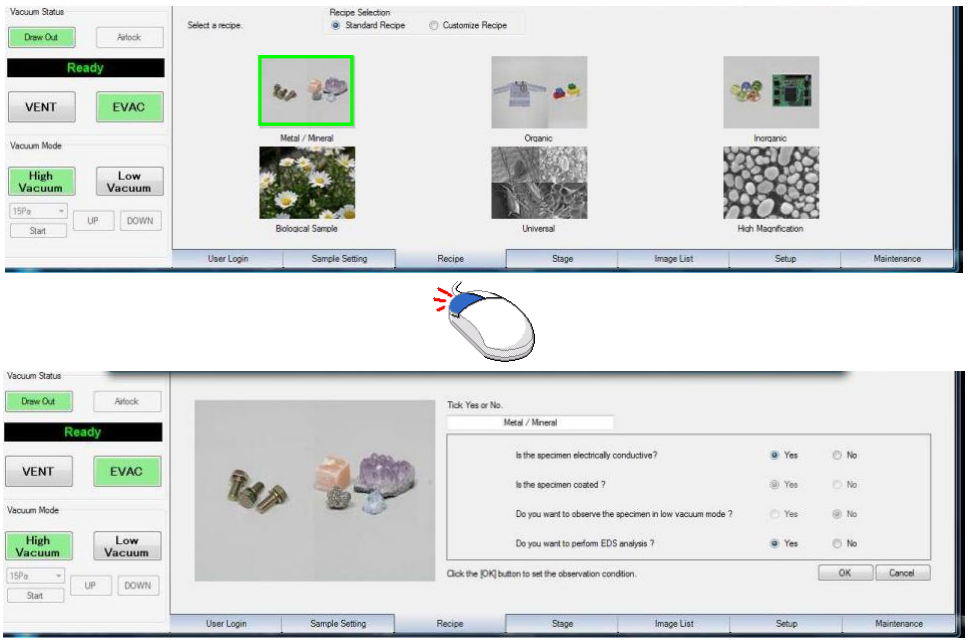
When the motor drive stage is installed

a. Select the specimen holder used, and click the **Selection** button.
b. If the specimen protrudes above the holder, make sure to input the protruding height in the dialog box.
c. Set the specimen holder onto the specimen stage.

If the optional stage navigation system and motor drive stage are installed
Click the **Navigation** button, and capture the navigation image according to the operational navigation. (Refer to 4.4)

3. Choose a recipe

a. Click the **Choose a recipe** button.
b. From the displayed list of Standard recipe, select a recipe applicable to the sample. And click it.
If you are not sure which recipe is applicable to the sample to be observed, select **Universal**. The standard observation conditions will be set.
c. The operation navigation is changed to the setup observation condition menu.



d. Set observation conditions according to the questions you will be asked.
If the specimen is not electrically conductive, not coated and High Vacuum is being selected, Acc. voltage is automatically set at 1kV. Under this condition EDS analysis question becomes grayed out, because the amount of signals for EDS analysis is insufficient.
c. Click the **OK** button. The observation conditions will be set.

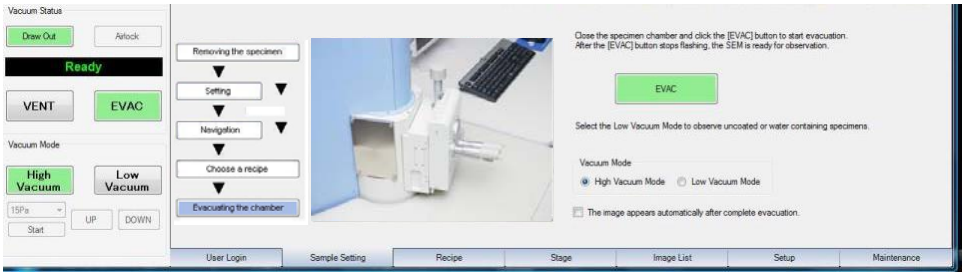
4. Evacuate the specimen chamber.

a. Click the **Evacuating the Chamber** button.
b. Close the specimen chamber and click the **EVAC** button. Evacuation in the specimen chamber will start.
c. If the sample without coating or containing water is observed as it is, the vacuum mode must be set to the low-vacuum mode.
d. After the mode is selected, a message will appear. Follow the instructions in the message to change the vacuum mode.
e. If you want an image to be displayed automatically after evacuation, tick the following check box. The image will be displayed automatically after evacuation.

If the **Filament Adjustment** in the **Maintenance** of the operation menu tab is not adjusted correctly, the image may not be displayed correctly. (refer to 4.23.1.b)

CAUTION !

When you push the stage back to the specimen chamber, be careful not to get caught your fingers between them.

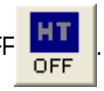


5. After the HT icon  turns OFF, you can start image observation.

4.3.2.b Airlock

1. Remove the specimen with an airlock system.

a. Click the HT icon 

to get HT OFF 

.

b. Click the **Airlock** button on the evacuation control menu.

c. Click the **Removing the Specimen** button.

d. Move the stage to the Specimen Exchange Position.

X = 40mm (15mm when motorized stage is installed)

Y = 40mm (15mm when motorized stage is installed)

Z = 20mm

T = 0°

R = 0°

e. Mount the exchange rod on the airlock chamber and press the **ALC-EVAC** button.
The button will change to **ALC-VENT**.

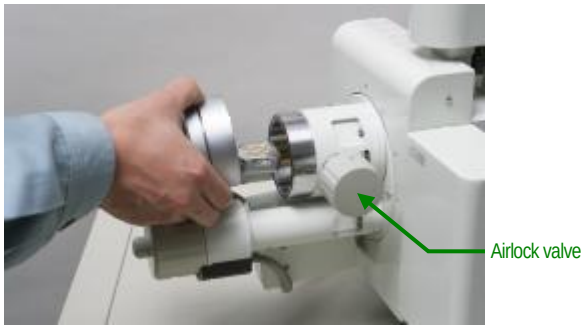
Press the **ALC-VENT** button while the button is flashing or lighting. Evacuation in the airlock chamber will stop, and the pressure in the airlock chamber will change to atmospheric pressure.

f. Open the airlock valve after the **ALC-VENT** button stops flashing.

g. Fully insert the exchange rod and screw it into the screw hole of the holder.

h. Fully withdraw the exchange rod until it stops, and close the airlock chamber.

i. After the pressure in the airlock chamber becomes atmospheric pressure in a few seconds, remove the exchange rod.



Withdraw the exchange rod

2. Setting the specimen

If the specimen protrudes above the holder, make sure to input the protruding height in the dialog box.

3. Evacuating the specimen chamber

a. Mount the specimen holder on the exchange rod.
b. Click the **Evacuating the Chamber** button.
c. Make sure that the stage position is at the Specimen Exchange Position.
   X = 40mm (15mm when motorized stage is installed)
   Y = 40mm (15mm when motorized stage is installed)
   Z = 20mm
   T = 0°
   R = 0°

d. Mount the exchange rod on the airlock chamber and press the **ALC-EVAC** button.
   The button will change to **ALC-VENT**.

   While the button is flashing, click the **ALC-VENT** button. Then, evacuation in the airlock chamber stops, and the pressure in the airlock chamber becomes atmospheric pressure.

CAUTION !

When mounting the exchange rod, be careful not to get caught your fingers between them.

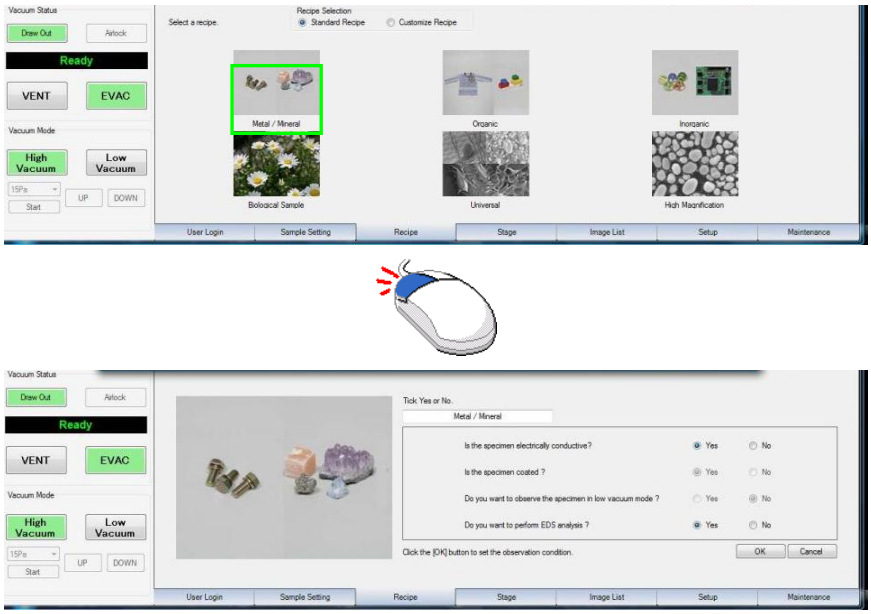
e. Open the airlock valve after the **ALC-VENT** button stops flashing.
f. Insert the exchange rod, and set the specimen holder on the stage.
g. Remove the exchange rod from the specimen holder, and fully withdraw the exchange rod.
h. Close the airlock valve
i. The specimen exchange rod can be fully removed after the airlock chamber is vented.

4. ***Choose a recipe.***

a. Click the ***Choose a recipe*** button.

b. Select a recipe applicable to the sample from the Standard Recipe in the Recipe Selection, and click it.
If you are not sure which recipe is applicable to the sample to observe, select ***Universal***. The standard observation conditions will be set.

c. The operation navigation is changed to the menu of the setup observation condition.



d. Set observation conditions according to the questions you will be asked about the conditions.
The condition of a high vacuum mode without coating is not suitable for analysis because the amount of signals for the EDS analysis is insufficient. If this condition is set, the EDS analysis item will be grayed out.

e. To set observation conditions, click the **OK** button.

5. ***After the HT icon***  ***turns OFF, you can start image observation.***

4.4 Navigation Image Acquisition

The device is to control a stage position by using images captured by the camera (color CCD) installed outside the specimen chamber. (The optional motor drive stage and stage navigation system are required.)

Navigation images can be captured by the following procedures. For more details, refer to the SNS Instruction Manual.

1. Click the ***Sample Setting*** (or ***Stage***) in the operation menu tab.
2. Click the ***Navigation*** button.
3. Vent the specimen chamber to atmospheric pressure, and draw out the stage fully where the Navigation image can be captured.
4. Move the specimen stage position as follows

   Z＝10mm、R=0° 、T=0°
5. Click the ***Capture*** (or ***SNS Capture***) button to capture the image

Navigation screen

When you click in the navigation screen with the right mouse button  , the pop-up menu appears.

Details of pop-up menu

Items	Explanation
Delete	Click the Delete button to delete the captured image.
Open Image File	Click “Open Image File” to display the “Open Image File window”.
Save Image File	Click “Save Image File” to display the “Save Image File window”.
Capture image	The most recently captured image is displayed.
Previous Display Image	The previously displayed image is displayed.
All Clear	The image on the navigation screen is deleted by clicking “All Clear”..

4.5 Observing a specimen

Proceed following procedures to observe the image, provided that the sample setting is complete （refer to 4.3）.

1. Click the HT icon 

to get HT ON 

.
2. Click the 

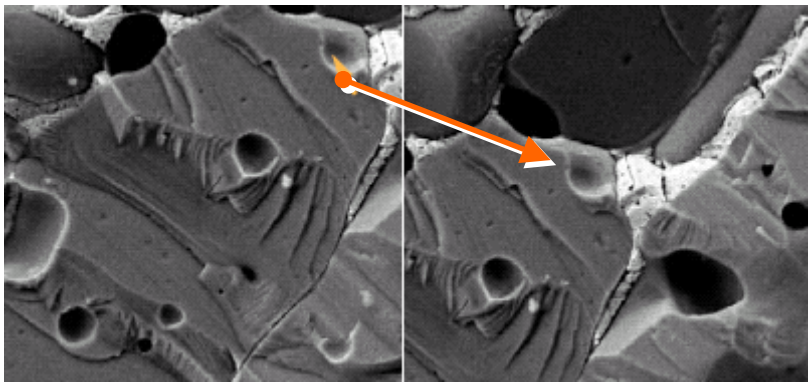
、the 

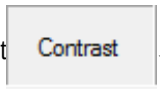
and the 

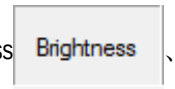
icons to observe the image.
3. Move view of interest to the center of main screen with “Click center”.

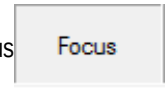
   Click center

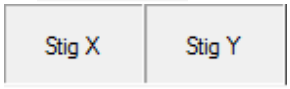
   Double-click the left mouse button at any position in main screen. The double-clicked position moves to the center of the screen.



4. Find view of interest.
5. Get view of interest by increasing magnification gradually.
6. Move view of interest to the center of the main screen, and set it at necessary magnification.
7. Adjust the image quality by using the Contrast 

、Brightness 

、Focus 

and Stig（X、Y） 

buttons.

For observing at high magnification it is recommended to focus at low magnification first and then increase magnification gradually. Or, when you want to observe more high resolutions, refer to the “4.6.Observation condition”.

4.6 Observation conditions

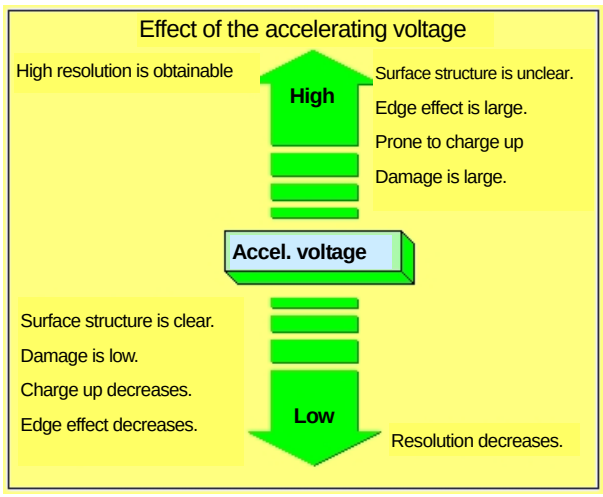
For the observation conditions of a specimen, you must select optimum values from various factors, such as accelerating voltage, probe current, movable aperture, and working distance. You should also take into consideration such as the sampling method (specimen preparation) and the specimen tilt. Moreover, in order to obtain a more optimum image quality, the brightness adjustment, astigmatism correction adjustment and focus adjustment become of importance.

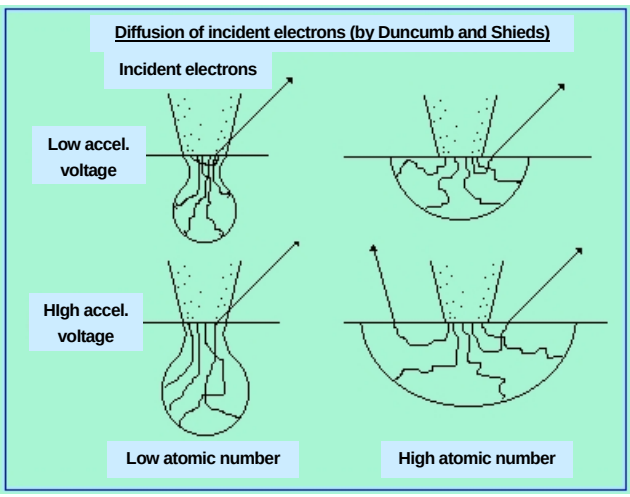
4.6.1 Difference of image quality depending on the value of the accelerating voltage

In the theoretical point of view if you consider only the probe diameter, as you increase the accelerating voltage, the probe diameter becomes finer. However, you cannot ignore some disadvantages that appear when you use a high accelerating voltage. Those disadvantages are as follows.

- The fine structure on the specimen is susceptible to vanish.
- Edge effect becomes prominent.
- Charging up is likely to occur.
- Specimen damage is likely to occur.

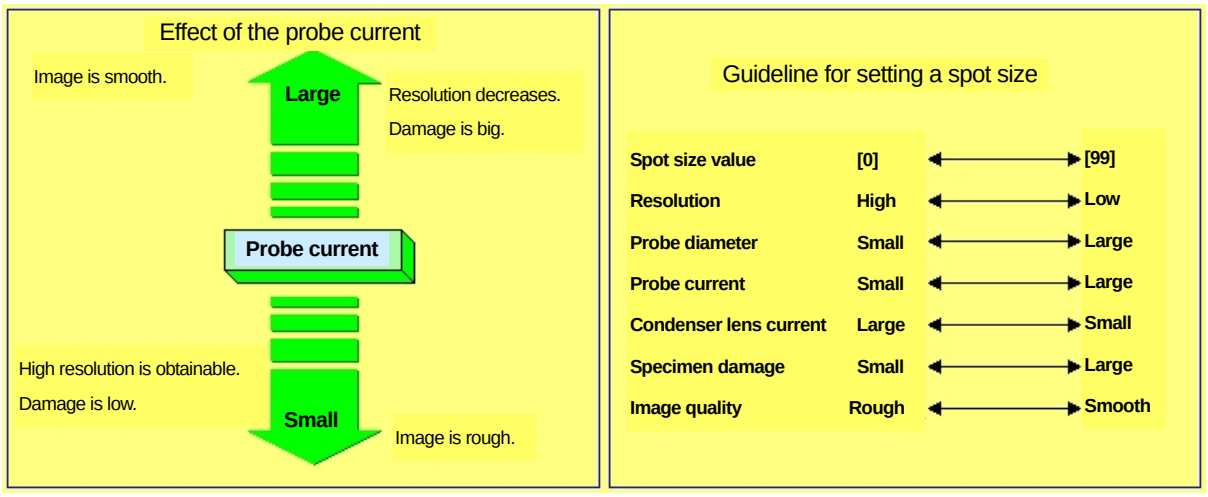
Generally, the more fine structure of the specimen surface appears when using a low accelerating voltage than using a high accelerating voltage. When you use a high accelerating voltage, the diffusion region of the incident electrons into the specimen becomes large; as a result, unnecessary signals (for example, backscattered electron, …) generated from the inside of the specimen decreases the contrast, hiding the fine structure on the specimen surface. Therefore, for the observation of a low-density material, in particular, a low accelerating voltage is desirable.





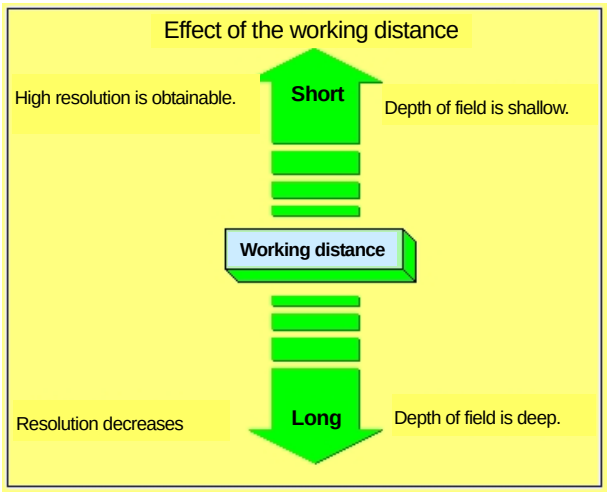
4.6.2 Effect of the probe current

You can obtain the higher magnification and the higher resolution for the SEM image, the smaller the probe diameter (spot size) to irradiate the specimen. However, the smoothness of the image, that is to say, the S/N (signal/noise) ratio depends on the probe current to irradiate the specimen. If you want to decrease the probe diameter, the probe current decreases. Therefore, you must select a probe current according to the magnification and the observation condition (such as the accelerating voltage and specimen tilt).



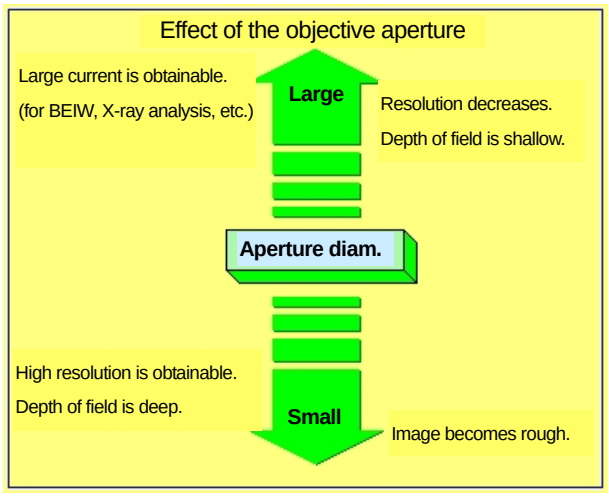
4.6.3 Effect of the working distance (WD) on the image

When you change the working distance (WD), in the short WD, although the depth of field becomes shallow, you can obtain high resolution; on the contrary, in the long WD, although the resolution decreases, the depth of field becomes deep. Moreover, in order to obtain a more optimum image quality, the brightness adjustment, astigmatism correction adjustment and focus adjustment become of importance.



4.6.4 Effect of the aperture diameter on the image

The objective lens aperture (movable aperture) provided in this instrument consists of three steps of size: 20, 30 and 100 μm diameter. To obtain high resolution, you must select an optimum aperture diameter.
However, because the image in this instrument requires not only the fineness of the electron beam, but also a sufficient amount of signals to form an image, you cannot reduce the aperture diameter more than is necessary. Select 20 μm diameter at the high-resolution observation, 30 μm diameter at the normal observation and the EDS analysis, and 100 μm diameter at the case when a large current is required such as the analysis using the WDS.



4.6.5 Relationship between the specimen tilt and the emitted electrons

When you irradiate the electron beam on the specimen, secondary electrons are emitted from a relatively shallow position of the specimen. The reason why this phenomenon occurs is that even the electrons having a low energy generated at a deep position cannot reach up to the surface of the specimen.
However, for a tilted part of the specimen, because the primary electrons enter a broad region at a shallow angle, the secondary electrons generated inside the specimen can easily reach the specimen surface, increasing the emission amount of the secondary electrons. Owing to this phenomenon, sometimes, only the tilted part of the specimen you are observing appears white (halation). In this case, by aligning the tilted surface to the opposite direction (downside of the observation screen) from the secondary electron detector, you can decrease the halation. Moreover, even doing that is not enough, the function of Neutralizer is effective. It can limit the amount of signals to decrease the halation more effectively.

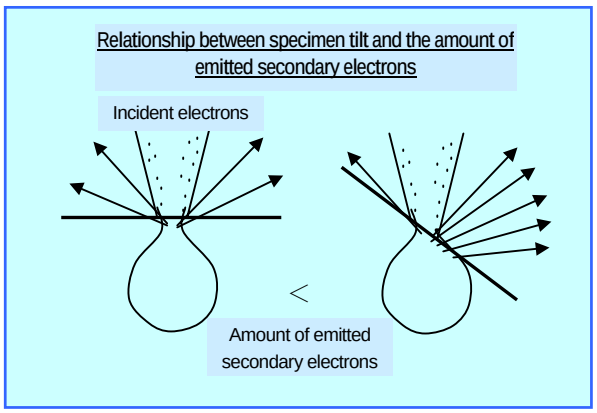
To use the function of Neutralizer, select the menu bar **Tools** ⇒ **Neutralizer**, or click the Neutral icon 

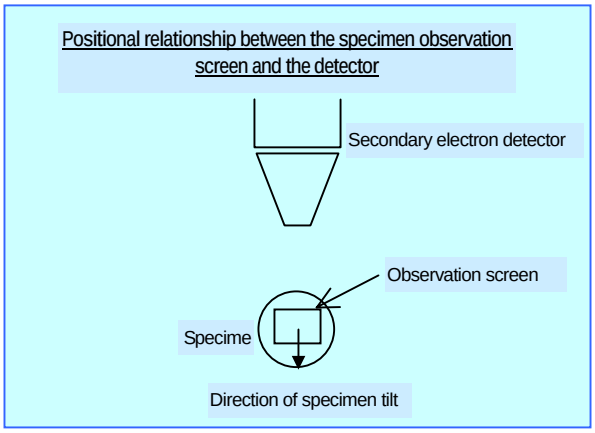
.

The function of Neutralizer is only effective for the secondary electron detector. You cannot select this function while you use other detectors.

4.6.6 Observation of the nonconductive specimen and charge up

When you irradiate a large current (high accelerating voltage and large spot size) electron beam on a nonconductive specimen, sometimes, electrons accumulate, in other words, charge up on the specimen.
In this case, it might change the trajectory of the primary electron beam or limit the generation of secondary electrons, causing the image shift and the brightness change for the obtained image–such an effect is considerable.
For such a specimen, you can reduce the charge-up to observe the specimen by using a low accelerating voltage or the low vacuum (LV) mode. Also, you can increase the emitted electrons by tilting the specimen, resulting in reducing the charge-up.





4.7 Operating the image

4.7.1 Setting the Signal

1. Click the signal 

in the image data display.

   The signal setting window is displayed

2. Double-click  on the desired signal in the list.

   When you tick the **SS Link**, the spot size will remain the same when you switch detectors and the image shift will not occur.

The selectable signals in the Signal combo box are as follows. (The selectable signals are different by an optionally installed detector.)

Signal	Data display
SEI	SEI （Secondary electron image）
BEIW	BEC （Backscattered electron – composition image）
	BET （Backscattered electron – Topographic image）
	BES （Backscattered electron – shadow image）
BEIC	BEI
BEIR	BEI
EMF	EMF （Electromotive force image）
CLD	CLI （Cathodeluminescence image）
CLDIR	CLI
AUX	AUX
REF	REF （Refrected electron mage）

BEIC : Centaurus backscattered electron detector
BEIR : Robinson backscattered electron detector
EMF : Electromotive force amplifier
CLD : Cathodeluminescence detector
CLDIR : Infrared cathodeluminescence detector

4.7.2 Setting the Accelerating Voltage

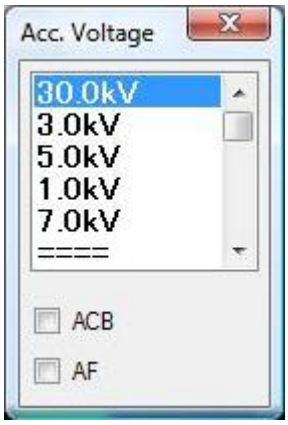
1. Click the Accelerating voltage 

in the image data display.

   An accelerating voltage is displayed.

2. Double-click  on the desired accelerating voltage in the list.

   If the ACB check box is checked, the image contrast and the image brightness are automatically adjusted when the accelerating voltage is changed.
   If the AF check box is checked, the image focus is automatically adjusted when the accelerating voltage is changed.



4.7.3 Setting the Spot Size

Set the spot size according to the purpose of use.

- When you observe a normal image, set the spot size SS about 30.
- When you perform a high-resolution observation, set the spot size SS smaller than 30.
- When you perform an analysis and other operations, set the spot size SS larger than 30.

1. Click the Spotsize (SS) 

on the image data display.

   The spotsize setting window is displayed.

2. Click the one of the preset button SS30, SS40 or SS50. Or select the desired spotsize with the slide button.

   When you slide the bar of the spot size adjustment in the dialog box to the right, the value of the spot size increases (in the direction to 99), and when you slide to the left, the value of the spot size decreases (in the direction to 0).

4.7.4 Recipe

Generally, when you observe a specimen using a SEM, you must set a suitable observation condition for the specimen.

In this instrument, typical observation conditions are registered as standard recipes, so by only selecting a suitable observation condition for the specimen, you can set a proper observation condition for the SEM.

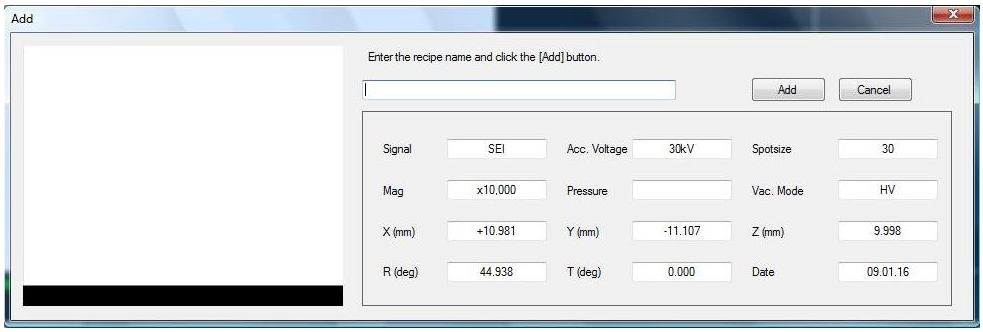
However, be aware that evacuation mode, pressure and stage position are only for display, and they are not actually reflected on the instrument. In addition, in order to respond to the observation condition of any specimen, you can create a custom recipe for each user and save it. Moreover, you can reproduce the created recipe at any time.

4.7.4.a Adding a new observation condition

1. Display a live image that you want to register the observation condition.
2. Click the Recipe icon 

, or select Menu bar ***File*** ⇒ ***Add Recipe File***.

   The Add Recipe window is displayed.



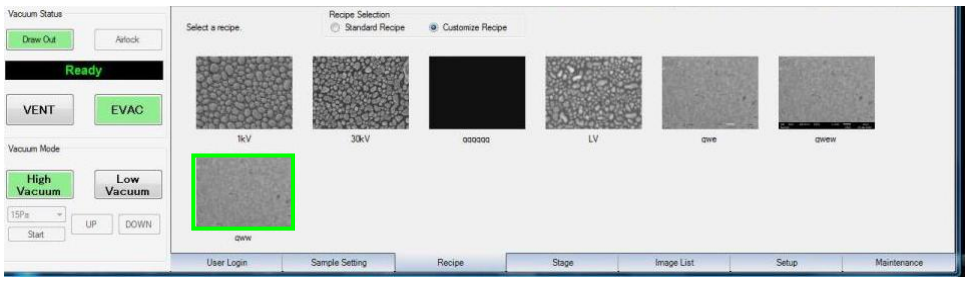
3. Enter the recipe name and click the ***Add*** button.

   When you want to register in the different observation condition, change the condition, focus the image once again and click the ***Add*** button.
4. A new recipe is added to the ***Image list***.

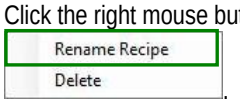
4.7.4.b Renaming a recipe file

Change the added recipe name.

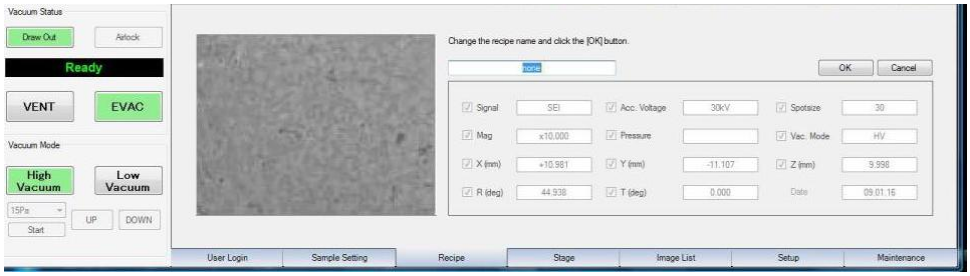
1. Click the ***Recipe*** in the Operation menu tab.
2. Select ***Custom***.



3. Click the right mouse button on the thumbnail and select ***Rename Recipe*** from the poop-up menu



4. Enter a new recipe name.

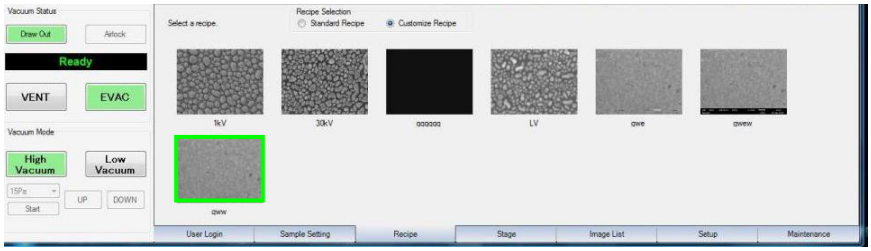


5. Click the ***OK*** button.
   The recipe file name is changed and returns to list of custom recipes.

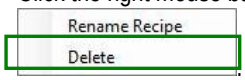
4.7.4.c Deleting a recipe file

Delete the recipe file

1. Click the ***Recipe*** in the Operation menu tab.
2. Select ***Custom***.



3. Click the right mouse button on the thumbnail and select ***Delete*** from the poop-up menu

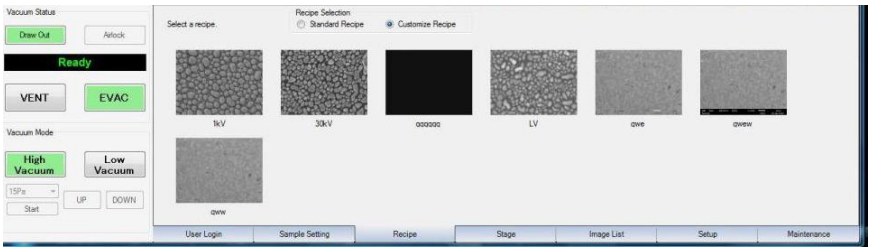


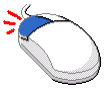
4. Click the ***Delete*** button.
   The selected recipe file is deleted and returns to list of custom recipes.

4.7.4.d Using the recipe function

To register the Recipe, refer to the 4.7.4.a.

1. Click the ***Recipe*** of the Operation menu tab.
2. Select ***Custom***.



3. Select the recipe you want to use and click  it.

   The registered image and observation condition are displayed.

4. Select the check box you want to set the observation condition, and click the ***OK*** button.

   When the “Move the stage to the stored image position” is selected, the reproduction of the stage position can be performed. (If the motorized stage is installed)

5. The observation condition is set.

4.7.5 Adjusting the Image Brightness

Place a mouse pointer on the 

button, and operate as follows.

Coarse adjustment

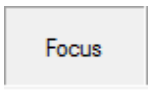
While holding down the right button,  move the mouse up (right) and down (left).

Fine adjustment

While holding down the left button,  move the mouse up (right) and down (left).

When you move the mouse up (right), the brightness increases, and when you move it down (left), the brightness decreases.

4.7.6 Adjusting the Focus

Place a mouse pointer on the 

button, and operate as follows

Coarse adjustment

While holding down the right button,  move the mouse up (right) and down (left).

Fine adjustment

While holding down the left button,  move the mouse up (right) and down (left).

When you move the mouse up (right), the image becomes over focus, and when you move it down (left), the image becomes under focus.

For observing at high magnification it is recommended first to focus at low magnification and then increase magnification gradually. Or, when you want to observe more high resolutions, refer to the "4.6 Observation condition".

When you adjust the focus of an image at high magnification, occasionally, the image appears sharp in one direction.

When focusing the image at a high magnification (×10,000 or more), carefully observe the image before and after the just focus. If the image appears sharp in one direction, the astigmatism correction is necessary. Proceed to Section 4.23, "Daily Maintenance."

4.7.7 Selecting the Scan Rate

Item	Icon	Explanation	Note
Scan 1		This is suitable for searching field of view and adjusting image quality.	You can select the averaging coefficient and scan rate. A exposure marker can be displayed. Refer to "4.19.3 Scan Speed Setting" for more information.
Scan 2		This is suited to observe the image.	You can select the averaging coefficient and scan rate.
Scan 3		This is suited to observe the image detail.	You can select the averaging coefficient and scan rate.
Scan 4		This is used to observe the more detail than the one at Scan 3 and acquire the image.	You can select the scan rate.
Photo		This is used to acquire the image and save the image automatically.	You can select the scan rate.
Freeze		An observation image becomes the frozen image.	When you want to cancel Freeze, click one of any scan icons. When you want to return to the previous scan rate before Freeze, click the Freeze icon again.

 If you click one of any scan icons while pressing the right mouse button  , a pop-up menu is displayed and you can change the scan speed. (except )

Details of the scan rate

	Horizontal (ms)	Vertical (s)	Number of pixels
SCAN1	0.284	0.075	320×240
	1.137	0.258	
	2.048	0.512	
SCAN2	0.284	0.150	640×480
	1.137	0.576	
	2.048	1.024	
SCAN3	20(16.67)	10(8.33)	640×480
	20(16.67)	20(16.77)	1280×960
	40(33.33)	40(33.33)	
SCAN4	80(66.67)	80(66.67)	1280×960
	160(133.3)	160(133.3)	
	80(66.67)	160(133.3)	2560×1920

The value in parentheses ( ) shows the values used at 60 Hz power frequency .

Relation between the lowest magnification and WD (Working Distance)

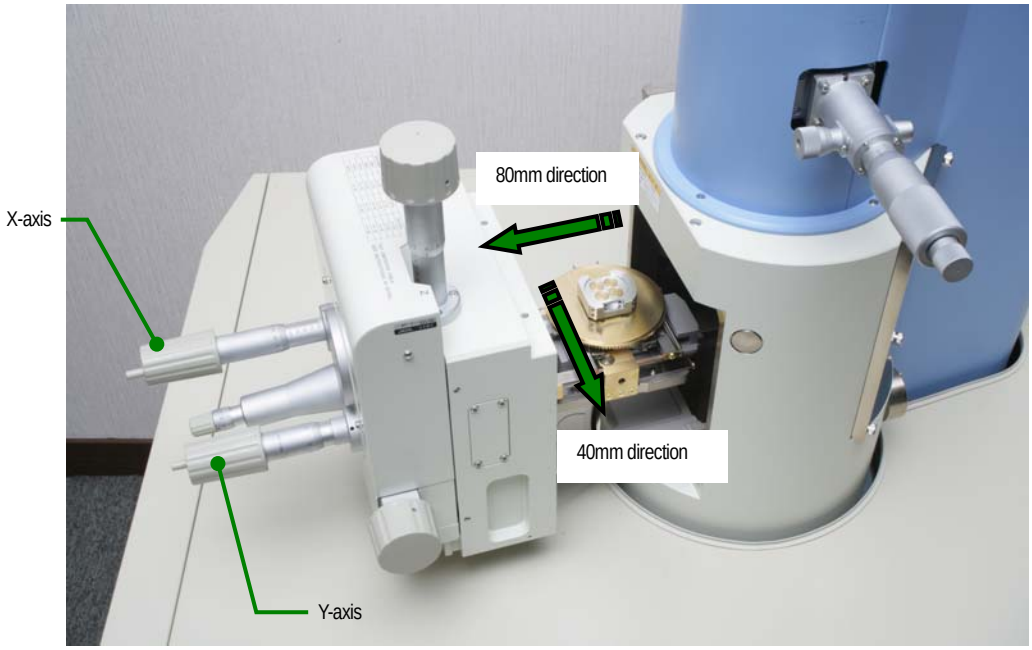
Lowest magnification	WD range (mm)	Lowest magnification	WD range (mm)
×40	4.4 - 5.4	×19	20.5 - 21.4
×37	5.5 - 6.4	×18	21.5 - 24.4
×35	6.5 - 7.4	×17	24.5 - 26.4
×33	7.5 - 8.4	×16	26.5 - 28.4
×30	8.5 - 11.4	×15	28.5 - 31.4
×27	11.5 - 13.4	×14	31.5 - 34.4
×25	13.5 - 15.4	×13	34.5 - 37.4
×23	15.5 - 16.4	×12	37.5 - 40.4
×22	16.5 - 18.4	×10	40.5 - 45.4
×20	18.5 - 20.4	×8(×5)	From 45.5

The value in parentheses ( ) shows the values when the accelerating voltage is used at less than 10 kV.

4.8 Moving the Field View

4.8.1 Manual Stage

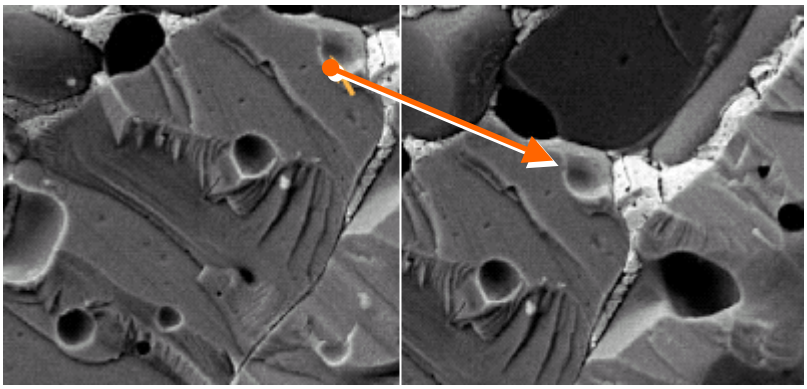
4.8.1.a Moving the stage in the horizontal direction(X and Y)



Moving to the center of the screen (Click center)

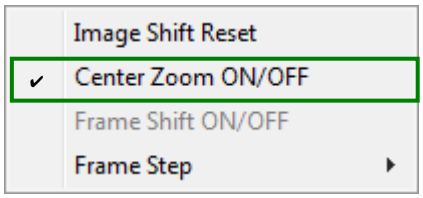
1. Double-click the left mouse button at any position in the main screen.
2. The double-clicked position moves to the center of the screen.

   ＊If the magnification is less than ×4500, the motor stage moves (If the motorized stage is installed).



After moving to the center of the main screen, make zoom up (Click center zoom).

1. When observing the live image, click the right mouse button on the main screen.
2. Tick **Center Zoom ON／OFF**.



3. Double-click the left mouse button at any position in the main screen.
4. The double-clicked position moves to the center of the screen, and the magnification is enlarged at 15 steps larger than the current magnification.

   ＊ When the magnification is less than ×4500, the motorized stage moves (If the motorized stage is installed).

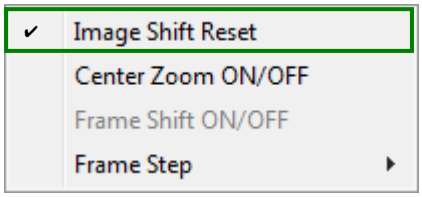
Drag moving

Drag the image window with the left mouse button.

✻ When the magnification is less than ×4500, the motorized stage moves (If the motorized stage is installed).

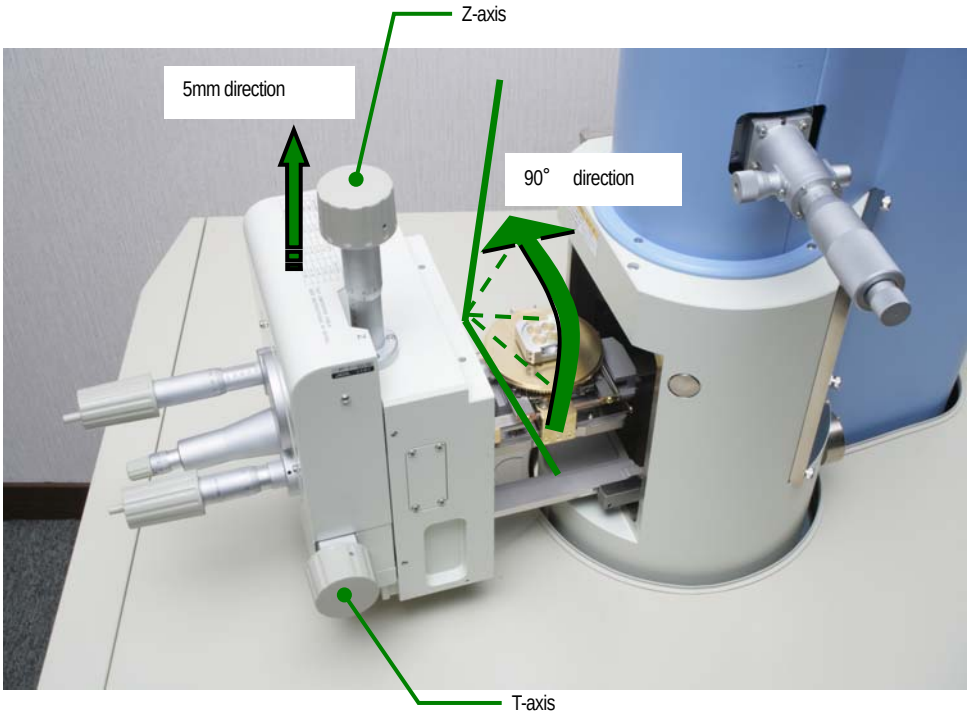
After moving the image, you can return the image to the original position (Image shift reset)

1. When observing the live image, right-click the mouse button on the main screen.
2. Tick **Image Shift Reset**.

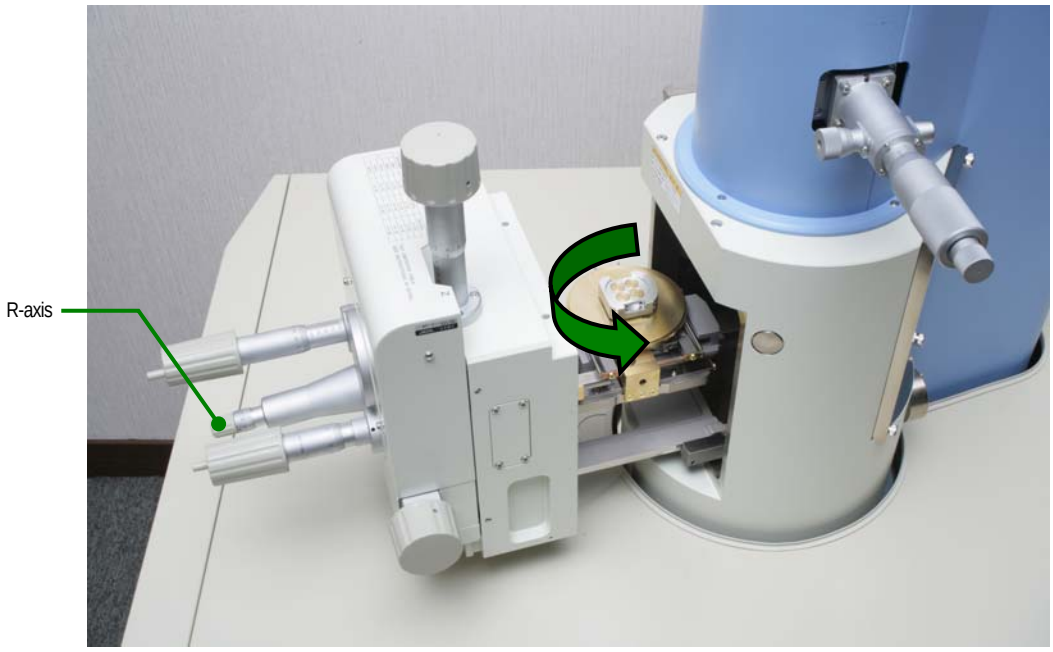


By performing Image Shift Reset, you can bring the image to the center of the electrical shift.

4.8.1.b Moving the stage in the vertical (Z) and tilt (T) directions



4.8.1.c Rotating the stage (R)



360° endless

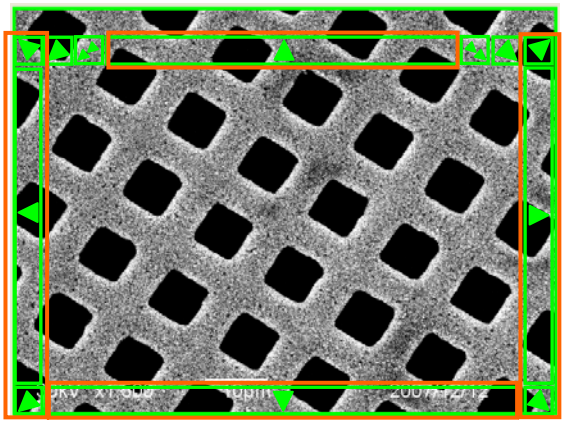
4.8.2 Motorized stage

4.8.2.a Moving the stage in the horizontal directions (X and Y)

Move the stage continuously

Main screen

1. Move the mouse pointer to the edge of the main screen.
   The mouse pointer will change to an arrow pointer (△).
2. If you keep pressing the left mouse button  in the specified region (edge) of the image frame, the stage keeps moving.
3. To stop the stage movement, release the left mouse button.



Pointer shape	Explanation of the operation
◤、◥、◣、◢	X and Y axes move simultaneously.
▲	Y-axis moves in the positive direction (image moves upward).
▼	Y-axis moves in the negative direction (image moves downward).
▶	X-axis moves in the positive direction (image moves rightward).
◀	X-axis moves in the negative direction (image moves leftward).

The Click center function is another way to move the X and Y axes in the main screen.

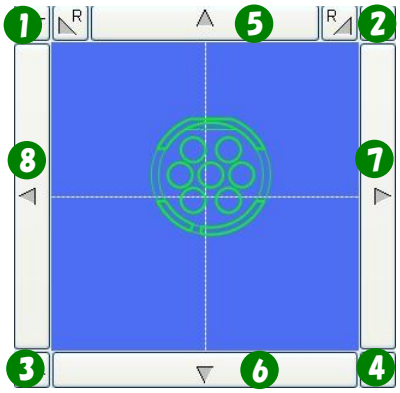
The stage moving buttons in the Graphic Display

1. Click the ***Stage*** in the Operation menu tab.
2. Keep pressing the right or left button on the X/Y button in the graphic display shown below.

   High speed : Right mouse button 

   Low speed : Left mouse button 

3. To stop the stage movement, release the mouse button.

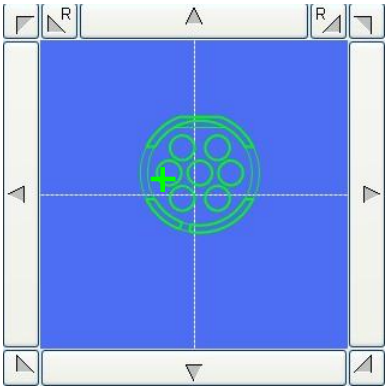


No.	Explanation of the operation
1, 2, 3, 4	X and Y axes move simultaneously.
5	Y axis moves in the positive direction (image moves upward).
6	Y axis moves in the negative direction (image moves downward).
7	X axis moves in the positive direction (image moves rightward).
8	X axis moves in the negative direction (image moves leftward).

Operation Navigation area ----the specified observation point

1. Click the ***Stage*** in the Operation menu tab.
2. Click the left-mouse button  in the Graphic Display.

   The shape of the mouse pointer changes to a cross (＋).

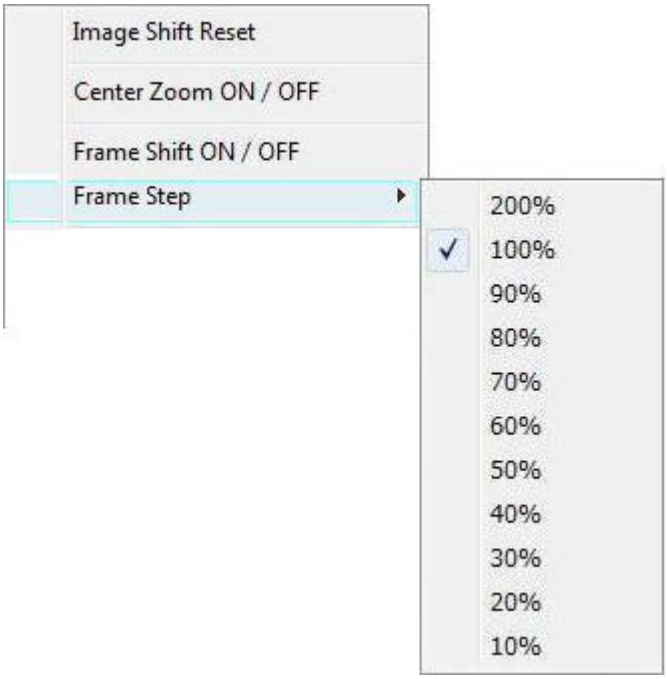


Specifying the point

3. Click the **YES** button in the 「Confirm your move？」message dialog.
4. When the stage movement is completed, the position you specified at Step 2 will be the beam center.

Feeding the frame

1. Display a Live image, and right-click the mouse on the main screen.
2. Tick **Frame Shift ON/OFF**.
3. Specify % values for **Frame Step**.



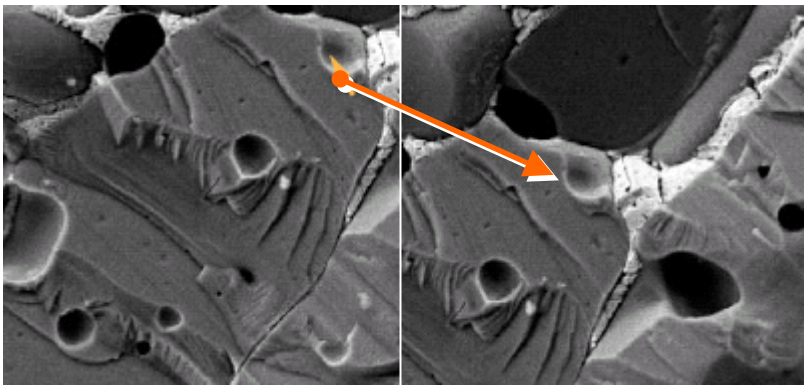
4. Move the mouse pointer to the edge of the main screen.
5. Click the Frame Feed icon  .

   The image moves in the direction of the icon at the specified % values.
   For example, when you specify the frame feed amount to 50%, the image moves by a half frame, when you specify it to 100%, the image moves one frame (one image).

Move the object to the center of the screen (Click center)

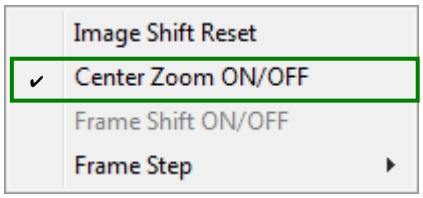
1. Double-click the left mouse button at any position in the main screen.
2. The double-clicked position moves to the center of the image.

   ＊ When the magnification is less than ×4500, the motorized stage moves (If the motorized stage is installed).



After moving the object to the center of the image, make zoom up (Click center zoom)

1. Display a Live image, and right-click the mouse on the main screen.
2. Tick **Center Zoom ON／OFF**



3. Double-click the left mouse button at any position in the main screen.
4. The double-clicked position moves to the center of the screen, and the magnification is enlarged at 15 steps larger than the current magnification.

   ＊ When the magnification is less than ×4500, the motorized stage moves (If the motorized stage is installed).

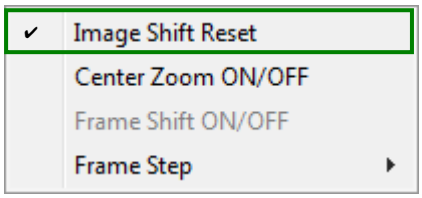
Dragging

Drag the image window with the left mouse button.

* When the magnification is less than ×4500, the motorized stage moves (If the motorized stage is installed).

After moving the image, you can return the image to the original position (Image shift reset)

1. Display a Live image, and right-click the mouse on the main screen.
2. Tick **Image Shift Reset**.



By performing Image Shift Reset, you can bring the image to the center of the electrical shift.

4.8.2.b Moving the stage in the vertical (Z) and tilt (T) directions

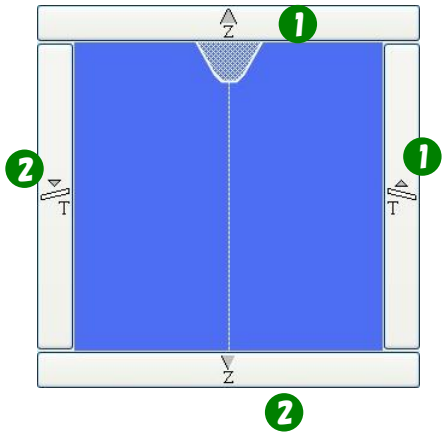
Move the stage continuously

1. Click the ***Stage*** in the Operation menu tab.
2. Keep pressing the right or left button on the Z/T button in the graphic display shown below.

   High speed : Right mouse button 

   Low speed : Left mouse button 

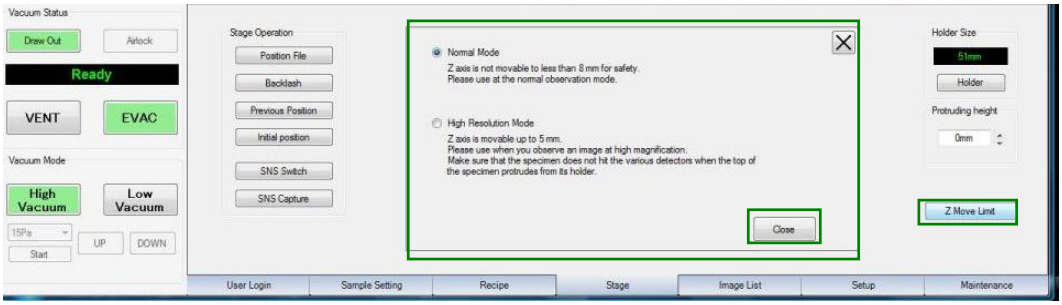
3. To stop the stage movement, release the mouse button.



No.	Explanation of the operation
1	Z and T axes move in the positive directions (image moves upward).
2	Z and T axes move in the negative directions (image moves downward).

4.8.2.c Z Axis Moving Limit

1. Click the **Stage** in the Operation menu tab.
2. Click the **Z Move Limit** button.
3. Select **Normal Mode** or **High Resolution Mode**.
4. Click the **Close** button.



Normal mode	Z axis can not be moved to less than 8mm to prevent collision. Please use at the normal observation mode.
High Resolution mode	Z axis is movable up to 5 mm. Please use when you observe an image at high magnification. Make sure that the specimen does not hit the various detectors when the top of the specimen protrudes from its holder.

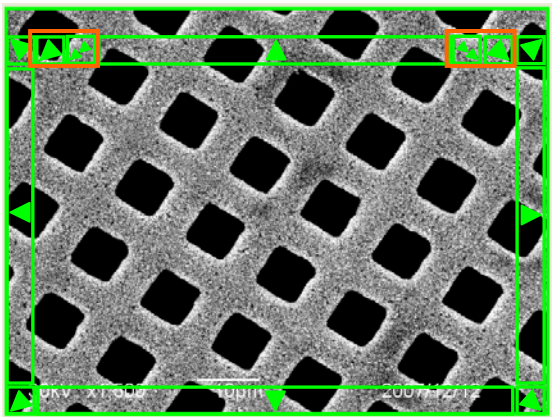
Z Axis Moving Limit

4.8.2.d Rotating the stage (R)

Moving the stage continuously

Main screen

1. Move the mouse pointer to the edge of the main screen.
   The shape of the mouse pointer changes to an arrow (△),
2. Keep pressing the left mouse button  in the specified region (edge) of the image frame.
3. To stop the stage movement, release the left mouse button.



Pointer shape	Explanation of the operation
	R axis moves in the negative direction (image rotates counterclockwise, low speed).
	R axis moves in the negative direction (image rotates counterclockwise, high speed).
	R axis moves in the positive direction (image rotates clockwise, low speed).
	R axis moves in the positive direction (image rotates clockwise, high speed).

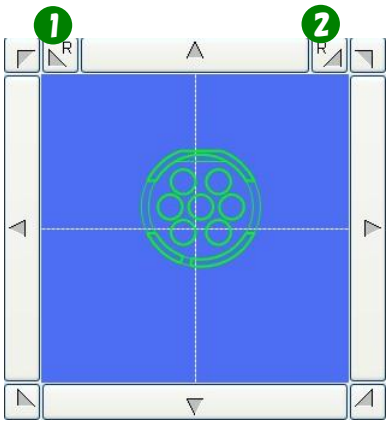
The stage moving buttons in the Graphic Display

1. Click the ***Stage*** in the Operation menu tab.
2. To rotate the stage, keep pressing the right or left button on the R button in the graphic display shown below

   High speed : Right mouse button 

   Low speed : Left mouse button 

3. To stop the stage rotation, release the mouse button.



No.	Explanation of the operation
1	R axis moves in the negative direction (image rotates counterclockwise).
2	R axis moves in the positive direction (image rotates clockwise).

4.8.2.e Moving the stage by specifying the coordinates

Relative movement and Absolute movement

1. Click  the one of the positions (X, Y, R, T, Z) in the coordinates display.

2. The Enter Coordinates menu is displayed.
3. Select the specifying ***Absolute*** or ***Relative*** mode.

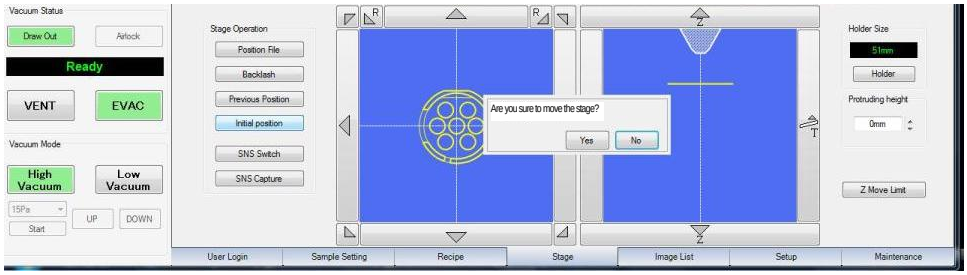
   Absolute : The stage is moved to the specified coordinates, wherever the present coordinates are.

   Relative : The stage is relatively moved by the specified values, where it refers the present coordinates as zero.

4. Click the Coordinates display box of the axes to specify, and enter numerical values using the ten keys.
5. Click the ***Move*** button.
6. Ensure the entered coordinates and click the ***YES*** button in the 「Confirm your move?」 dialog box.
7. When the stage is reached to the specified position, it stops movement.

Initial position

1. Click the ***Stage*** in the Operation menu tab.
2. Click the ***Initial Position*** button.



3. After the message of 「Are you sure to move the stage?」 is displayed, click the **YES** button.
4. The stage stops its movement when it reaches the initializing coordinates.

   ＊ If the axis is not motorized, only the Graphic Display is displayed and the axis is not driven.

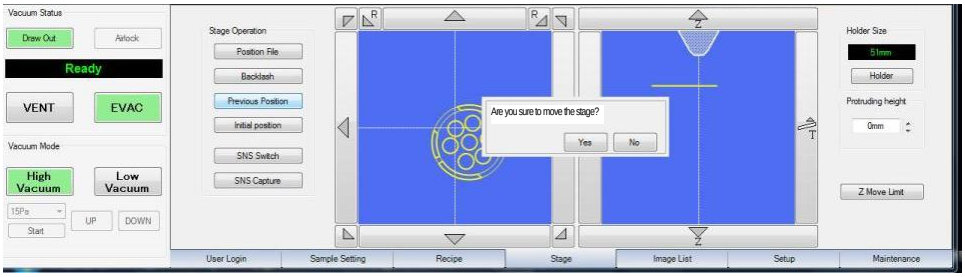
Axis	Coordinate display
X	0.000mm
Y	0.000mm
R	0.000deg.
T	0.000deg.

Initial position

Previous Position

The Previous Position is the one that you have previously moved position by using such function as the Position File, Coordinates specify, Initial Position, Previous Position and + Marker.

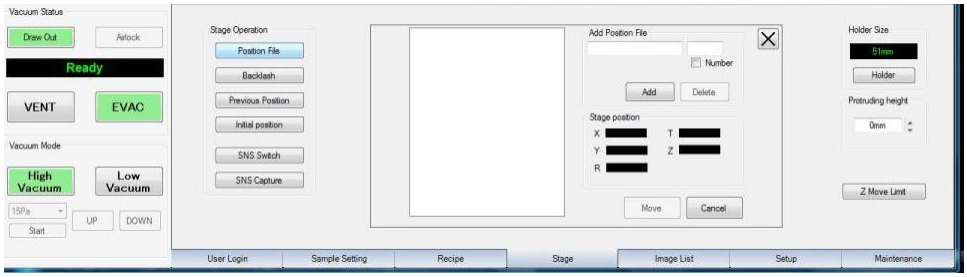
1. Move the stage by using such as the Position File, Coordinates specify, Initial Position, Previous Coordinates and + Marker.
2. Click the ***Previous Position*** button.



3. The coordinates in the Coordinates Display area displays the previous coordinates.
4. Click the ***YES*** button after the message of the 「Are you sure to move the stage?」 is displayed.
5. The stage stops moving after it reaches to the previous position.

4.8.2.f Stage Position file

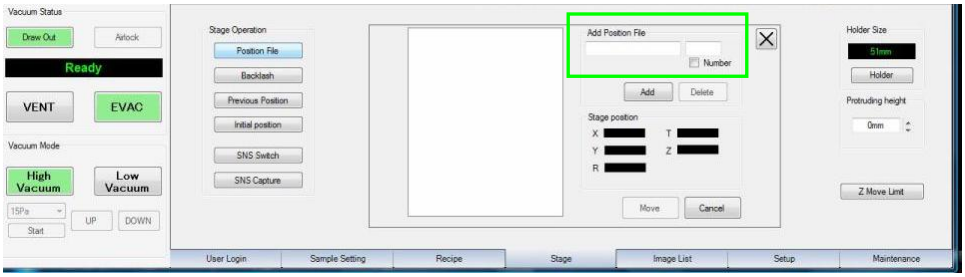
This function saves the image and the stage coordinates, and displays it in the Stage Position File. By selecting the file, the stage moves to the saved stage coordinates.
The reproducibility of the coordinates depends on the precision of the stage. When magnification after moving the stage is high, sometimes, the object moves out of the image display. In this case, search the vicinity of the object at lower magnification.



The Stage Position file menu

Add Position File

1. Click the ***Stage*** in the Operation menu tab.
2. Click the ***Position File*** button.
3. The Position File menu is displayed.



Position File menu

4. Enter the file name in the Add Position File box, and click the ***Add*** button.

   If the "Number" box is ticked, the count is displayed under the file name. And, the Position File can be added with the same file name.

Delete

Open the Position File menu, select the saved file to delete, and click the ***Delete*** button.

4.8.2.g Snap Shot

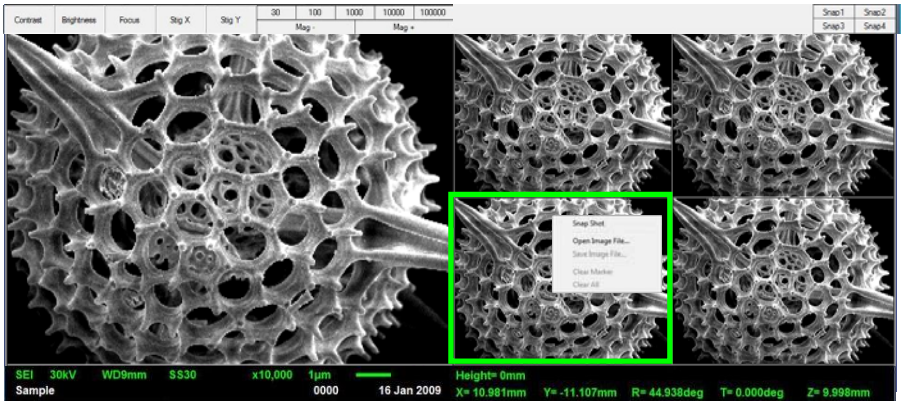
We recommend that you use Snapshot as a navigation of moving the stage.
If you paste a low magnification image on the Snapshot display, and move the stage using the function described below, you can display the objective image at the center of the "Main screen." However, be aware that you cannot move the stage using the image loaded from a file.

If you change the observation conditions in the main screen such as observation position and magnification, such changes are also reflected in the Snapshot display as well.

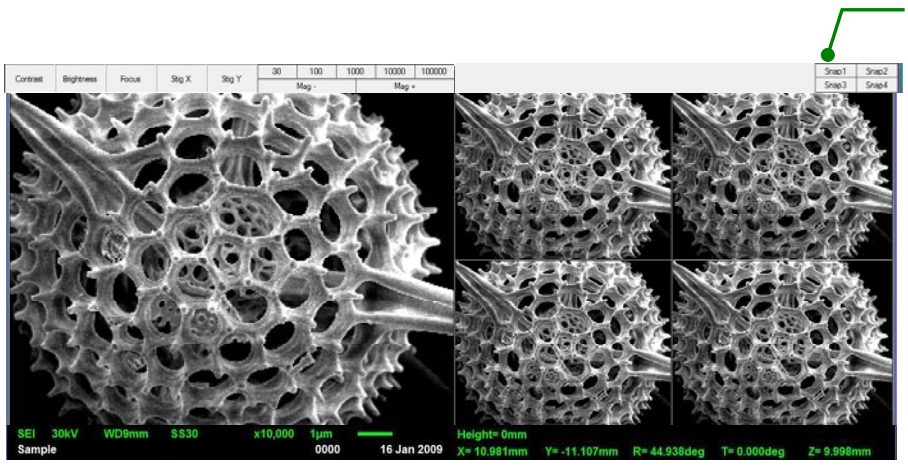
Click center function

1. Display a Live image (except Scan1 mode) or a Freeze image in the main screen.
2. Right-click the mouse on the objective image （example：Standard Live Image・left bottom）
3. Click **Snap Shot** in the pop-up menu.

The image is pasted in the snap shot screen.

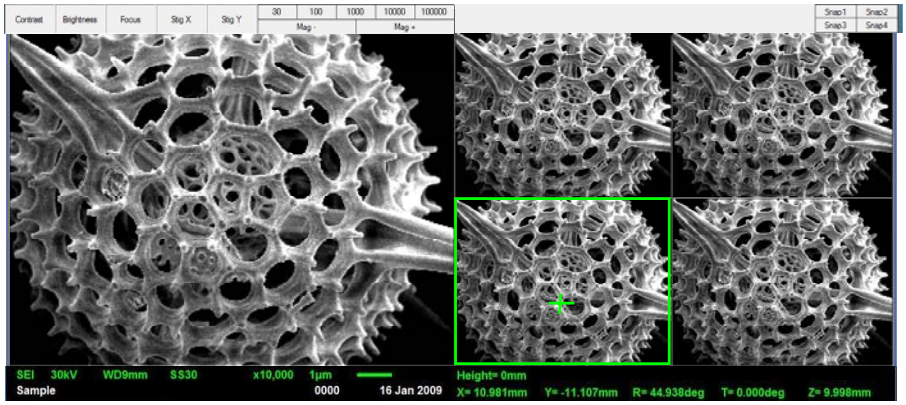


The image can be similarly pasted by the ***Snap Shot*** (1/2/3/4) button.



4. Double-click the mouse button (cross cursor appears) on the Snapshot screen.

   To delete the cross cursor position, right-click the mouse on the objective image and click in ***Clear Marker*** in the pop-up menu.

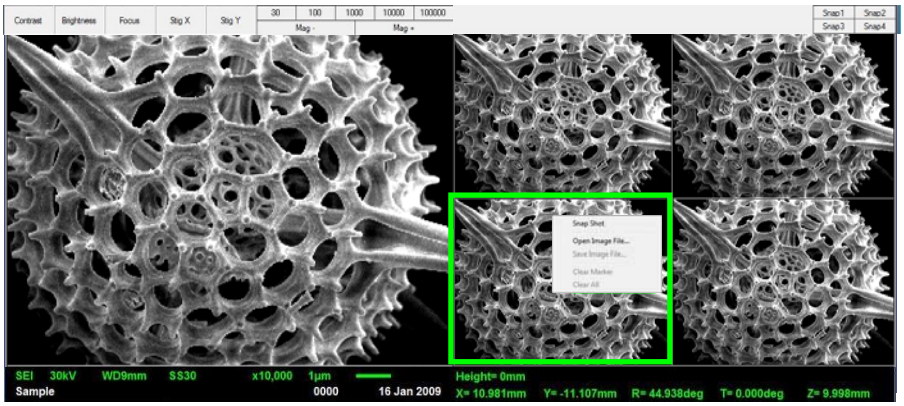


5. The system controls the motorized stage to move it to the double-clicked position, and displays the image at the center of the main screen.

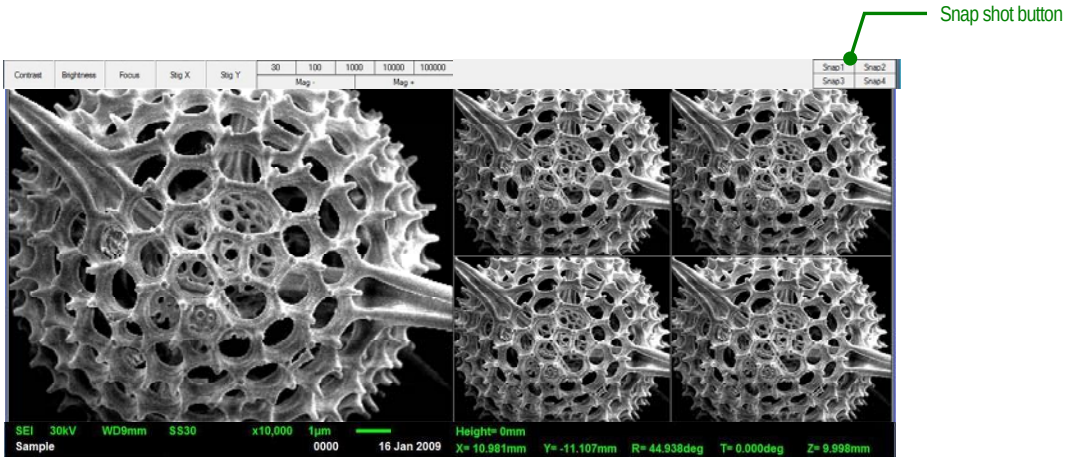
Click center zoom function

1. Display a Live image (except Scan1 mode) or a Freeze image in the main screen.
2. Right-click the mouse on the objective image （example：Standard Live Image・left bottom）
3. Click  ***Snap Shot*** in the pop-up menu.

   The image is pasted in the snap shot screen.

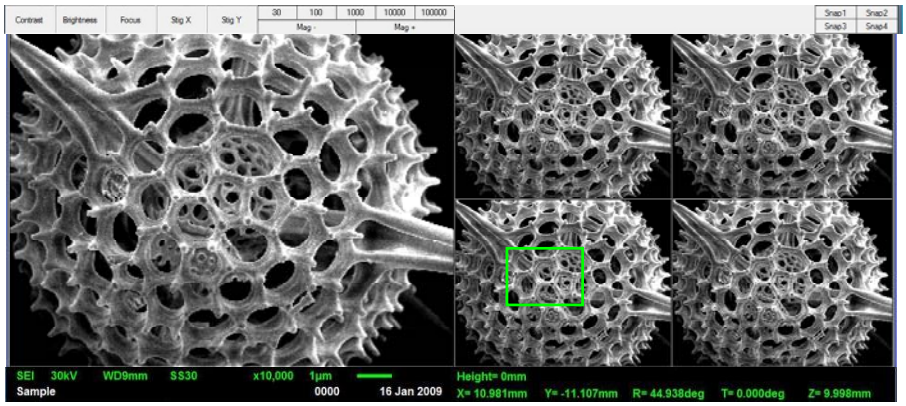


The image can be similarly pasted by the ***Snap Shot*** button (1/2/3/4).



4. Drag (the frame is drawn) in the snap shot screen with the left mouse button.

   The frame size is changed according to the drag.
   To delete the frame position, right-click the mouse on the objective image and click in ***Clear Marker*** in the pop-up menu.



5. Double-click in the frame with the left mouse button.

   The stage (if the motorized stage is installed) is moved to the position where you double-clicked, and the image is displayed to the center on the main screen with the magnification near the frame.
   After movement, the frame is corrected according to the display magnification.

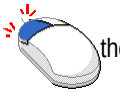
4.9 Changing the Magnification

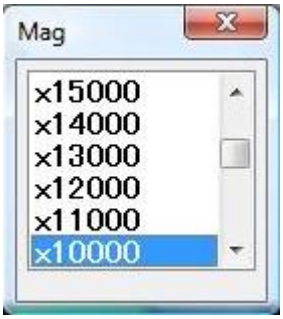
To change the magnification, you can choose from the following operation.

- Using the Magnification window
- Using the Magnification button
- Using the mouse wheel
- Using the Preset Mag. button

4.9.1 Using the Magnification window

1. To display the magnification window, click on the magnification box in the SEM data display.
2. Click 

on the Magnification data display.
3. Double-click  the desired magnification from the list.

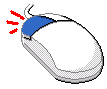


4.9.2 Using the Magnification button

You may use both the Mag.－button [Mag -] (to reduce) and Mag.＋ button [Mag +] (to increase) in the Image Adjustment button.

Left-clicking the mouse can change the magnification by one step, and keeping the left mouse button held down can change the magnification continuously.

The magnification down or up by one step

Click  the [Mag -] or [Mag +] button.

The magnification continuously down or up

Keep the left mouse button held down on the [Mag -] or [Mag +] button.

4.9.3 Using the mouse wheel

If there are mouse cursor in the main screen or dual screen live image (right or left), and using the wheel mouse, you can enlarge or reduce the magnification by scrolling the mouse.

Enlarging operation ： Scroll the mouse wheel backward (pull side).
Reducing operation ： Scroll the mouse wheel forward (push side).

Wheel mouse

4.9.4 Using the Preset magnification

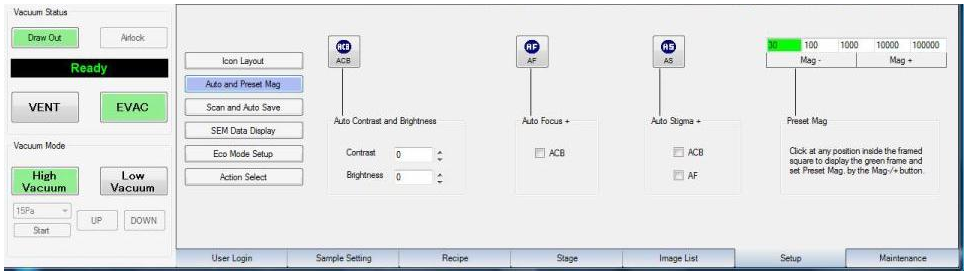
If you use ***Preset*** button from the Image Adjustment button, you can instantly switch the magnification. You can change the Preset magnification as you choose, so we recommend that you save the frequent use magnification.

Preset magnification

Saving the magnification used more frequently

1. Click the ***Setup*** in the Operation menu tab.
2. Click the ***Auto and Preset Mag.*** button.

   The Operation Guide screen is changed to the Auto function Preset Mag. Screen.



3. Click the one of the Preset Mag. box.

   (The box gets highlighted in green frame)

4. Click the 

   or 

   button to set the desired magnification.
5. If you keep the mouse button held down, the magnification changes continuously.

4.10 Observing the Backscattered Electron Image

4.10.1 Principle of image formation

Formations of a composition image and a topographic image

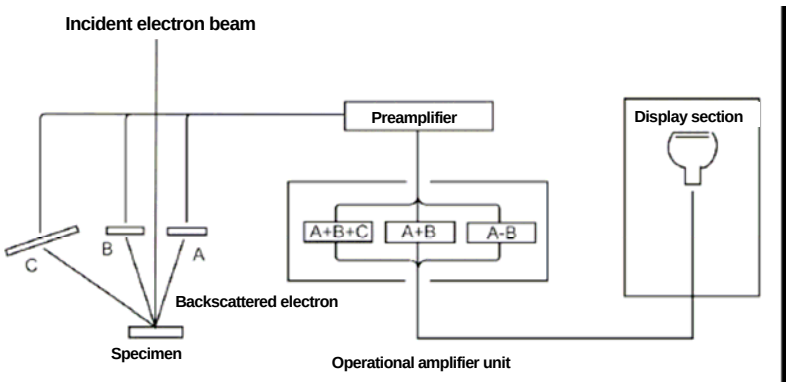
The following figure is a block diagram showing the basic signal routes of forming images. When the incident electron beam is scanned on the specimen surface, backscattered electrons carrying topographic, physical and chemical properties of the specimen are emitted from the specimen.

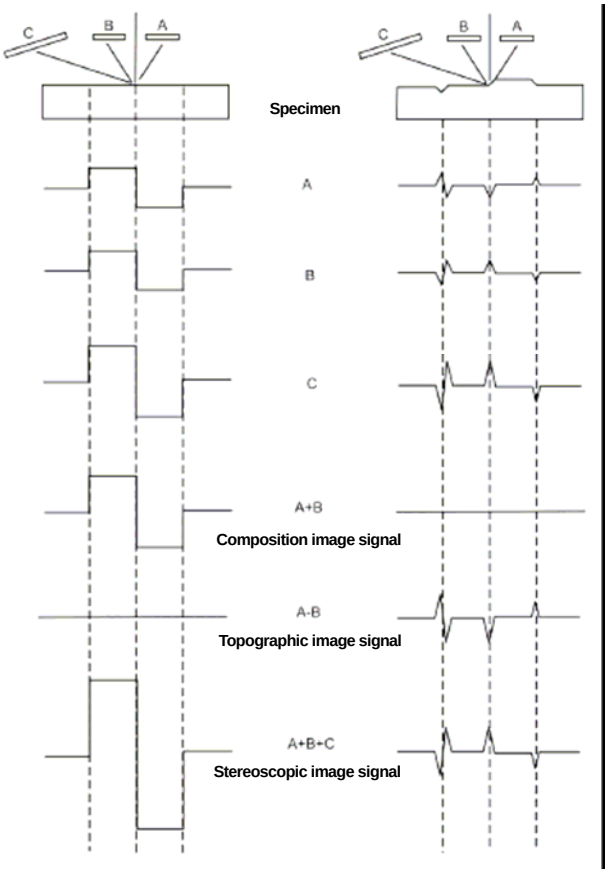
The instrument detects the backscattered electrons carrying the information from the specimen by a pair of two divided semiconductor elements allocated symmetrically to the optical axis from the different directions, converts the variation of its amount into the electric signals, amplifies each signal with the preamplifiers, and supplies it to the operational amplifier unit.

The operational amplifier unit further amplifies the signals and performs arithmetic computation of the signals. That is to say, on one hand, it extracts the added signal for the signals of detection elements A and B, on the other hand, it extracts the subtracted signal between the signals of detection elements A and B. The sum of the input signals becomes the signal for forming a composition image, and the difference between the input signals becomes the signal for forming a topographic image (refer to the figure in the next page). And the instrument display those signals on the monitor.

Formation of a stereoscopic image

When the signal of the semiconductor detection element C for stereographic image is added further to the composition image signal in which signals of a pair of two divided semiconductor detection elements A and B are added, a stereoscopic (shadow) image, which is mixed with the compositional information and topographical information on the specimen surface and gives three-dimensional appearance of the specimen surface, is obtained.





4.10.2 Observing a backscattered electron image

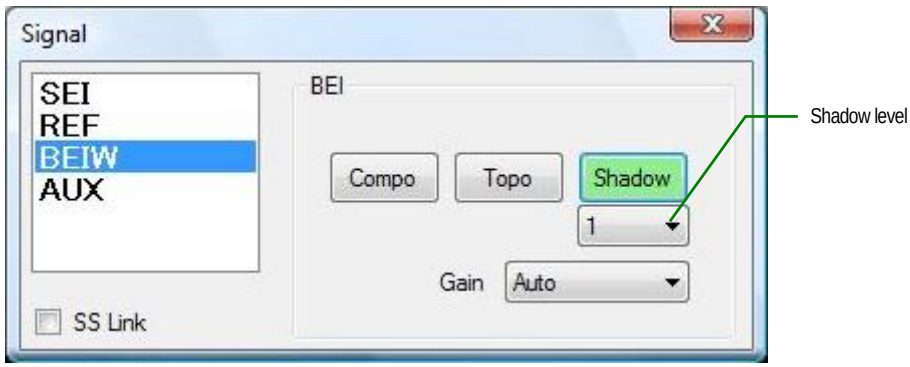
You can detect backscattered electrons having information from the specimen surface, and observe the topography and the composition distribution of the specimen surface. When you display the secondary electron image at first, you can smoothly display the backscattered electron image.

Features of backscattered electron images・・・

- The brightness of the composition image becomes darker as the composition becomes lighter elements, and brighter as the composition becomes heavier elements.
- The topographic image looks like as if a light is illuminated from the right side of the specimen.
- For the convex part, the right side becomes bright and the left side becomes dark. For the concave part, the right and left sides become vice versa.

1. Vent the specimen chamber, and then set a specimen.
2. Display a secondary electron image (SEI).
3. Click the signal SEI in the image data display.
4. Double-click the ***BEIW*** in the Signal setting window.

   When you tick the ***SS Link***, the spot size will remain the same when you switch detectors and the image shift will not occur.



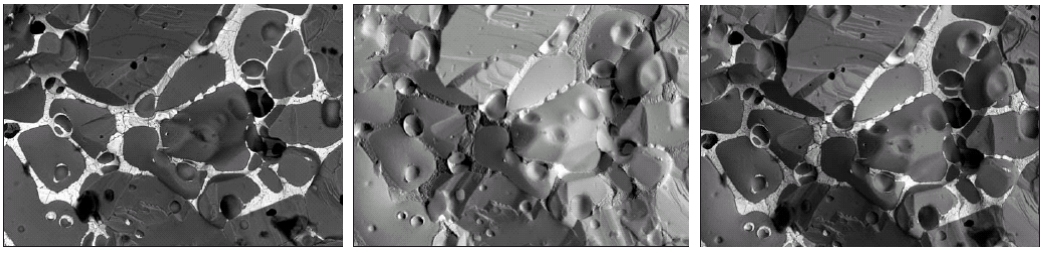
5. Click one of ***Compo*** Compo, ***Topo*** Topo or ***Shadow*** Shadow button in the BEI.

   At Shadow, the shadow level can set with the combo box (1 – 10, EX : ultra 3 - D view).

   If the number goes high, you can get more enhanced stereoscopic 3-D view.
   And, you can set the ***Gain*** to Auto (adjusted automatically depending on the "Spotsize" and "Acc. Voltage") or Manual (High, Medium, Low, Analysis).

6. Adjust the image quality of the backscattered electron image optimal by using Contrast and Brightness.

   When you switch the signal type (Example : Compo ⇒ Topo), the image brightness may change. It that case, adjust the image brightness by means of ACB icon ACB or Contrast and Brightness.



Composition image ***Topographic image*** ***Stereoscopic image***

Guideline of the observation condition

	Criterion	Tendency	Caution
WD	10 - 20mm	Image is brighter at shorter WD	Make sure not to damage the mechanical hitting with the detector and the sample.
Accelerating voltage	15 - 20kV	Image is brighter at higher accelerating voltage	Some sample are damaged by electron beam
Spotsize	30 - 50	Image is brighter at larger Spotsize	Same as above
Movable aperture	1 or 2	Image is brighter at **2**.	

CAUTION !

Just after starting the instrument, or when you largely change the accelerating voltage or the WD, sometimes, the brightness of the image changes slowly. The brightness change will stop after a while, however take note that when you use the slow scans (such as Scan4 or Photo) for the brightness change.

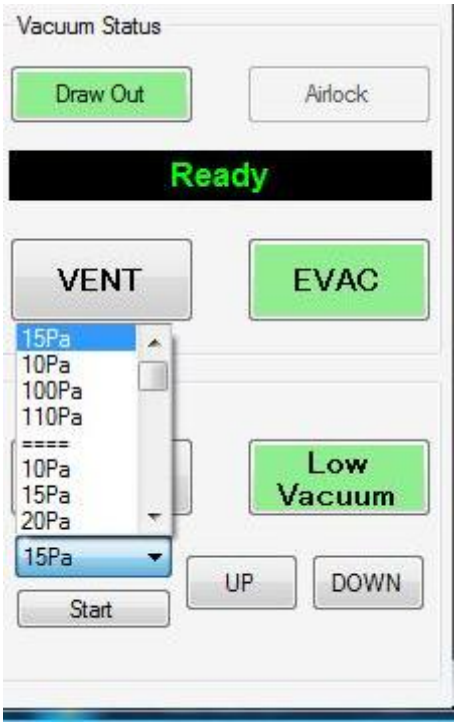
4.11 Low Vacuum Mode Observation

In the observation under low vacuum mode, sometimes, the charge-up phenomenon occurs. When the charge-up phenomenon is observed, you must take measures such as to set the pressure to relatively high pressure.

4.11.1 Dry specimen

1. Set a specimen (a dried specimen such as paper, cloth and resin) (refer to Section 4.3).
2. Click the **Low Vacuum** button in the Vacuum menu.

   The vacuum mode is switched from high vacuum to low vacuum, and starts evacuating the specimen chamber.



Vacuum control panel

3. Click the HT icon 

to get HT ON 

.
4. Set the accelerating voltage to **15 kV**.

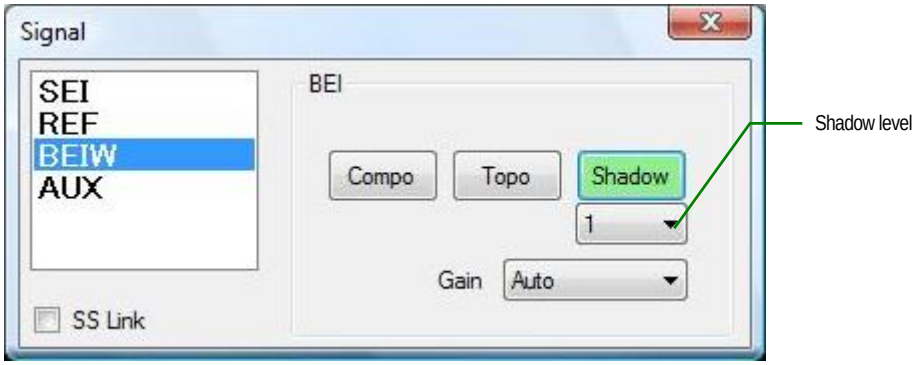
5. Set the pressure of the specimen chamber to **30 Pa**.

   Select the value from the pressure values combo box, and click the **Start** button.
   The **Start** button switches to **Stop**, and it starts flashing. When the pressure reaches to selected value, flashing stops. (it takes a few minutes until the pressure setting completes).
   If the pressure does not reach for more than 5 minutes, or the valve is locked, an error message appears. Close the error message, and perform the pressure setting again.

6. Set the Spotsize to **30** - **60**.

7. Switch the Signal to **BEIW**, and click the Shadow button [Shadow].

8. Set the shadow level to "1".



Signal setting window

9. Click the Scan1 icon [Scan1]

10. Set the specimen stage to the specimen center (0 mm for both X and Y axes).

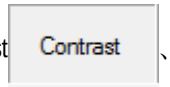
    If the motorized stage is installed, use the Holder Graphic Display or Stage Navigation System (option) to set the stage to the position where you want to observe.

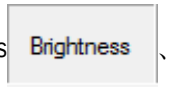
11. Click the 

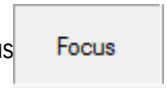
、the 

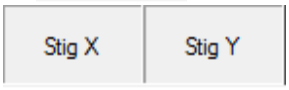
and the 

icons to observe the image

12. Adjust the image quality by using the Contrast 

、Brightness 

、Focus 

and Stig（X、Y） 

buttons.

13. Increase the magnification by four steps, and check to see the image whether the charge up occurs or not on the specimen.

If the charge-up occurs on the specimen, increase the pressure of the specimen chamber or adjust the Spotsize so that the charge-up disappears.

Low ←	***Pressure***	→ High
Much ←	***Charge up***	→ Few
Bright ←	***Brightness***	→ Dark

Relationship between pressure, charge-up and brightness

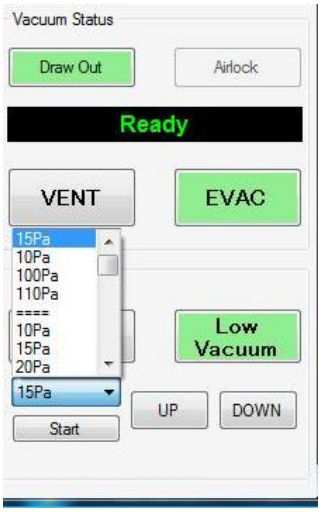
What is the charge-up?

This is the electrical charging on the specimen where the electrons cannot flow through to the ground due to the electrically non-conductive specimen. When it occurs, sometimes, abnormal brightness appears in the observing region, or the field of view shifts during the scan at slow scan.

4.11.2 Water-containing specimen

1. Vent the specimen chamber to atmospheric pressure.
2. Set the specimen such as not containing water as a metal or a specimen holder, and set up the observation condition by getting the image. (Refer to Section 4.5)
3. Click the **Low Vacuum** button in the Vacuum menu.

   The vacuum mode switches from high vacuum to low vacuum, and starts evacuating the specimen chamber.



Vacuum control panel

4. Set the pressure of the specimen chamber to **50 - 70 Pa**.

   Select the value from the pressure values combo box, and click the **Start** button.
   The **Start** button switches to **Stop**, and it starts flashing. When the pressure reaches to selected value, flashing stops. (it takes a few minutes until the pressure setting completes).
   If the pressure does not reach for more than 5 minutes, or the valve is locked, an error message appears. Close the error message, and perform the pressure setting again.

5. Mount a specimen (an aqueous specimen such as plant and biology), and evacuate the specimen chamber.
6. Click the HT icon 

to get HT ON 

.

7. Adjust the image quality by using the Contrast [Contrast] 、Brightness [Brightness] 、Focus [Focus] and Stig（X、Y） [Stig X] [Stig Y] buttons.

8. Increase the magnification by four steps, and check to see the image whether the charge-up occurs or not on the specimen.

   If the charge-up occurs on the specimen, increase the pressure of the specimen chamber or adjust the spot size so that the charge-up disappears.

Low ←	**Pressure**	→ High
Much ←	**Charge up**	→ Few
Bright ←	**Brightness**	→ Dark

Relationship between pressure, charge up and brightness

What is the charge-up?

This is the electrical charging on the specimen where the electrons cannot flow through to the ground due to the electrically non-conductive specimen. When it occurs, sometimes, abnormal brightness appears in the observing region, or the field of view shifts during the scan at slow scan.

4.12 Observing a Tilted Specimen

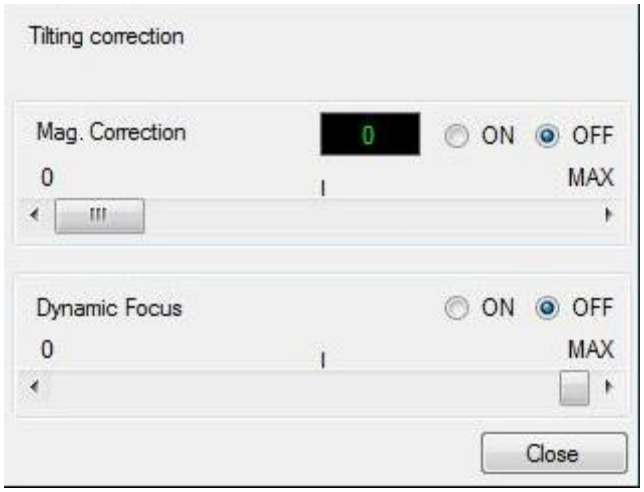
4.12.1 Tilt correction (Dynamic Focus)

If the focus is not adjusted at both edges of the field of view for a tilted specimen, adjust the focus using the slide bar.

1. Adjust the focus at the center of the Live image.
2. Click the Tilt icon 

, or select Menu bar **Tools** ⇒ **Tilt Correction**.

   The Tilting correction menu is displayed.



3. Select the ON/OFF radio button in the Dynamic Focus to **ON**.
4. Click the Scan 3 icon 

or the Scan 4 icon 

.
5. Correct the focusing with the slide bar.

   Once the correction is performed, the amount of correction remains stored in the memory, even if you set the ON/OFF button to **OFF**.

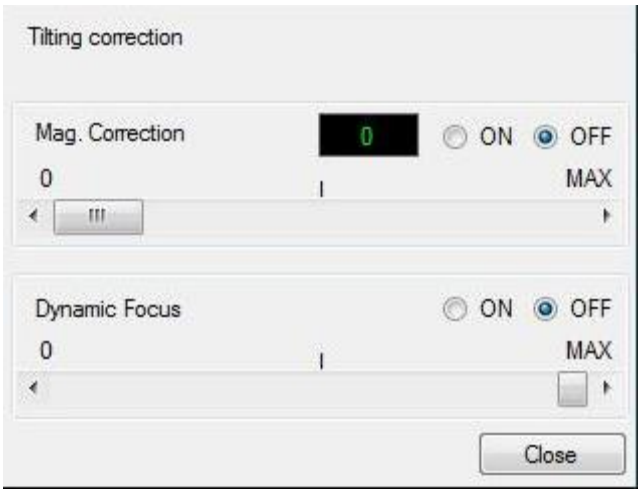
4.12.2 Tilt correction (MAG correction)

For the tilted specimen, you can correct the frontward and backward magnifications relative to the magnification at the center.

1. Adjust the focus at the center of the Live image.
2. Click the Tilt icon 

, or select Menu bar **Tools** ⇒ **Tilt Correction**.

   The Tilting correction menu is displayed.



3. Select the ON/OFF radio button in the Mag. correction to **ON**.
4. Click the Scan 3 icon 

or the Scan 4 icon 

.
5. Adjust the tilting angle with the slide bar.

   Once correction is performed, the amount of correction remains stored in the memory, even if you set the ON/OFF button to **OFF**.

4.13 Observing the image by the Scan Rotation

This function rotates the image by rotating the scan direction.
(The SCAN ROTATION is necessary)

1. Click the SRT icon 

, or select Menu bar **Tools** ⇒ **Scan Rotation**.

   The Scan Rotation menu opens.

2. Select **ON** of the ON/OFF radio button in the Scan Rotation window.
3. Set the rotation angle using the slide bar and arrow button.

   The image rotates to the set angle.
4. If you select **OFF** of the ON/OFF radio button, the rotated image returns to the previous one.

4.14 Capturing a Stereo Image

You can save multiple images in the same field of view at a different angle.
For creating and analyzing three-dimensional images, please refer to the user manual of THREE-DIMENSION IMAGE SOFTWARE.

1. Click the ***Stereo*** icon 

or select the menu bar **Tools** ⇒ ***Stereo Pair***.

   The stereo pair menu opens.

2. Select the scan mode (Scan2, 3 or 4) for saving the reference image.

   Set the scan speed of each scan mode using the ***Scan and Auto Save*** in the ***Setup*** of the Operation menu tab.

3. Move the object to the cursor center by moving the specimen stage.

4. Click the ***Save*** button to save the reference image.

   Save the image in any given folder. When saving is completed, the screen displays as follows:

Capturing a reference image (Left screen: Reference image)

5. Slant the T-axis.

   The manual stage

   Slant the T-axis （input range±15° 、generally, 5 to 7° ）, and input a tilt angle.

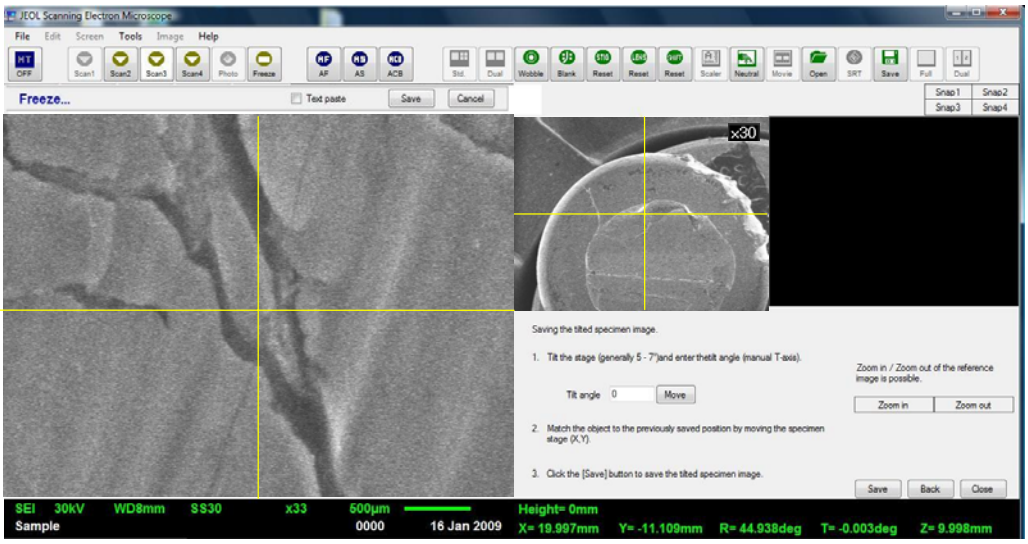
   The motorized stage

   When the T axis is tilted, the tilt angle value is input automatically.

6. While enlarging or reducing the comparison image using the Enlarged／Reduce buttons, adjust the image position using the X and Y axes of the stage to bring the image in the same field of view as that of the reference sample image.

7. Click the ***Save*** button to save the tilted image

   Save the image in any given folder. When saving is completed, the screen displays as follows：



Capturing a tilted image (Left screen：reference image、Right screen：tilted image)

8. Click either ***Yes*** or ***No*** button on the message.

   When you click the ***Yes*** button, the 3D analysis software starts up. For details, refer to the operation manual of THREE-DIMENSION IMAGE SOFTWARE

   When you click the ***No*** button, the Stereo pair function is finish.

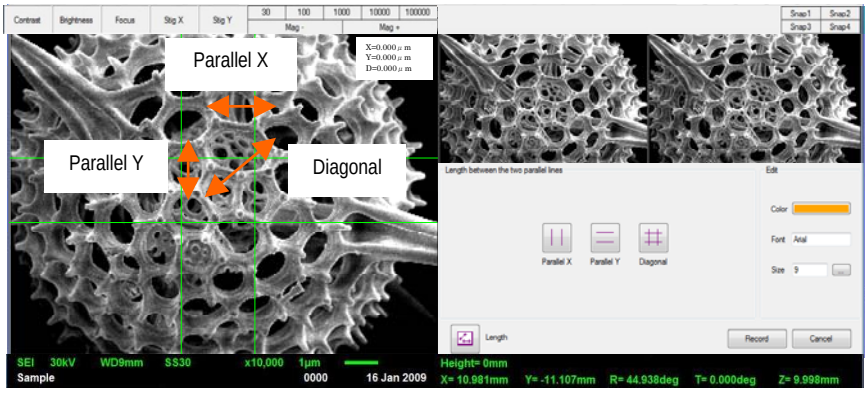
4.15 Measurement

4.15.1 Parallel measurement

1. Click the Scaler icon 

, or select menu bar **Tools** ⇒ **Scaler**.

2. Click the Parallel icon  .



3. Select the direction of distance measurement

Select ***Parallel X***  when you want to measure the distance in the horizontal direction. (Two cursors are displayed in the vertical direction.)

Select ***Parallel Y***  when you want to measure the distance in the vertical direction. (Two cursors are displayed in the horizontal direction.)

Select ***Diagonal***  when you want to measure the distance in the diagonal direction. (Two cursors are displayed respectively in the horizontal and vertical directions.)

4. Drag the displayed cursor and set a measurement point.

The measured value is displayed in real time in the window. When you set a measurement point, drag each cursor (in the case of ***Parallel X*** and **Y**), or drag the cursor to the intersection points (in the case of ***Diagonal***).

5. Click the ***Record*** button. You can create a freeze image in which the cursor and measured value are drawn.

If you click ***Cancel*** button, an original image re-appears.

You can change the color of measurement point and measured value, or change the text style. Click the target object, and change the color and text style. (Based on Windows)

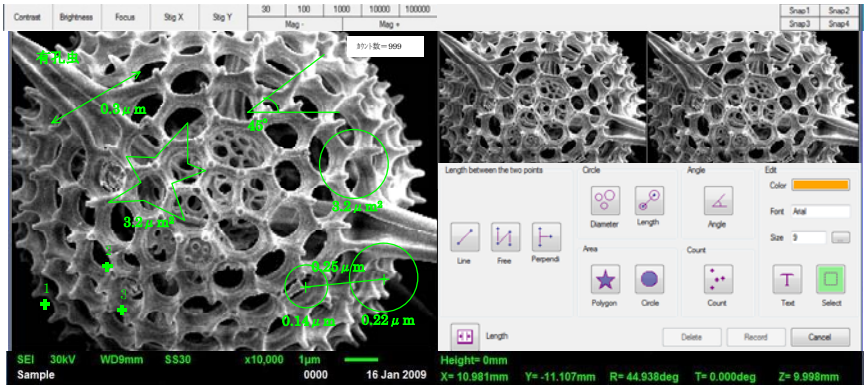
4.15.2 Distance measurement between two points

1. Click the Scaler icon 

, or select menu bar **Tools** ⇒ **Scaler**.

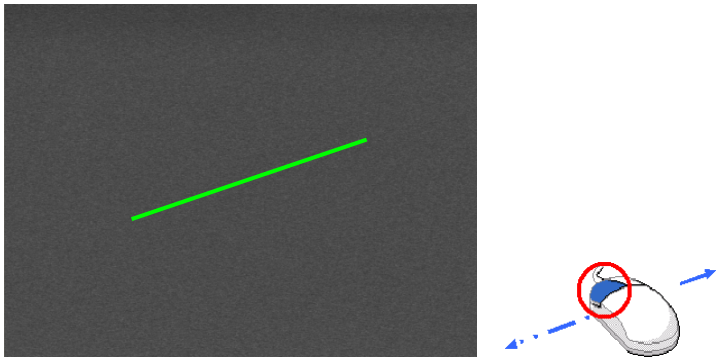
2. Click the Distance icon 

   The image area changes as shown below.



Measuring the straight line

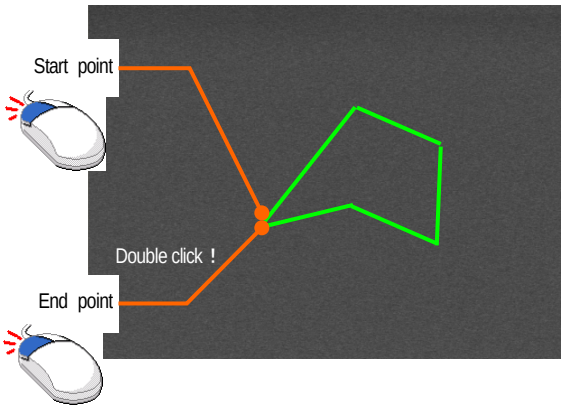
1. Click the Line icon  .
2. Drag the left mouse button from the start point to the end of the target object.



3. The straight line which connects the start point and the end point is displayed, and the measured value is displayed.
4. Click the ***Record*** button. You can create a freeze image in which the straight line and measured value are drawn.

Measuring the linear distance successively

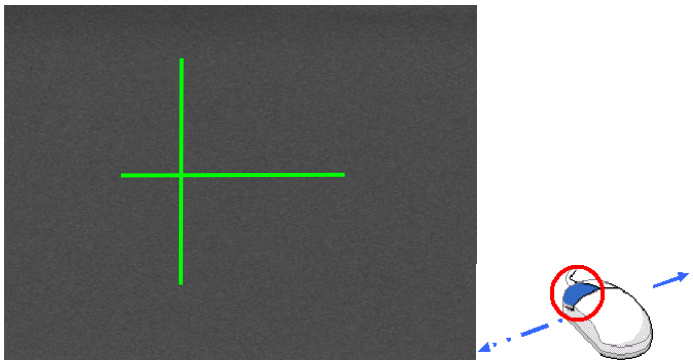
1. Click the Free icon  .
2. Click the start point of the target object, and click again on the arbitrary position. Repeat this operation successively.
3. Double click the end point of the target object.
4. The polygon which connects the start point and the end point is displayed, and the measured value is displayed.



5. Click the ***Record*** button. You can create a freeze image in which the polygon and measured value are drawn.

Measuring the perpendicular line for arbitrary straight line

1. Click the Perpendicular icon  .
2. Drag the left mouse button on the target object to draw the base line.
3. For a drawn base line, a perpendicular line is displayed.
4. Drag and drop the perpendicular line.
5. The perpendicular line is set, and measured value is displayed.



6. Click the ***Record*** button. You can create a freeze image in which the perpendicular line and measured value are drawn.

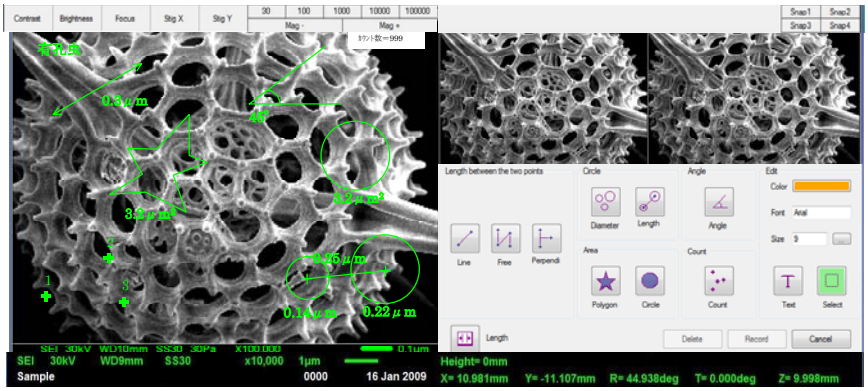
4.15.3 Angle measurement

1. Click the Scaler icon 

, or select menu bar ***Tools*** ⇒ ***Scaler***.

2. Click the Distance icon 

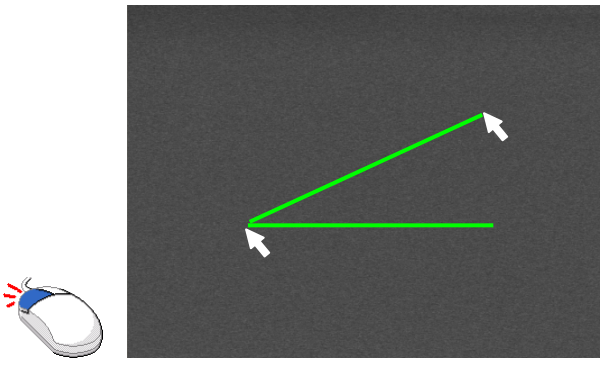
   The image area changes as shown below.



3. Click the Angle icon  .

4. Click the left mouse button on the vertex for which you want to measure the angle.

5. Move the mouse, and draw one of the two sides which sandwich the angle to measure, and then, click the left mouse button on the end point.
   If you move the mouse from the end point, one more side will be drawn and the measured value will be displayed



6. When you want to finish the angle measurement, click the left mouse button.

7. If you freeze an image and click the ***Record*** button, you can create a freeze image under the angle management.

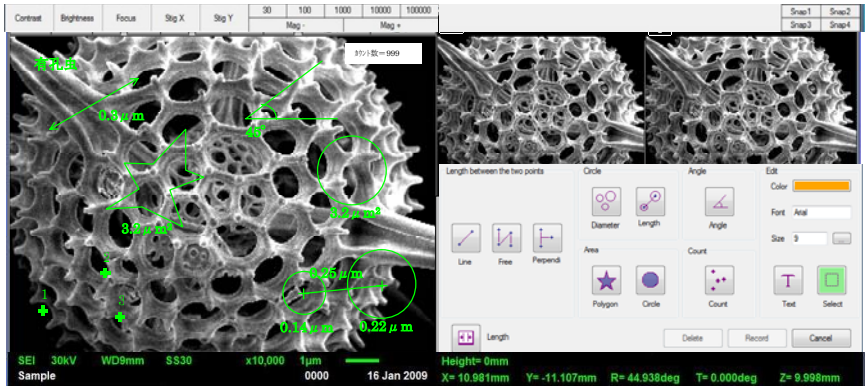
4.15.4 Circle measurement

1. Click the Scaler icon 

, or select menu bar **Tools** ⇒ **Scaler**.

2. Click the Distance icon 

   The image area changes as shown to the below picture.

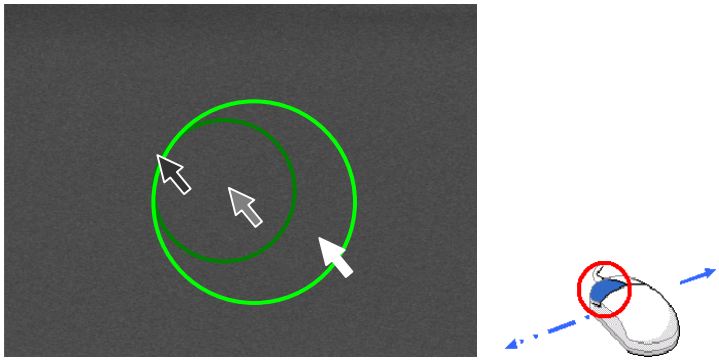


Measuring the diameter of circle

1. Click the Diameter icon  .

2. Drag the left mouse button on the target object.

3. The circle that the circumference on the starting point is drawn.



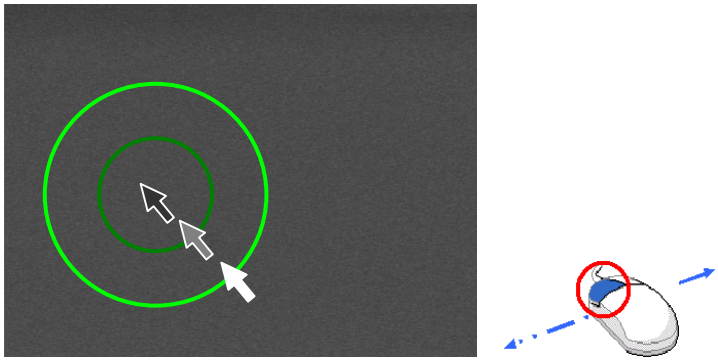
4. The circle is set, and the measured value (diameter of circle) is displayed.

5. The circle size can be changed by dragging.

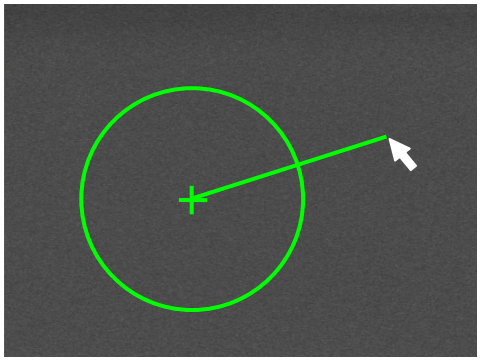
6. Click the ***Record*** button. You can create a freeze image in which the circle and measured value are drawn.

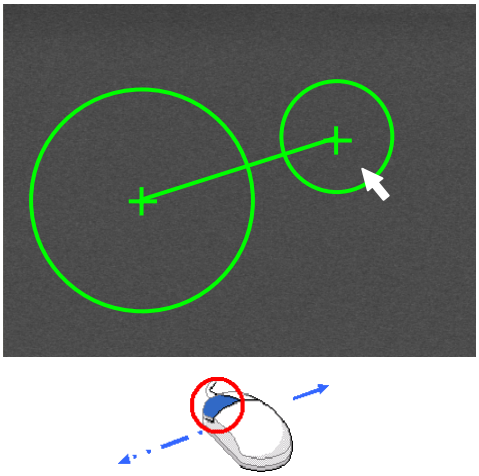
Measuring the length between the center of two circles

1. Click the Distance icon  .
2. Drag left mouse button on the target object.
3. The first circle that centers on the starting point is drawn.



4. The straight line for connecting the center between two circles is displayed.
5. Specify (start point for dragging) the center of the second circle, the straight line is set and draw the second circle by dragging.





6. The second circle is set, and the measured value between two centers is displayed.
7. Click the ***Record*** button. You can create a freeze image in which the two circles and measured value are drawn.

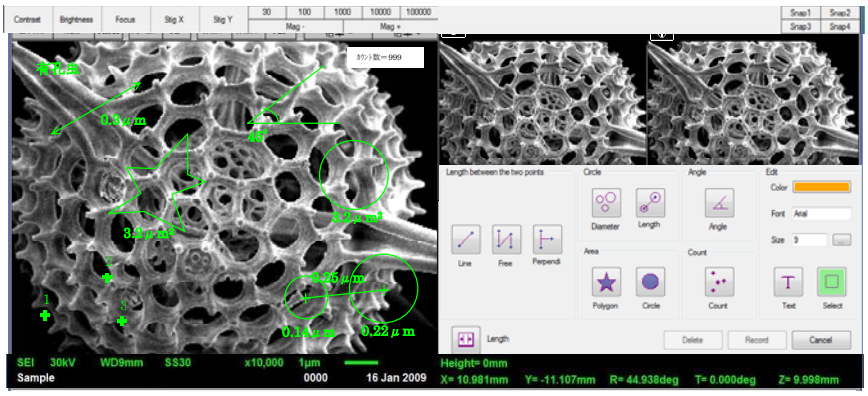
4.15.5 Area measurement

1. Click the Scaler icon 

, or select menu bar **Tools** ⇒ **Scaler**.

2. Click the Distance icon 

The image area changes as shown to the below picture.



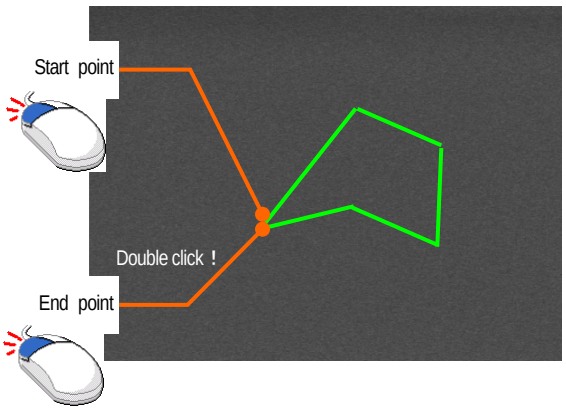
Measuring an area of polygon

1. Click the Polygon icon  .

2. Click the start point of the target object, and click again on the arbitrary position. Repeat this operation successively.

3. Double click the end point of the target object.

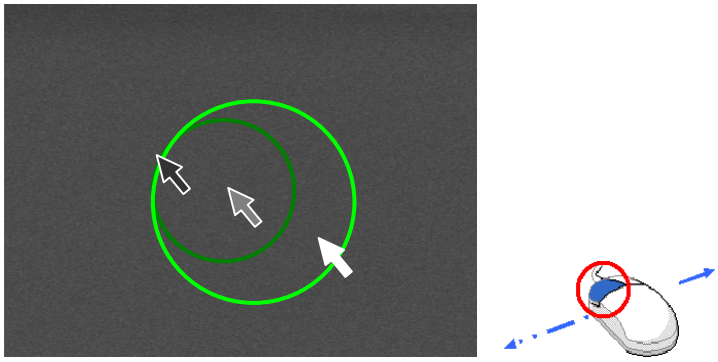
4. The polygon which connects the start point and the end point is displayed, the area of polygon is displayed.



5. Click the ***Record*** button. You can create a freeze image in which the polygon and measured value (area) are drawn.

Measuring an area of circle

1. Click the circle icon  .
2. Drag left mouse button on the target object.
3. The circle that assumed the start point circumference is drawn.



4. The circle is set, and the measured value (area of circle) is displayed.
5. The circle size can be changed by dragging.
6. Click the ***Record*** button. You can create a freeze image in which the circle and measured value (area) are drawn.

4.15.6 Counts the number of measurements

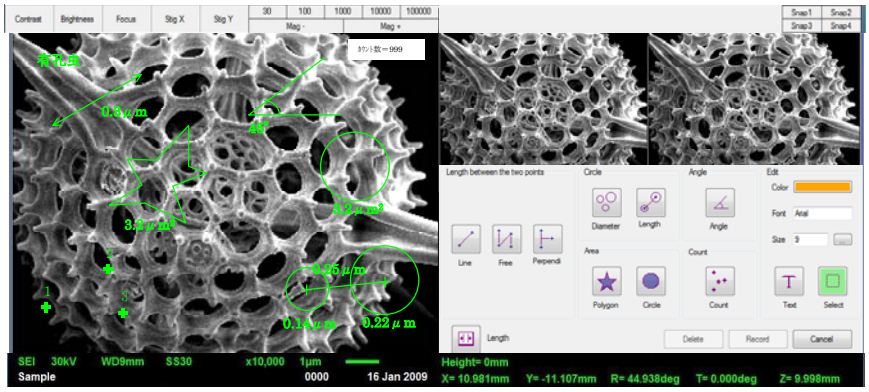
When you want to count the measured target object, perform the following procedures.

1. Click the Scaler icon 

, or eelect menu bar ***Tools*** ⇒ ***Scaler***.

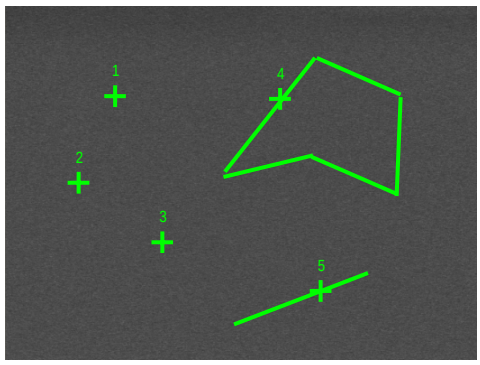
2. Click the Distance icon 

   The image area changes as shown to the below picture.



3. Click the Count icon  .

4. Left-click a target object or any point you want.



5. A plus "＋" symbol and numerical quantity appear, and the number you clicked will be counted.

6. Click the ***Record*** button to create a freeze image drawn by counting.

4.16 Edit

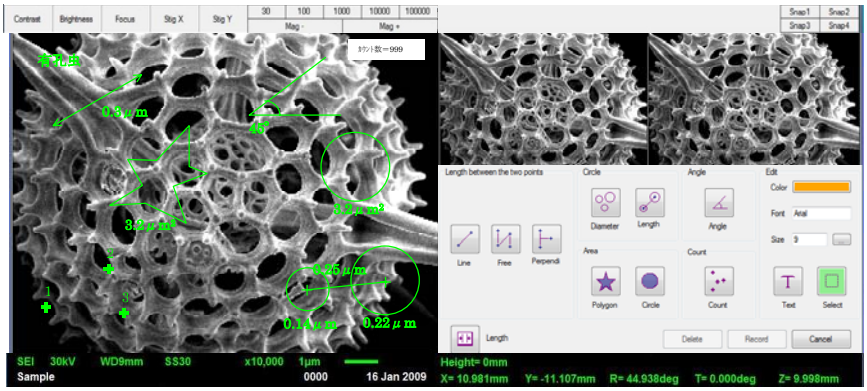
By using the Text icon and Select icon, you can change the color of measured position and enter the text on the scree.

1. Click the Scaler icon 

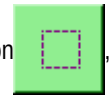
, or select menu bar ***Tools*** ⇒ ***Scaler***.

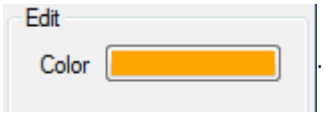
2. Click the Distance icon 

   The image area changes as shown below picture.



Changing the color of measured position

1. Click the Select icon  , and drag it so that a target can be included.

2. Select the specified color 

.

3. Click ***Save*** button, you can create a freeze image in which the target was changed to desired color.

Entering text

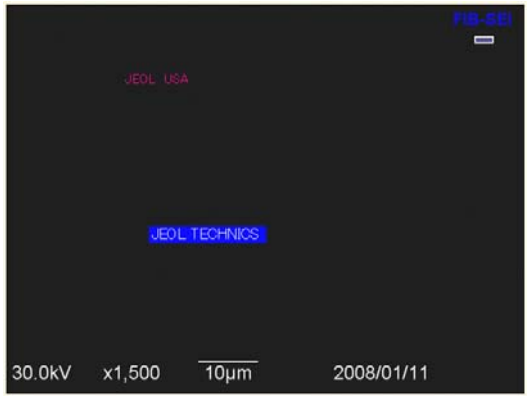
1. Click the Text icon.  .
2. By dragging with left mouse button on the main screen, draw the text box.
3. Move a text box.
    a. Click the Select icon, and drag it so that the box can be included.
    b. Set the mouse cursor on box, and move the box while pressing the left mouse button. Then, release the mouse button with the desired position.
4. Change the text box size.
    a. Click the Select icon, and drag it so that the box can be included.
    b. Set the mouse cursor on box, and move the box while pressing the left mouse button. Then, release the mouse button with the desired size.
5. Enter text in the text box

    If necessary, change the color, style and size of a font.

Item	Explanation
Color	Sets font colors.
Font	Sets font types.
Size	Sets font sizes.

✻ In accordance with Windows

6. Click the **Save** button to create a freeze image with text in it.



4.17 Various image displays

4.17.1 Digital Zoom

If you are interested to observe the enlarged image at a certain area with the magnification of 2 or 4 times. The Digital Zoom function is convenient for such purpose.

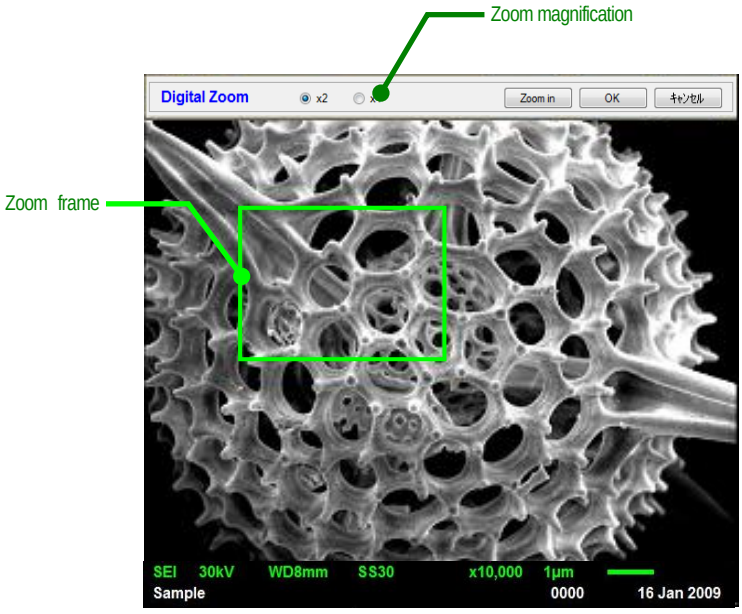
1. Click the Freeze icon 

2. Click the Zoom icon 

or select the menu bar **Image** ⇒ **Digital Zoom**.

   The Live image on the main screen becomes the freeze image.

3. Select the zoom magnification **×2** or **×4**.



Digital Zoom window

4. Move the Zoom frame, and click the **Zoom In** button.

   Set the mouse cursor on the Zoom frame, and drag the left button to move the Zoom frame. Release the mouse button at the zoom position where you want to enlarge. The image in the Zoom frame is enlarged (× 2 or × 4), and displayed on the whole main screen.

5. Click the **OK** button.

   A freeze image is displayed under the condition of step 3.

4.17.2 Dual Mag

This is the function display to simultaneously the two images on the screen with the different magnification. The original image is displayed on the left half screen and the enlarged image specified with frame in the original image is displayed on the right half screen.

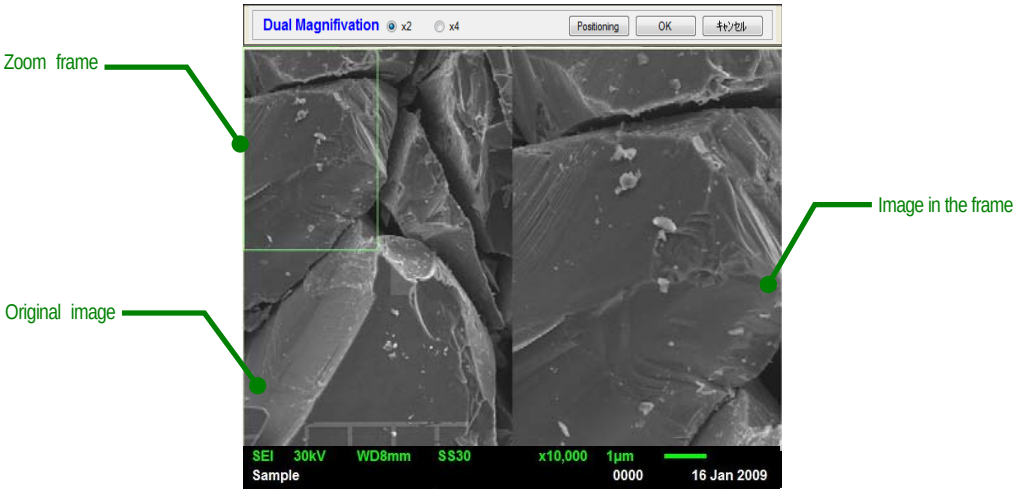
1. Click the Freeze icon 

2. Click the D-Mag icon 

, or select the menu bar ***Image*** ⇒ ***Dual Magnification***.

   The Live image on the main screen becomes freeze image. The original image is displayed on the left-side, and the image in the zoom frame is displayed on the right-side.

3. Select the zoom magnification **×2** or **×4**.



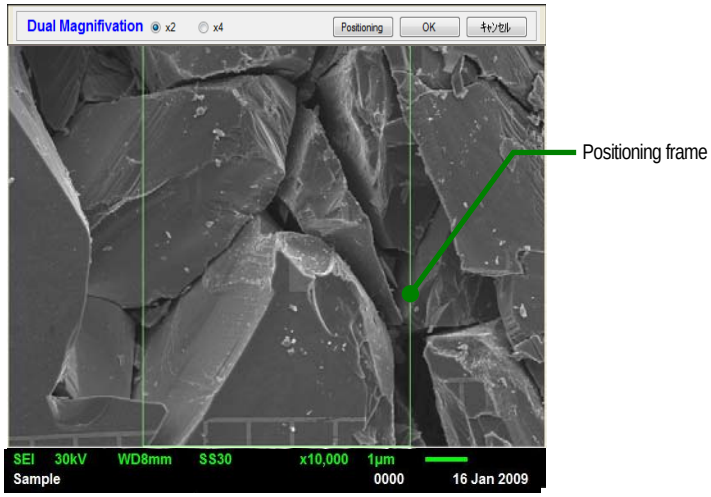
Dual Magnification window

4. Move the Zoom frame, and specify the enlarging position.

   Set the mouse cursor on the frame, and drag the left mouse button to move the frame. Release the mouse button at the Zoom position where you want to enlarge.

When you want to change the Zooming position

a. Click the **Positioning** button, and move the Positioning frame to the position you want to enlarge.
b. Repeat Step 3 and Step 4.



5. Click the **OK** button.

   A freeze image is displayed.

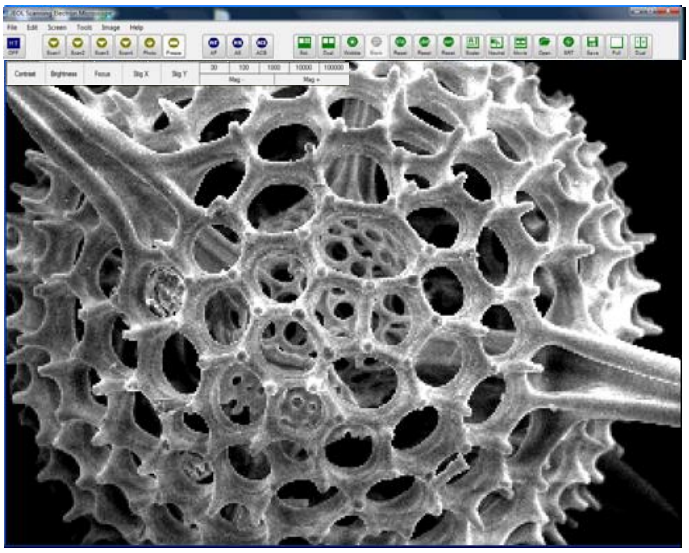
4.17.3 Full Screen Display

A full screen display can be displayed.

1. Click the Zoom icon 

, or select the menu bar ***Screen*** ⇒ ***Full screen Live Image***.

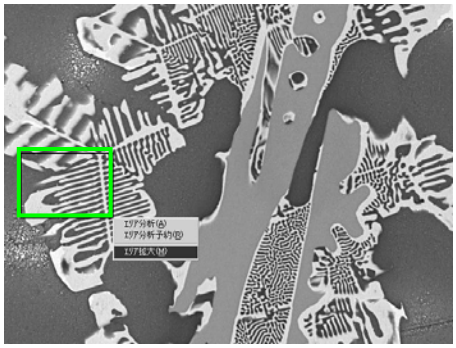
An image in the size of 640 × 480 (1 screen) will be displayed on the full screen.
To cancel the Zoom display, select another display from the screen icon (such as Std, Dual) or menu bar Screen (such as Standard Live Image, Dual Screen Live Image).



Full screen live image

Area Zoom (can be possible depending on models and options of your device)

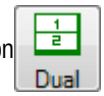
When you drag the main screen with the right mouse button, the rectangle frame and the pop-up menu appears. Click the ***Area Zoom***. The image in the frame is moved to the center of the screen, and it is displayed with the full size
To cancel the Area Zoom, select another display from the screen icons（such as Std, Dual）or menu bar ***Screen*** (such as Standard Live Image, Dual Screen Live Image）



When dragging with the right mouse button

4.17.4 Dual Live image

The live images in the same view field can be displayed side by side with different signals.

1. Display a Live image.
2. Click the Dual icon 

(UD) or 

(LR), or select the menu bar ***Screen*** ⇒ ***Dual Live Image*** ⇒ ***UD*** or ***LR***.

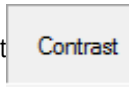
3. Change the frame, if necessary.

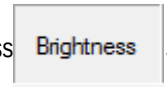
   To change the active frame, click the left mouse button  on the display to make it active.

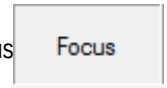
4. Click the signal 

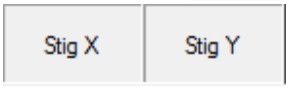
in the Image Data Display.
5. Change a signal in the selected frame using the Signal window.

   If you tick the ***SS Link***, the Spotsize will remain the same when you switch detectors and the image shift will not occur.

6. Adjust the image quality of selected screen using the Contrast 

、Brightness 

、Focus 

and Stig（X、Y） 

buttons.

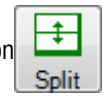
The Click center can be performed only on the current frame.
The SEI and REF images can be displayed side by side, if only the secondary electron detector is installed.
If the MIX display mode is activated while the system is in low vacuum and the BEIW is the only low vacuum detector, then three display windows will display the BEIW signals.

4.17.5 Split Live image

One view field can be split, and both live images can be displayed with different signals.

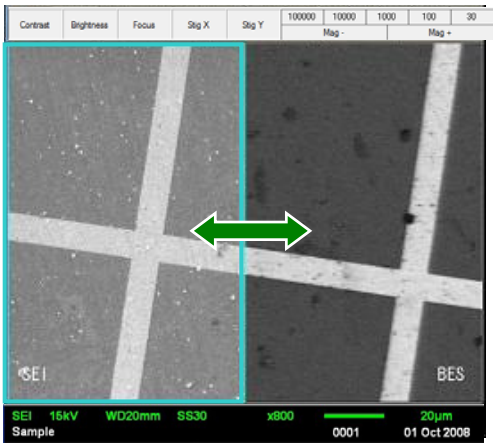
CAUTION !

The SnapShot function cannot be used.

1. Display a Live image.
2. Click the Split icon 

(UD) or 

(LR), or select the menu bar ***Screen*** ⇒ ***Split Live Image*** ⇒ ***UD*** or ***LR***.



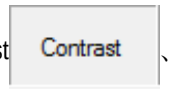
3. Change the frame, if necessary.

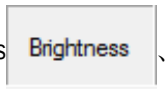
   To change the active frame, click the left mouse button  on the display to make it active.

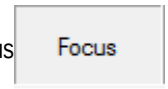
   A frame ratio of the main screen can be changed by dragging the frame.

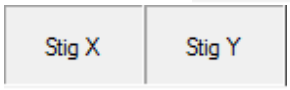
   Double-click the left mouse button on the border (when a pointer is an arrow) to return to its default.

4. Click the Signal 

of the Image Data Display.
5. Change a signal in the selected frame using the Signal window.
   If you tick the ***SS Link***, the Spotsize will remain the same when you switch detectors and the image shift will not occur.
6. Adjust the image quality of selected screen using the Contrast 

、Brightness 

、Focus 

and Stig（X、Y） 

buttons.

The Click center can be performed only on the current frame.

The SEI and REF images can be displayed side by side, if only the secondary electron detector is installed.

If the MIX display mode is activated while the system is in low vacuum and the BEIW is the only low vacuum detector, then three display windows will display the BEIW signals.

4.17.6 Flexible Window image

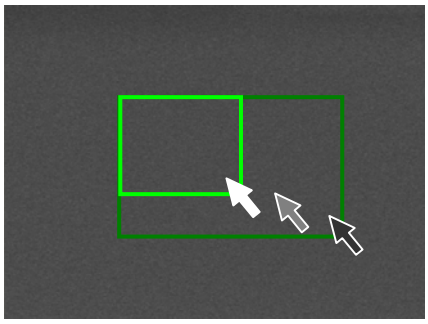
If you make any square area in the observation screen, the inside of this area can be displayed with a different signal.

1. Display a Live image
2. Click the Window icon 

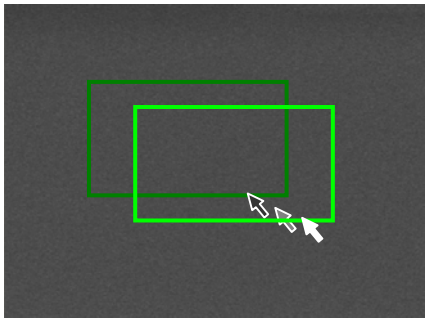
, or select the menu bar ***Screen*** ⇒ ***Flexible Window Image***.
3. The square frame will be displayed on the main screen.

4. Change the frame size or move the frame, if necessary.

   If you want to change the frame size, drag the left mouse button on the corner of the frame. Release the mouse button at the desired position.

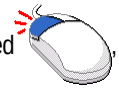


To move the frame (the rectangle area), drag the frame.



5. Click the Signal SEI of the image data display.
6. Change a signal in the selected frame by using the Signal window.

   If you tick the **SS Link**, the spotsize will remain the same when you switch detectors and the image shift will not occur.
7. Adjust the image quality of selected screen using the Contrast Contrast 、Brightness Brightness 、Focus Focus and Stig（X、Y） Stig X Stig Y buttons.

If the outside of a rectangular screen is left-clicked  , the current screen moves to outside.

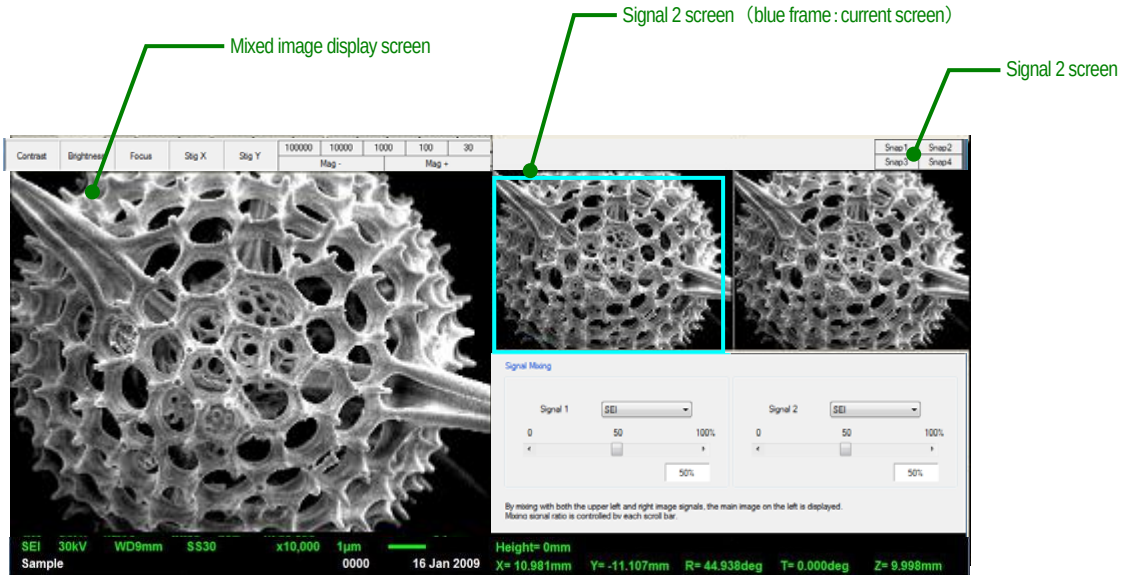
The Click center can be performed only on the current frame.
The SEI and REF images can be displayed side by side, if only the secondary electron detector is installed.
If the MIX display mode is activated while the system is in low vacuum and the BEIW is the only low vacuum detector, then three display windows will display the BEIW signals.

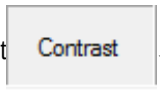
4.17.7 Mixed image

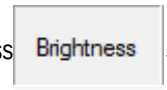
You can display an image by mixing any signals. Perform the following procedure.

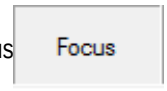
1. Display a Live image.
2. Click the Mix icon 

, or select the menu bar ***Screen*** ⇒ ***Signal Mix Image***.

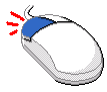


3. Switch the signal with Signal 1／2 combo box.
4. Adjust the image quality in the current screen using the Contrast 

、Brightness 

、Focus 

and Stig（X、Y） 

buttons.
5. To change the active frame, click the left mouse button 
on the screen to make it active.
6. Adjust the mixing ratio of Signal 1 and Signal 2 using the slide bar.
7. The (MIX) Live image mixed with Signal 1 and Signal 2 is displayed to with the adjusted mixing ratio.

If the MIX display mode is activated while the system is in low vacuum and the BEIW is the only low vacuum detector, then three display windows will display the BEIW signals.

4.17.8 Dual／Quad Split Screen Display

It can be convenient for comparison and observation of two or four different images because it can simultaneously display two or four image files on one display.

1. Click the Freeze icon 

.

2. Click the Dual icon 

or Quad icon 

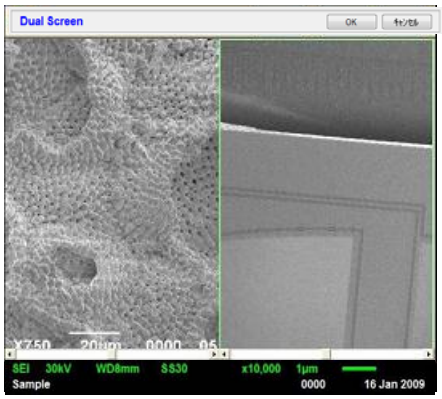
, or select the menu bar ***Image*** ⇒ ***Dual Screen／Quad Screen***.

   The Live image on the main screen becomes freeze image

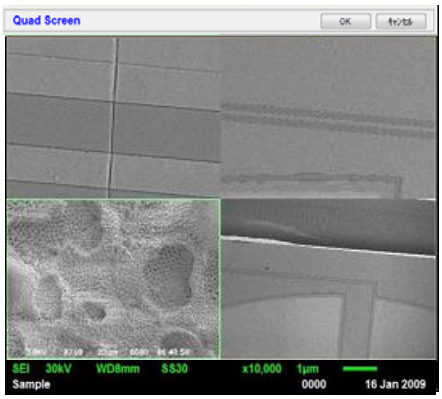
3. Select Image file from the dialog, and click the ***Open*** button.

4. Only the number of split screens performs the above operation.

   If you want to change the current image to a different image, double click on the image. Then, perform item 3 once again.



Dual screen



Quad screen

5. Click the ***OK*** button.

   A freeze image is obtained.

6. Click the ***Save*** button.

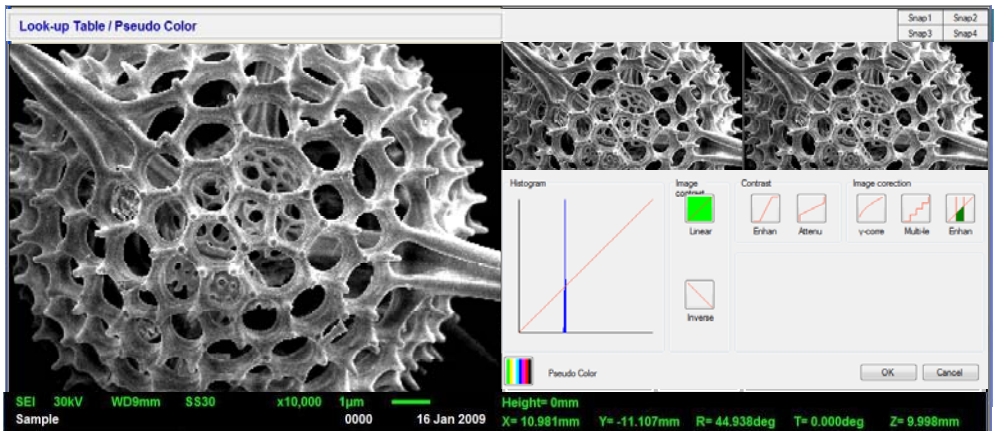
   The Save window opens, and the freeze image can be stored.

4.17.9 Adjusting the image brightness

1. Display the freeze image.
2. Click the LUT icon 

, select the menu bar **Image** ⇒ **Look-up Table / Pseudocolor**.
3. Click the brightness correction button and adjust the correction level by using the scroll bar.
4. Click the **OK** button.

   You can create a freeze image in which the brightness is corrected, and operation panel closes.



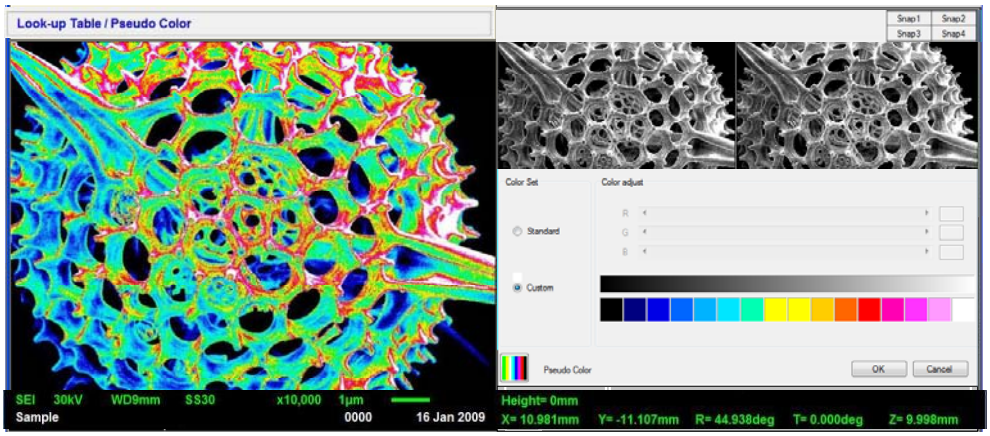
Item	Details	Explanation
Linear		Without correction
Brightness reversal		The brightness is reversed, and displayed.
Contrast enhancement		The contrast between the L-H levels is enhanced. Setting range: L level (0-254), H level (1-255)
Contrast reduction		The contrast between the L-H levels is reduced. Setting range: L level (0-254), H level (1-255)
Gamma correction		The brightness is corrected by the gamma curve and the corrected brightness is displayed. Setting range: 1-1.0, 1.1, 1.25, 1.5, 1.7, 2.0, 2.5, 3.0, 5.0, 10.0
Multi-valued processing		The brightness is displayed by the multi-valued processing. Setting range: 4, 8, 16, 32, 64, 128
Partial enhancement		Part of the image is enhanced by green and displayed. Green is allocated to the L-H levels, whereas monochrome is allocated to other regions. Setting range: L level (0-254), H level (1-255)

4.17.10 Displaying the image with color

By displaying the image with color, it is possible to more strongly show the structure which you want to emphasize.

1. Display the freeze image (click the Freeze icon.).
2. Click the LUT icon 

, or select the menu bar ***Image*** ⇒ ***Look-up Table/Pseudocolor***.
3. Click the Pseudocolor button 



4. Select the ***Standard*** or the ***Custom*** with the radio buttons.

   You cannot change the standard color.
   In the ***Custom***, you can create the colors of each color level by using the scroll bar to set the numerical value (1-255) of RGB.
5. Click the ***OK*** button.

   You can create a freeze image with the pseudo color, and the operation panel is closed.

* Color level: The colors, which are set as Levels 1-16, are allocated according to their brightness that is divided into 16 equal parts. The standard colors for each individual brightness range are shown in the table below.

Level	Brightness	Standard color
Level 1	1 – 15	Black
Level 2	16 – 31	Blue
Level 3	32 – 47	Green
Level 4	48 – 63	Cyan
Level 5	64 – 79	Red
Level 6	80 – 95	Magenta
Level 7	96 – 111	Yellow
Level 8	112 – 127	White
Level 9	128 – 143	Gray
Level 10	144 – 159	Bright blue
Level 11	160 – 175	Bright green
Level 12	176 – 191	Bright cyan
Level 13	192 – 207	Bright red
Level 14	208 – 223	Bright magenta
Level 15	224 – 239	Bright yellow
Level 16	240 – 255	Bright white

4.18 Recording Images

4.18.1 Automatic saving

Cautions !

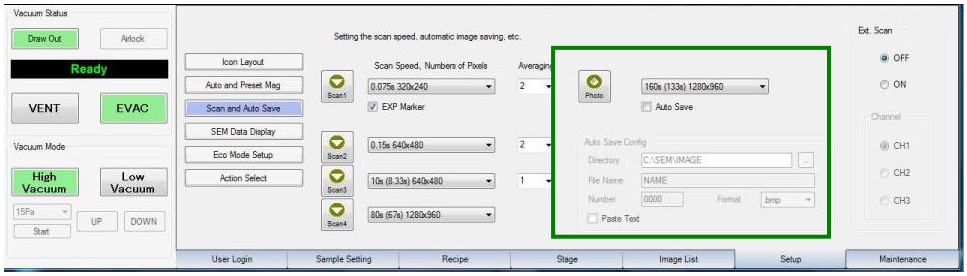
For the file that already exists in the saving location, do not change the extension of its filename when saving this file again with the same filename.

If you do this, the information on the instrument (*.TXT) is replaced and the previous information is erased. (At this time, the confirmation message, “Do you save a file by replacing the existing file?” does not appear. So, you have to be careful.)

To avoid this, specify a different saving location, or change the filename when saving the file.

1. Click the ***Setup*** in the Operation menu tab.
2. Click the ***Scan and Auto Save*** button.
3. Perform the following preparation.

- Selection of the scanning rate
- Tick the ***Auto Save*** check box
- Specify the saving location and others (selection of pasting data at the bottom of the image, setting a count start value, format)



Setting – Scan and Auto Save

4. Click the Photo icon 

. The selected image is saved automatically.

About file name

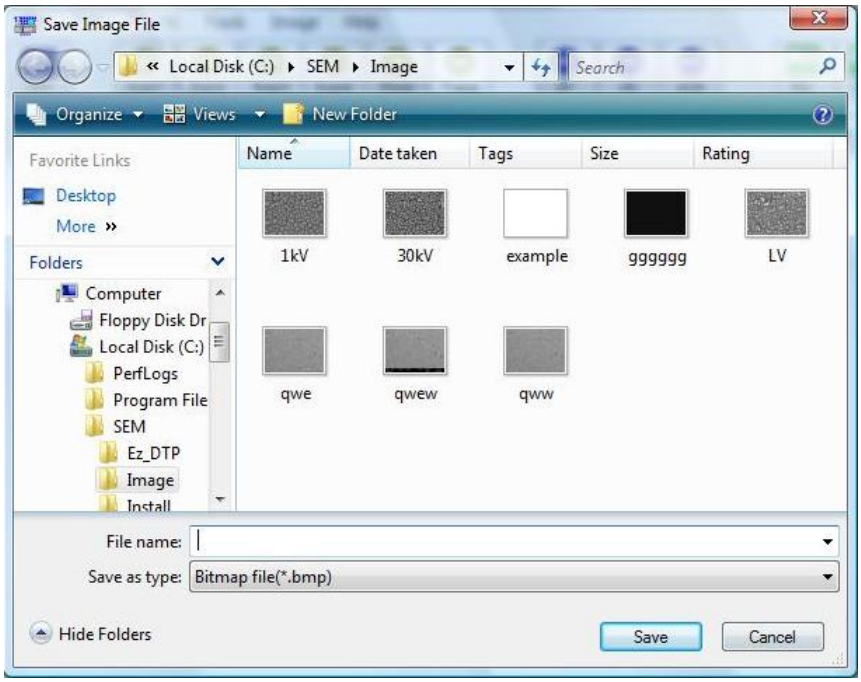
Images at each screen and Dual Freeze images are simultaneously saved.

File name: “ Ambient name” _ ”Signal name” _ ”Count” _Extension

4.18.2 Manual saving

1. Display a freeze image on the main screen.
2. Click the Save icon 

, or select the Menu bar ***File*** ⇒ ***Save Image File***.
3. Specify the saving location and enter the filename.



Save window

4. Click the ***Save*** button

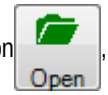
About the filename

The name of the image file is created as follows.

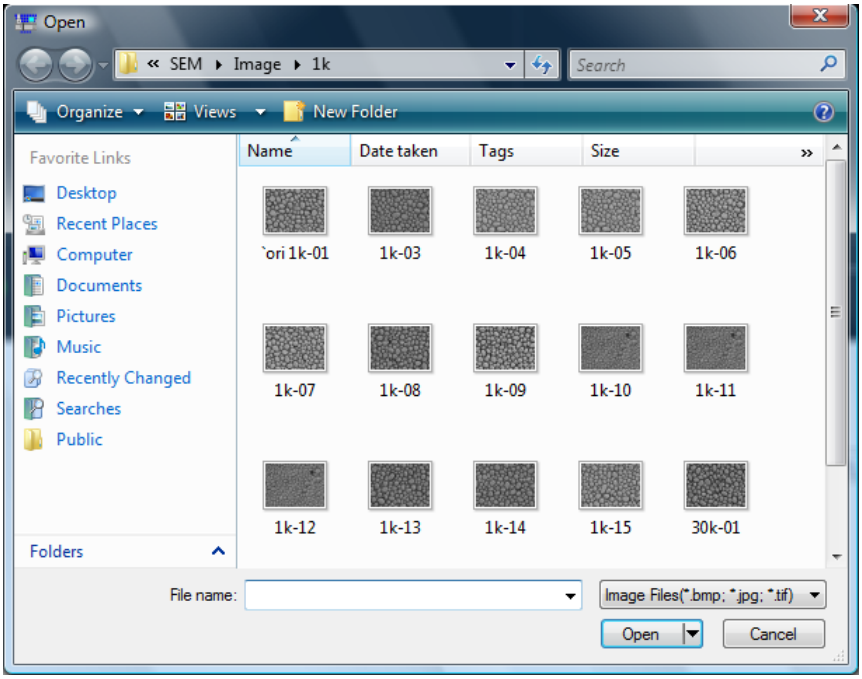
Filename: “Specified (entered) filename” _ “signal name”_ ”count” _Extension

Therefore, if you perform Save while SEM signals are multi-displayed, the system automatically saves all of the SEM images by distinguishing between signal names.

4.18.3 Open image file

1. Click the Open icon 

, or select the Menu bar ***File*** ⇒ ***Open Image File***.



Open Image File window

2. Select an image file to open and click the ***Open*** button.
3. The selected image file appears in the main screen and the window closes

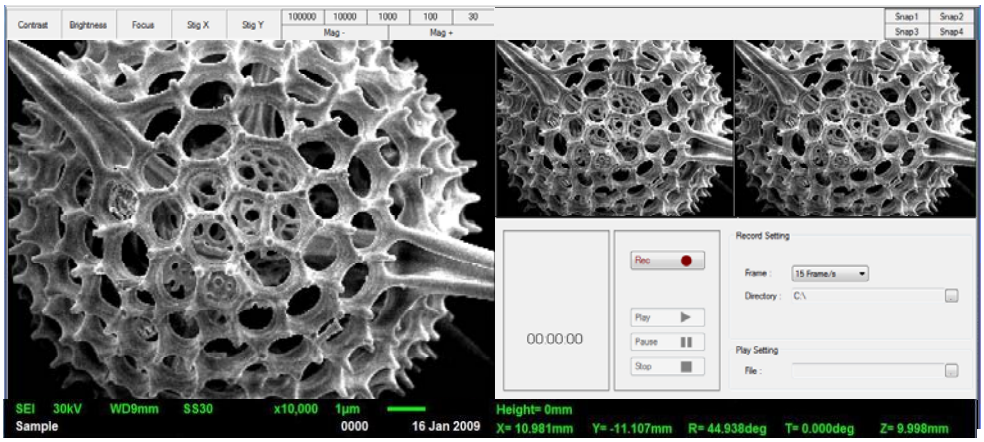
4.18.4 Recording a live image

Perform the following procedure to record and replay the image. Observation through the saved movie and the dynamic behavior of the specimen can be possible. However, please note the followings.

- The recording image size is only 640×480 (Pixel).
- Can not change the screen display while recording the image
- Can not adjust the image quality while replaying or pausing

1. Display a live image.
2. Click the Movie icon 

, or select the menu bar ***File*** ⇒ ***Movie***.
3. Set the frame rate and specify the saving folder (Directory).



Items		Explanation
Rec.		A live image （640×480 dots, single screen） displayed on the main screen is recorded. ＊ A message (Recording…) and a time of recording (00:00:00) are displayed.
Play		Select a live image file, and replay ＊ A message (Playing…) and a time of playing (00:00:00) are displayed.
Pause		Stop replay at one time ＊ A message (Pause…) and a time of stopping (00:00:00) are displayed.
Stop		Stop live image recording, and save it to the specified folder.
Record Settings	Frame	Set the number of the frames per one second. ＊ 30, 15 （default）, 10 frame/second
	Directory	Specify the directory for saving a live image.
Play Settings	File	Specify the file you want to play.

4. Click the Record button 

.

The recording time is not restricted (depending on a recording media), and a message and recording time are displayed during recording.

About saving of a file

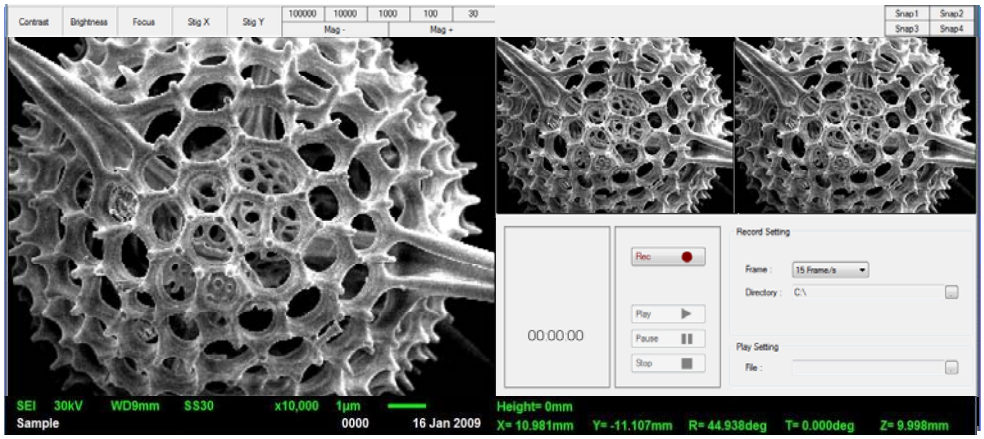
- Whenever you start recording, a folder is created as follows, and a file is saved there.
  Example:
  When you start recording at 10:00:00 on mm dd, yyyy, a folder "**yyyy.mm.dd_100000**" is created.
- A filename is **Mov00000.avi** (AVI file). (*00000 are the count value and the counting goes up every one step: 00000-99999)
- Since the file size of the movie is restricted at 2GB, if the storage capacity reaches 2 GB, the movie is saved automatically in the file. Further if the storage capacity reaches 2 GB at the number of times to count filenames 99999, recording finishes automatically.
- The recording file name is automatically specified with the count-up new file.

4.18.5 Playing a recorded live image

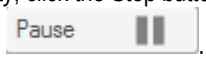
1. Click the Movie icon 

, or select the menu bar ***File*** ⇒ ***Movie***.
2. Select a play file from the Play setting (File).
3. Click the Play button 

.



4. When you want to stop a play, click the Stop button 

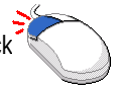
, whereas when you want to pause a play, click the Pause button 

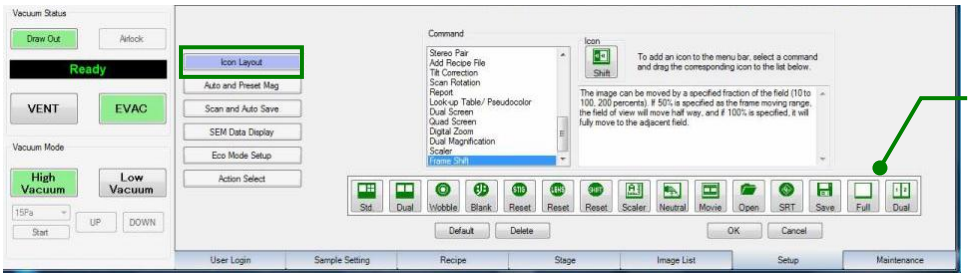
.
5. To replay again after clicking the Pause button, click the Pause button again.

4.19 User Settings

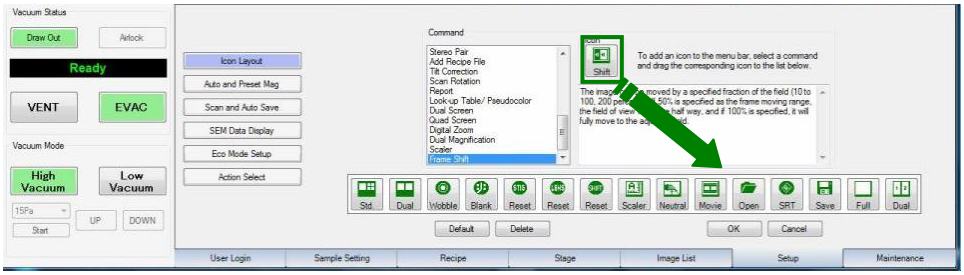
4.19.1 Icon Layout

4.19.1.a Changing the icon layout

1. Click the ***Setup*** in the Operation menu tab.
2. Click  the ***Icon Layout*** button.

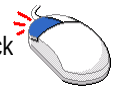


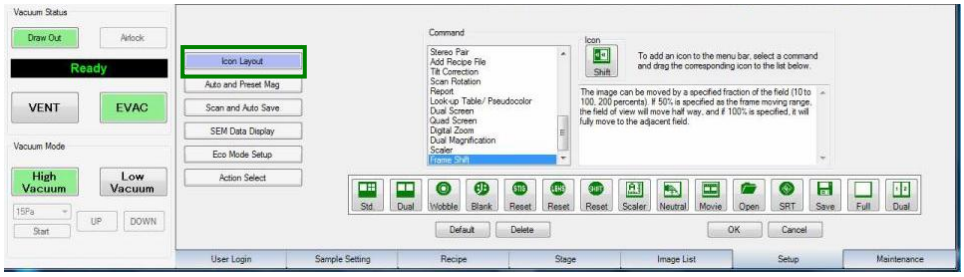
3. Select an icon, and drag and drop it between icons in the Icon Layout.



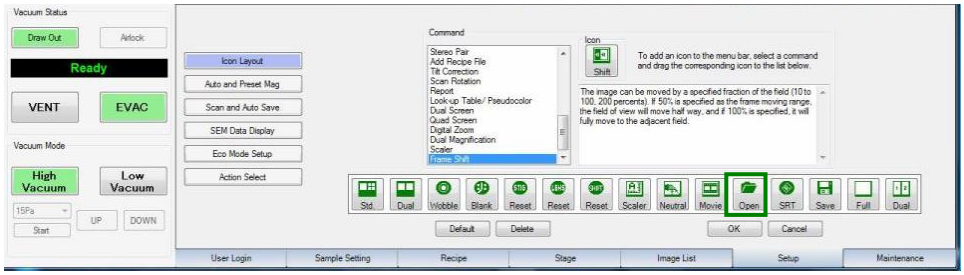
4. Repeat the above operation. After the desired layout is achieved, click the ***OK*** button.

4.19.1.b Replacing icons

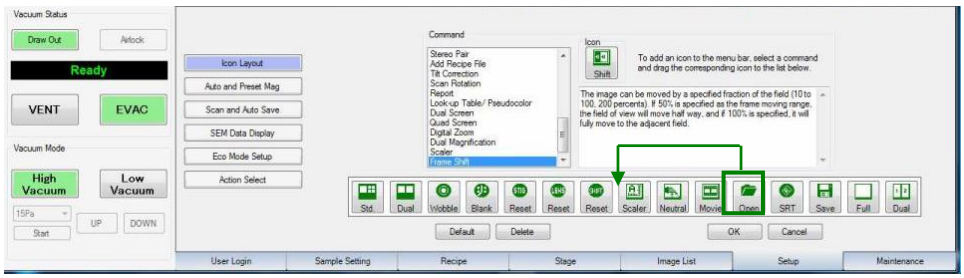
1. Click the ***Setup*** in the Operation menu tab.
2. Click  the ***Icon Layout*** button.



3. Click the icon you want to replace. (The selecting frame is highlighted).



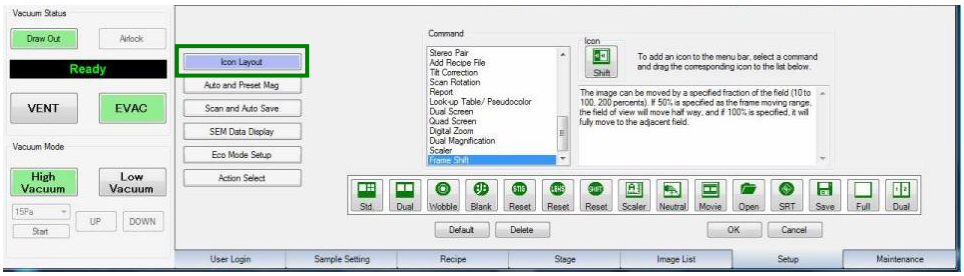
4. Drag the selected icon and drop it between icons.
   The icon layout will be changed.



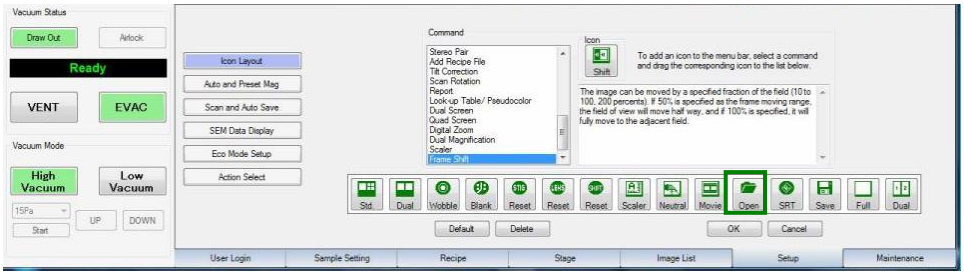
5. After the desired layout is achieved, click the ***OK*** button.

4.19.1.c Deleting the arranged icon position

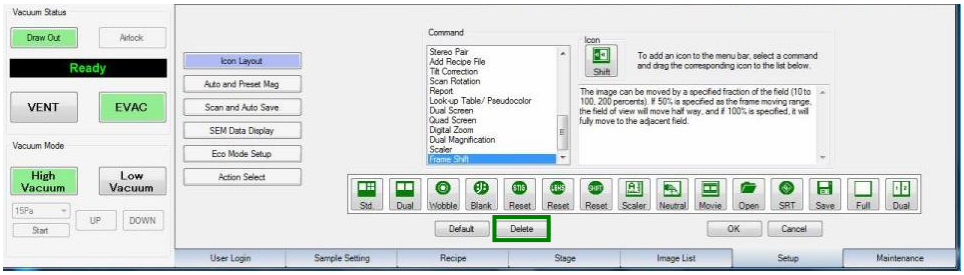
1. Click the ***Setup*** in the Operation menu tab.
2. Click  the ***Icon Layout*** button.



3. Click the icon you want to delete. (The selecting frame is highlighted)



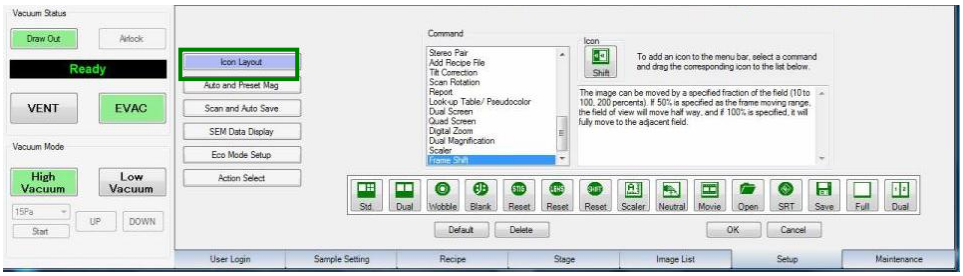
4. Click the ***Delete*** button.
   Then, the icon you selected will be deleted from the layout.



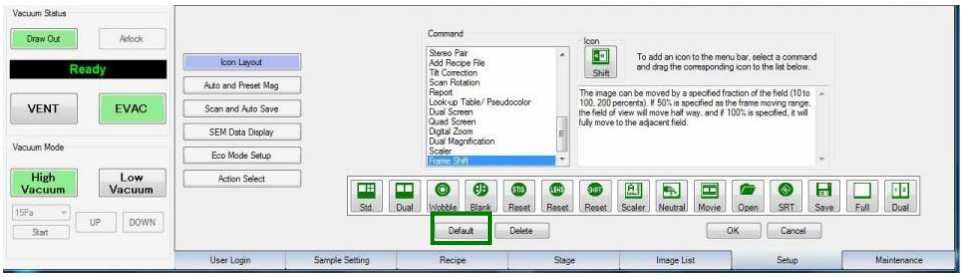
5. After the desired layout is achieved, click the ***OK*** button.

4.19.1.d Default icon

1. Click the ***Setup*** in the Operation menu tab.
2. Click  the ***Icon Layout*** button.

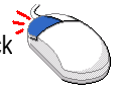


3. Click the ***Default*** button to get the default icon layout.

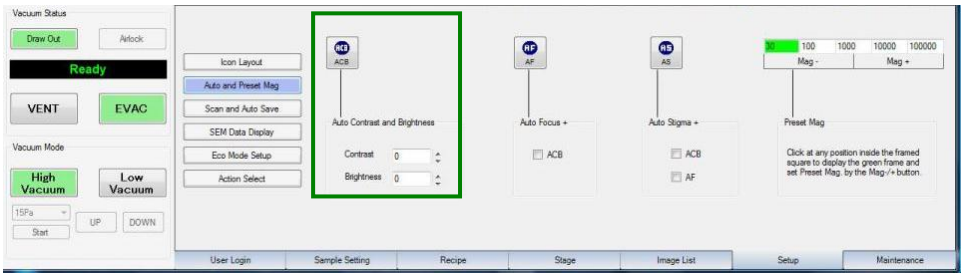


4.19.2 Auto and Preset Mag. Setting

Auto-correction levels can be changed. To set the Preset Mag., refer to 4.9.4_ Using the Preset magnification

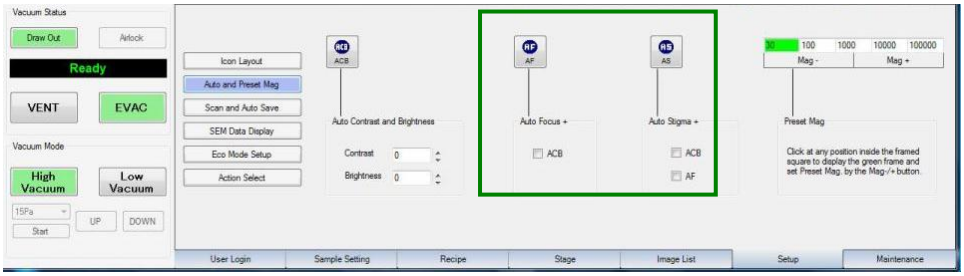
1. Click the ***Setup*** in the Operation menu tab.
2. Click  the ***Auto and Preset Mag.*** button.
3. Adjust the correction level of the Auto contrast and brightness.

   Adjust the correction level (±4) in the combo box.



4. A link of auto-functions can be set.
   Perform the setting of a link of auto-functions by referring the table below.

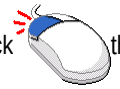
   ACB : Automatic contrast-brightness control
   AF : Automatic focusing
   AS : Automatic astigmatism correction

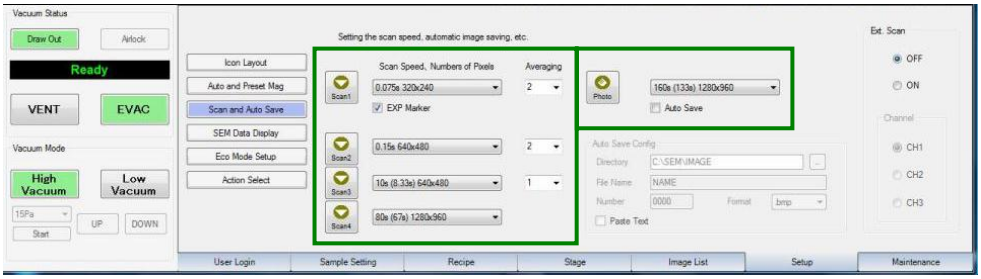


	Check items	Operation description
Auto focus +	ACB	Can be performed with AF+ ACB when AF is started.
Auto stigma +	ACB	Can be performed with AS + ACB when AS is started.
	AF	Can be performed with AS + AF when AS is started.
	ACB and AF	Can be performed with AS + ACB + AF when AS is started.

4.19.3 Scan Speed Setting

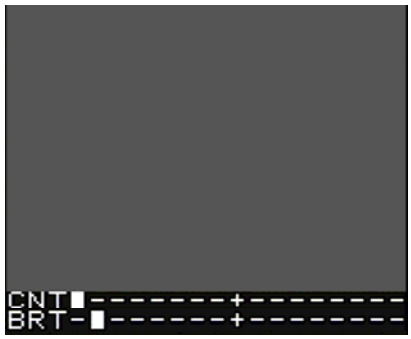
The averaging coefficient and scan rate / number of pixel can be set for each scan.
("Ext Scan" is effective when an optional ESIF is installed.)

1. Click the ***Setup*** of the operation menu tab.
2. Click  the ***Scan and Auto Save*** button.
3. Set the scan rate and averaging coefficient in the combo box of each scan.



Scan 1 – Exposure marker

You can select the averaging coefficient and scan rate.
When you check the EXP marker, an exposure marker appears, and the cursor position moves according to the contrast (CNT) and brightness (BRT). When the cursor is almost at the center of the screen, the image contrast and brightness become optimum. The relation differs a little depending on the sample.



Exposure marker

Photo – Auto save

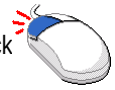
Tick the ***Auto Save*** check box to save the current live image automatically when the Photo button 

is clicked.

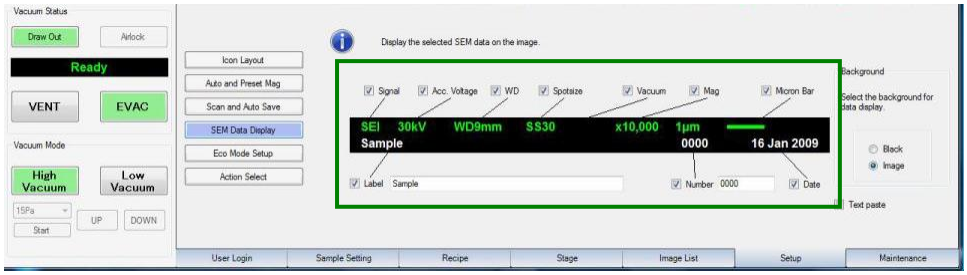
The image gets slightly darker until the averaging coefficient (setting range: 1 - 255) reaches to the set values, and this phenomena is not a malfunction. Furthermore, in Scan 2 and Scan 3, this phenomenon appears remarkable as the scan takes longer. Please note this.

4.19.4 Turning ON/OFF of SEM Data Display

SEM data display can be turned ON／OFF, and the data background can be changed.

1. Click the ***Setup*** of the operation menu tab.
2. Click  the ***SEM Data Display*** button.
3. Data display

   Check the item of which data will be displayed. To turn OFF the data display, uncheck the item.



Number：0000 - 9999、Tick the Number check box to increase the count number by one step when saving the image automatically.

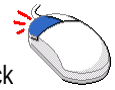
4. Background

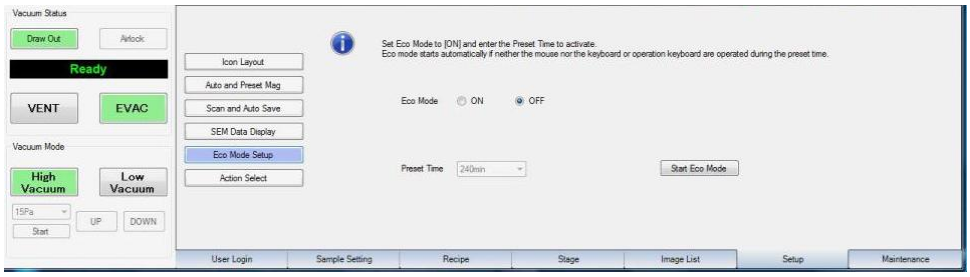
   If ***Black*** is selected, the data background will be black. If ***Image*** is selected, the data background will be an image.

Text paste： When you tick the Text paste check box, the SEM data and the text which you write on the image can be displayed.

4.19.5 Eco Mode Setting

If the operation such as computer operation is interrupted for a certain period of time, the operation mode can be changed automatically to the Eco (energy saving) Mode.

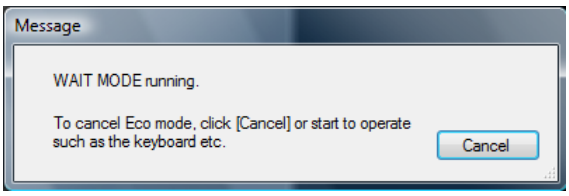
1. Click the ***Setup*** in the Operation menu tab.
2. Click  the ***Eco Mode Setup*** button.



3. Select ***ON*** of the eco Mode.
4. Enter the Preset Time (default : 240 minutes), and click the ***Start Eco Mode*** button.

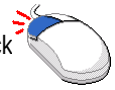
   Eco mode starts automatically if neither the mouse nor the keyboard or operation keyboard are operated during the preset time.

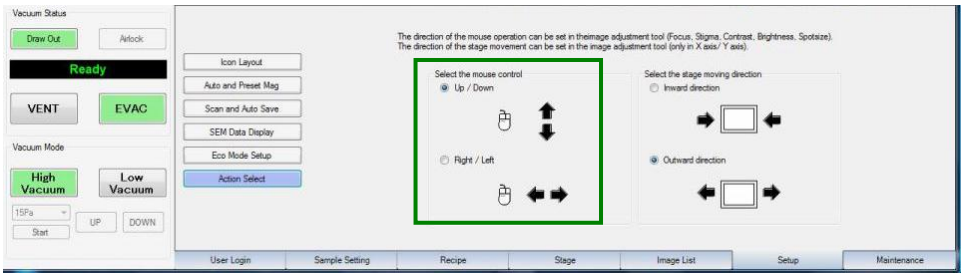
To cancel the Eco mode, click the ***Cancel*** button or start to operate such as the keyboard etc.



4.19.6 Selecting the mouse control

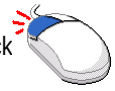
The direction of the mouse operation can be set in the image adjustment button (Focus, Stigma, Contrast, Brightness, Spot Size)

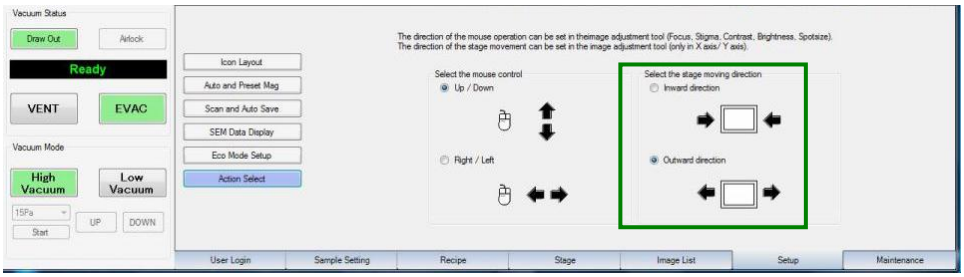
1. Click the ***Setup*** in the Operation menu tab.
2. Click  the ***Action Select*** button.
3. Select either ***Up/Down*** or ***Right/Left***.



4.19.7 Selecting the stage moving direction

The direction of the motorized stage movement can be set (only in X axis/ Y axis).

1. Click the ***Setup*** of the operation menu tab.
2. Click  the ***Action Select*** button.
3. Select either ***Inward direction*** or ***Outward direction***.

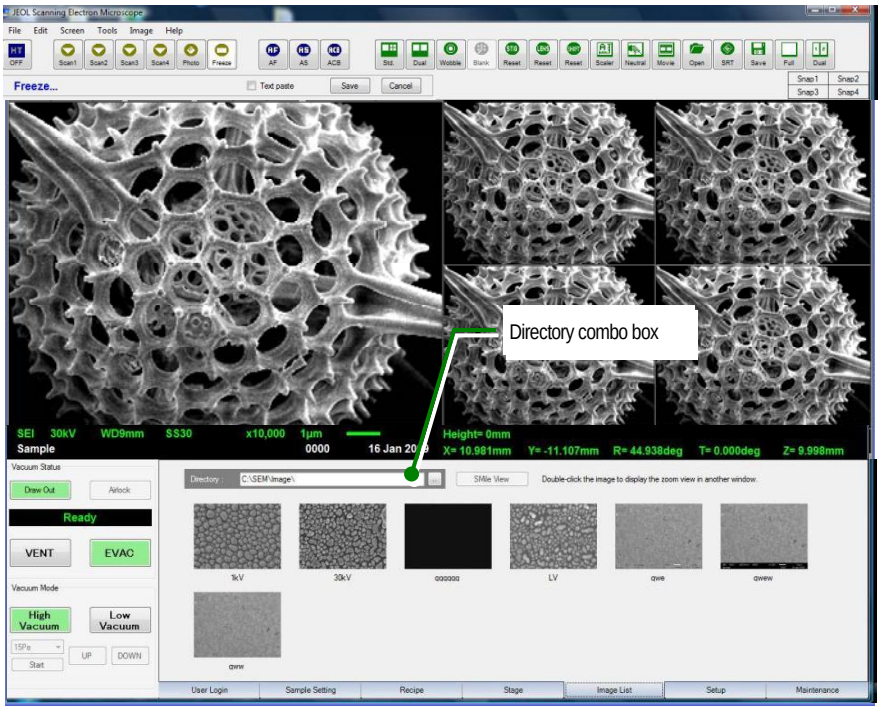


4.20 Image List

The ***Image List*** can display the stored image with a thumbnail, and renaming and deleting the file are possible. Also, by starting the SmileView (option), the report can easily create by drag &. drop.

4.20.1 Open Image File

1. Click the ***Image list*** in the Operation menu tab.



2. Select a folder which includes the target file from the directory combo box.
3. Double-click the left mouse button on the thumbnail.
4. Double-click the image to display the zoom view in another window.

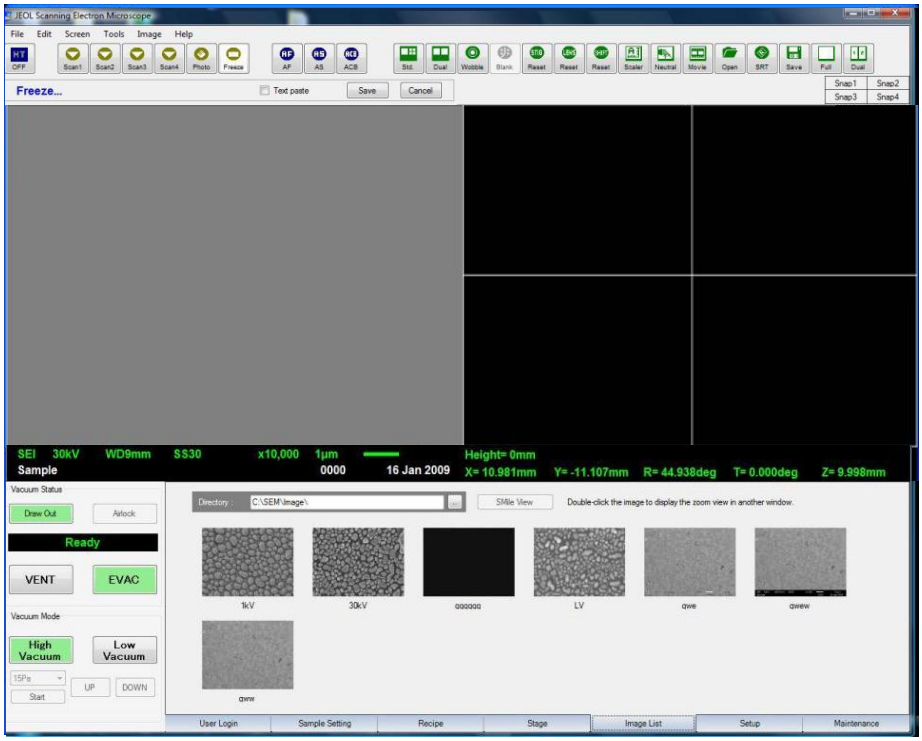
   When you dragged in another window with the left mouse button, the window size can be changed.
   The switch button is displayed in another window as follows.

   Original size button : The image is displayed with the pixels of image file.
   It is possible to change the display position.

   Window size button : The image size is matched to the window.

4.20.2 Past an image on the main screen or snap shot screen

1. Click the ***Image list*** of the Operation menu tab.

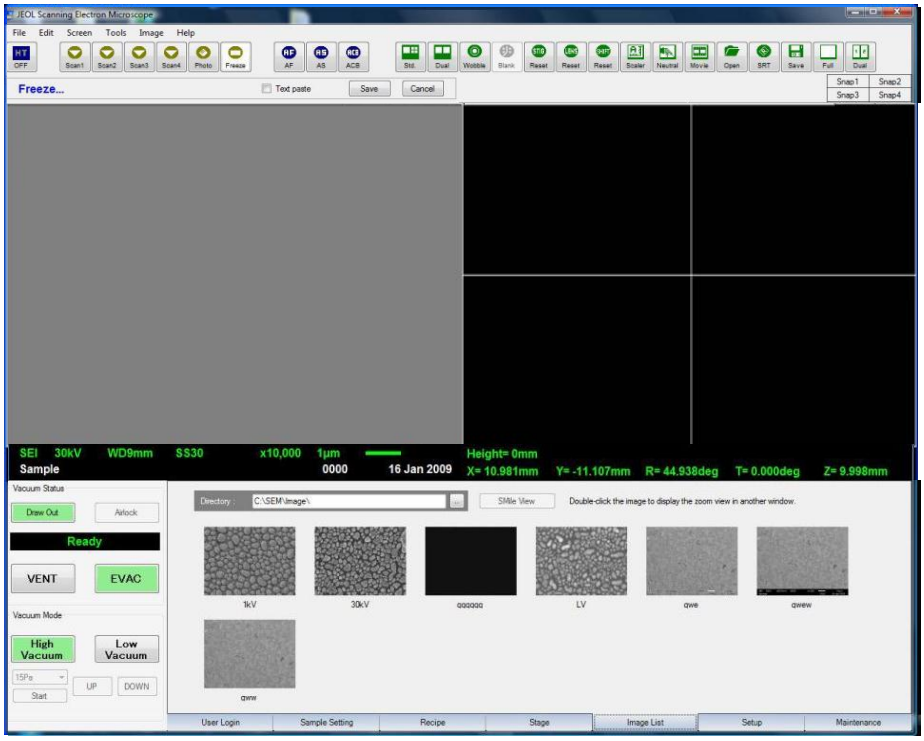


2. Select a folder that includes the target file from the directory combo box.
3. Drag and drop a thumbnail to the main screen or snap shot screen.
4. A thumbnail is pasted onto the main screen or snap shot screen.

4.20.3 Move the stage to the stored image position

The motorized stage is necessary.

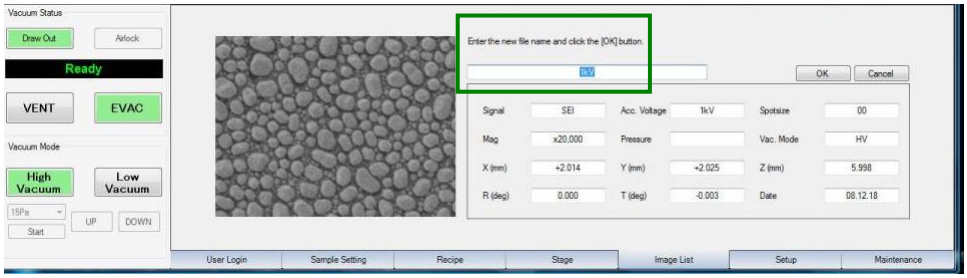
1. Click the Image list in the Operation menu tab.



2. Select a folder that includes the target file from the directory combo box.
3. Click the right mouse button on the image (thumbnail) which you want to reproduce the stage position, and select **Move the Stage** from the pop-up menu.
4. The stage is moved and the position is reproduced.

4.20.4 Rename a file

1. Click the ***Image list*** of the operation menu tab.
2. Select a folder that includes the target file from the directory combo box.
3. Click the right mouse button on the image (thumbnail) that you want to rename, select ***Rename File Name*** from the pop-up menu.
4. The operation navigation screen is changed as shown below.

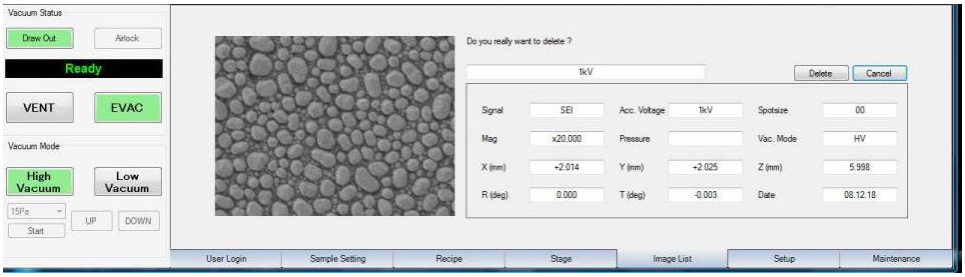


5. Enter a new file name.
6. Click ***OK*** button.

   The image file name is changed and returns to the Image list window.

4.20.5 Deleting an image file

1. Click the ***Image list*** in the Operation menu tab.
2. Select a folder that includes the target file from the directory combo box.
3. Click the right mouse button on the image (thumbnail) that you want to delete, select ***Delete*** from the pop-up menu.
4. The operation navigation screen is changed as shown below.



5. Click the ***Delete*** button.

   The image file is deleted and returns to the Image list window.

4.21 Report Creation

4.21.1 Report Creation by using the DTP software

1. Display the freeze image on the main screen.
2. Click the Report icon, or select the menu bar **File** ⇒ **Report**.

   The DTP program starts and the DTP window is displayed

3. Select a format

   Click one of  , or select the menu bar **File** ⇒ **New** ⇒ **Format 1／2／3／4／5**.

Format	Explanation
1	One image is printed within a sheet of A4 size/letter. SEM information included. A title and comment can be entered, and a logo (.bmp image) can be pasted. The image size is 128.0mm × 96.0mm The printing direction is vertical
2	Two images are printed within a sheet of A4 size/letter paper. SEM information included. A title and comment can be entered, and a logo (.bmp image) can be pasted. The image size is 128.0mm × 96.0mm The printing direction is vertical
3	One image is printed within a sheet of A4 size/letter paper. SEM information included. A title and comment can be entered, and a logo (.bmp image) can be pasted. The image size is 208.0mm × 156mm The printing direction is horizontal
4	One image is printed within a sheet of A4 size/letter paper. The image size is 208.0mm × 156.0mm The printing direction is horizontal
5	Four images are printed within a sheet of A4 size/letter paper. The image size is120.0mm × 90.0mm The printing direction is horizontal

Details of format

4. Paste a image on the format.

   a. Click one of  , or select the menu bar ***File*** ⇒ ***Open Image File***.

   b. Select the target file from the folder, and click the ***Open*** button.

   c. An image is pasted and the observation conditions are written beside the image.

   d. Repeat operation a. and b. by the selected format.

5. Enter the title or the comment to the format.

   Enter the title or the comment directly into the format.
   If the SEM data check box is ticked, the SEM data can be printed.

If a new report is prepared using each time the same title, comment, name and logo, proceed as follows because they can be recorded.

Save title, date, name

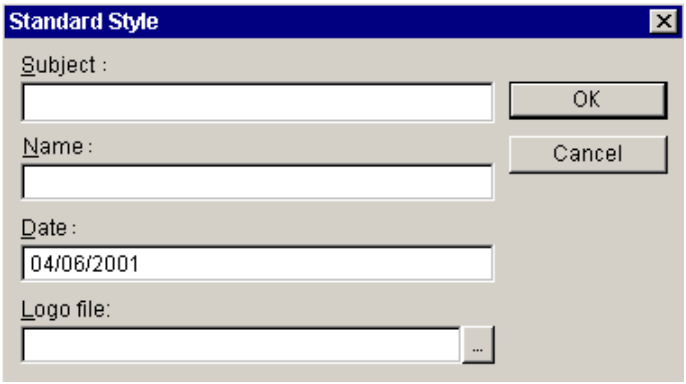
a. Select the menu bar **Setup** ⇒ **Standard Style** in the DTP window.
b. The Standard Style window opens.
c. Click Title, Date and Name, and then enter them.
d. Click **OK** button.

Save logo

a. Create a logo. (For details, refer to the manual of logo creation.)
b. Enter the file name directly in to Logo file, and click the **OK** button.

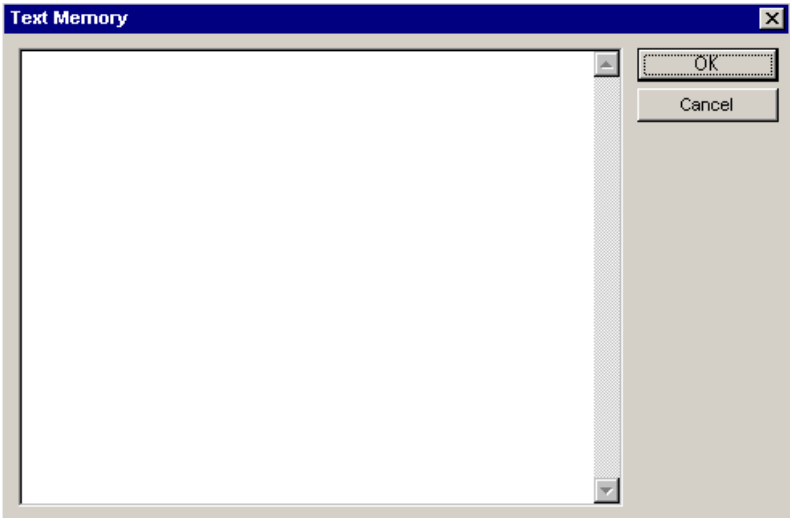
Other method : Click ... button and select a file.

Select menu bar **File** ⇒ **Logo File Open** and Select a file.
Then click the **OK** button.



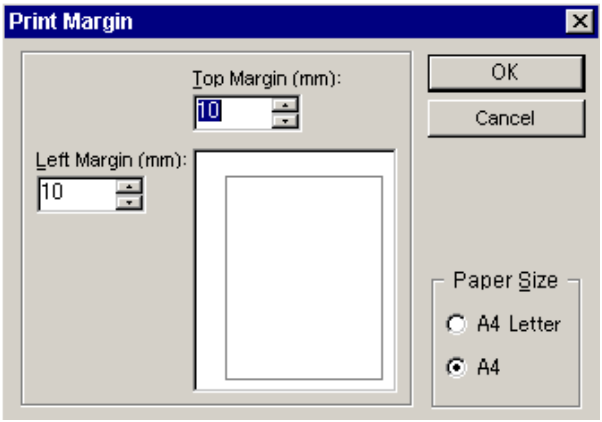
Save comment

a. Select the menu bar ***Setup*** ⇒ ***Text Memory*** in the DTP window.
b. The Text Memory window opens.
c. Click an area and click the OK button after entering a comment.
d. The comment is recorded.



6. Set the print margin

a. Setup the printer to print. (Refer to the printer manual for more information)
b. Set the print margin
c. Select menu bar ***File*** ⇒ ***Print Margin*** in the DTP window.
d. Select a Paper Size (A4 Letter or A4).
e. Enter the margin value (0～60) and click the ***OK*** button.



7. Print the format.

   a. Check the printing range on the print preview.
   b. Selct ***File*** ⇒ ***Print Preview*** in the DTP window, and the preview screen opens.
   c. Click the Print button in the preview screen.
   d. Or, click the OK button after selecting the menu bar ***File*** ⇒ ***Print*** in the DTP window

CAUTION

- When a Mitsubishi digital color printer (CP770D or other) is used, set the print margins at both left and top to 0 mm and the paper expansion factor in the property of the print window to 50% or less. Otherwise, the format will be printed off the paper.
- The printing range varies with the type of printer.
- If the printer is changed, set it so that the print margin fits the printer.
- Printout may differ from that checked on the screen and the actual one may not fit within the paper size.

8. Save the format.

   Click the save icon  , or select menu bar ***File*** ⇒ ***Save As***

   Select a driver and folders, enter a file name, then click the Save button. The format is saved as a DTP file.

9. Open the DTP file.

   Click the Report icon, or select menu bar ***File*** ⇒ ***Report***.

   Click the open image file icon  , or select menu bar ***File*** ⇒ ***Open***.

   Select the DTP file and click the ***Open*** button.

10. Exit DTP

    Select the menu bar ***File*** ⇒ ***Exit DTP***.
    If there is any DTP file that is not saved, the message dialog will appear.

Yes	The file saving dialog appears.
No	DTP program ends and the DTP window closes.
Cancel	Close the message dialog.

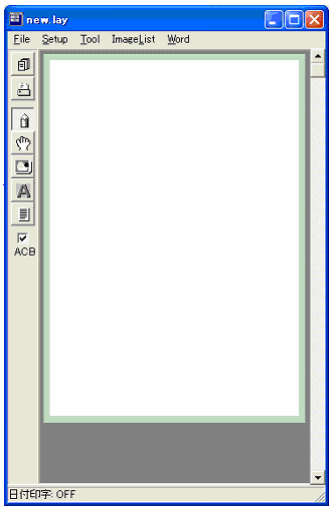
4.21.2 SMile View (option)

The report enables you to output the image saved beforehand by a fixed display format. You can easily paste the image in the image file to the layout sheet (fixed format) created beforehand, only by dragging the image to the layout sheet with the mouse. Moreover, you can also display the observation conditions (magnification etc.) of the pasted image. An optional Smile View is necessary.

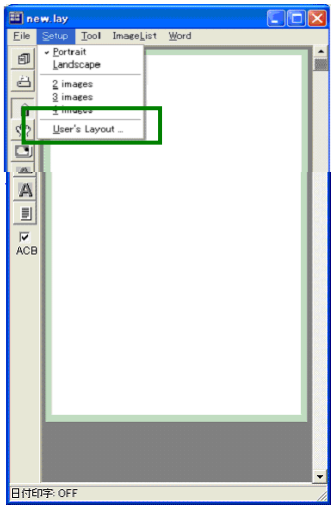
1. Click the ***Image list*** of the Operation menu tab.
2. Click the ***SMile View*** button.

   Or, click the SMV icon or selecting menu bar ***File*** ⇒ ***SMile View***.

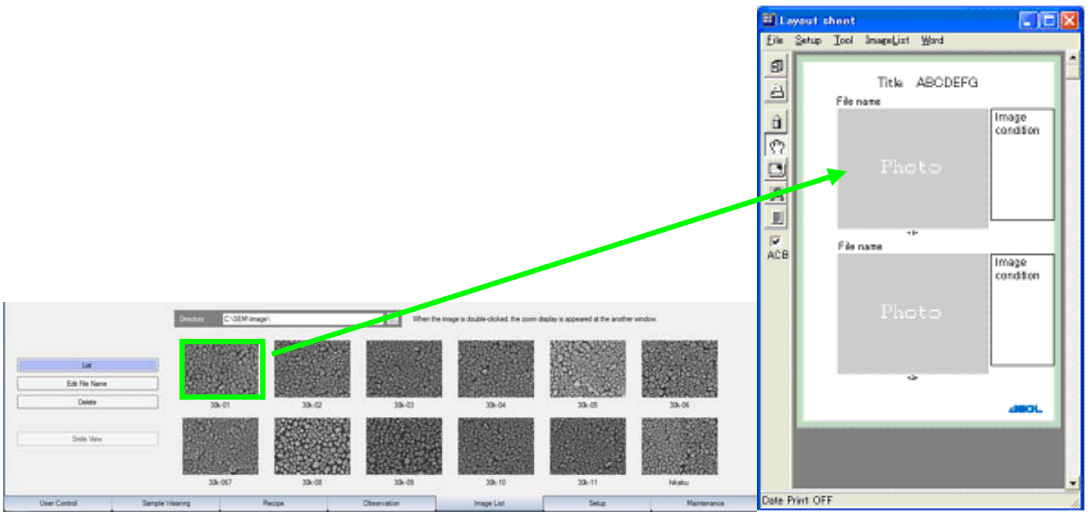
3. The layout sheet (fixed format) for the SMile View™ opens.



4. Select ***Setup*** ⇒ ***User's Layout*** from the menu bar on the layout sheet, and then select the layout to use.



5. Drag and drop an image to the layout sheet from an image file.



6. An image is pasted and the observation conditions are written beside the image.

7. Print or save a report.

Printing

Select ***File*** ⇒ ***Print*** from the menu bar on the layout sheet, and then click the ***Print*** button in the print window. A report (image + observation conditions) is printed.

Saving

You can select one of the following formats to save.

Layout File (*.lay)

Rewriting is possible again on a report.

JPEG (90dpi for Web) File (*.jpg)

This file saves the whole image in the JPEG format with the image quality equivalent to 90 dpi.

BMP (90dpi) (*.bmp)

This file saves the whole image in the bitmap format with the image quality equivalent to 90 dpi.

4.22 Backing up／Installing a user file

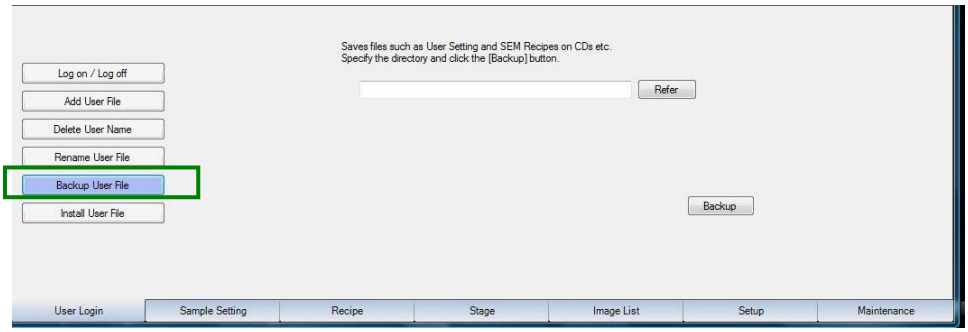
This instrument is compatible with multi-users. The SEM operating conditions for each user are managed using user files and are usually saved on the hard disk in the computer.

The saved file contains the SEM conditions when the user logged out , the custom recipe files created by the user and stage files.

These files can be backed up on a media (CD-ROM, etc.), in a batch, so that if the file on the hard disk is damaged or erased, the back-up disk can be used to install the file.

4.22.1 Backing up a user file

1. Click the ***User Login*** in the Operation menu tab.
2. Click the ***Backup User File*** button.
3. Insert the media in the computer. Select of the media of the place of the backup and a directory, then click the ***Backup*** button.



Backup User File

4.22.2 Installing a user file

1. Click the ***User Login*** in the Operation menu tab.
2. Click the ***Install User File*** button.
3. Insert the backup media in the computer. Select a directory, and click the ***Install*** button.

Install User File

4.23 Daily Maintenance

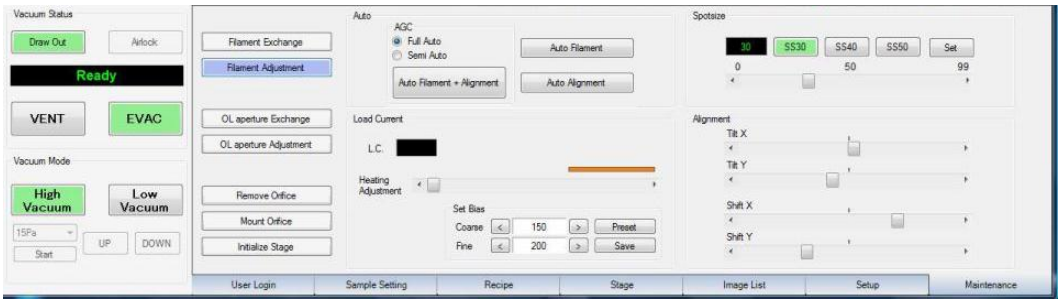
4.23.1 Gun Alignment

CAUTION !

In the following conditions, the vacuum in the electron gun chamber might deteriorate and become unstable.

- When you have set the acceleration voltage to 15 kV or more.
- When you have dragged the filament heating button to the right (increased the L.C value)
- Just after maintenance (such as filament change and Wehnelt cleaning)
- When the room temperature exceeds 25 ℃ or more.

1. After mounting the specimen, evacuate the specimen chamber （refer to Section 4.3.2）
2. Click the ***Maintenance*** in the Operation menu tab.
3. Click the ***Filament Adjustment*** button.



Maintenance – Adjusting a filament

4.23.1.a Auto Gun Alignment

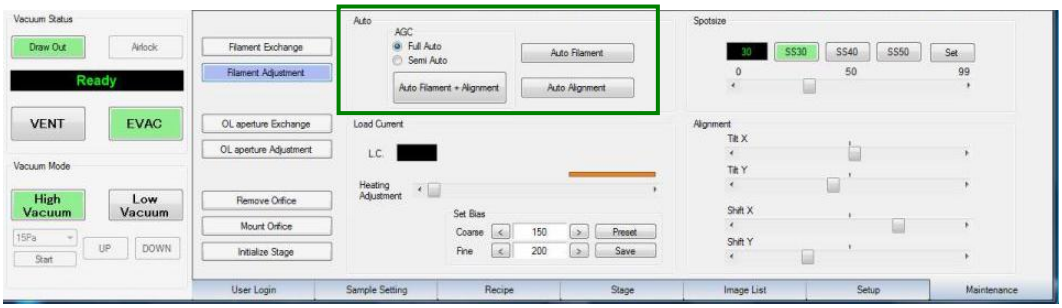
By using this function, the filament heat and the alignment-Tilt and Shift will be adjusted automatically.
There are combinations as shown below. After the action is completed, the accelerating voltage is restored to the original value.
When the present accelerating voltage is below 5kV, automatic adjustment is carried out at 5kV.
And, after the action is completed, the accelerating voltage is restored to the original value.

CAUTION !

Cannot use the auto gun alignment function when you select LaB6 in the filament mode. (When an optional LAB6 UNIT is installed)

	Auto Filament + Alignment	**Auto Alignment**	**Auto Filament**
Full Auto	The filament heating and filament alignment (Tilt and Shift) will be adjusted automatically after setting the accelerating voltage to 30kV.		
Semi Auto	The filament heating and filament alignment (Tilt and Shift) will be adjusted automatically at the current accelerating voltage.	The filament alignment (Tilt and Shift) will be adjusted automatically at the current accelerating voltage.	The filament heating will be adjusted automatically at the current accelerating voltage.

1. Select ***Full Auto*** or ***Semi Auto***.
2. Click the ***Auto Filament + Alignment***, ***Auto Alignment***, ***or Auto Filament*** button.



3. When the auto gun alignment function is completed, the accelerating voltage is restored to an original value.

4.23.1.b Manual Gun Alignment

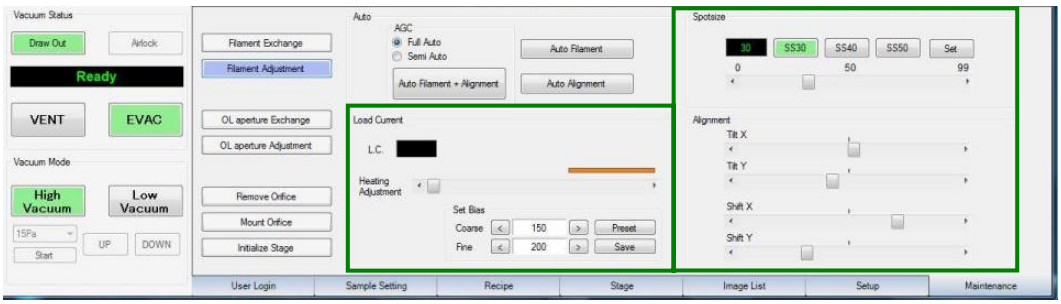
When you want to change the spotsize to observe the image, perform the manual operation. Probably, manual operation will be required in following cases.

- The Spotsize (SS) is increased for X-ray analyzing
- The Spotsize (SS) is increased for observing the image in LV mode.
- The Spotsize (SS) is decreased for obtaining the sharp image.

1. Mount one of the samples below, and evacuate the specimen chamber.
   - The conductive sample which the damage by the electron beam is ignored.
   - Specimen holder
   - Specimen stab
2. Click **Maintenance** in the operation menu tab.
3. Click the **Filament Adjustment** button.
4. Set the desired accelerating voltage, and click HT icon 

to get HT ON 

.
5. Set the filament slide bar to the front of the orange colored area.
6. Set the Spotsize (SS) to **30**, and adjust the alignment adjustment－Tilt / Shift X and Y slide bars so that the image becomes as bright as possible.
7. Move the filament slide bar to the left edge once.
8. When you slowly drag the slide bar to the right, the image becomes bright a moment in the vicinity of the slide bar center.（The first peak）
9. Further drag the slide bar to the right to display an image, and the load current (L.C) gets stabilized. And the image brightness will not change any more from a certain position onward. (The second peak: saturation point)
10. Set the filament slide bar to just the left of the saturation point.



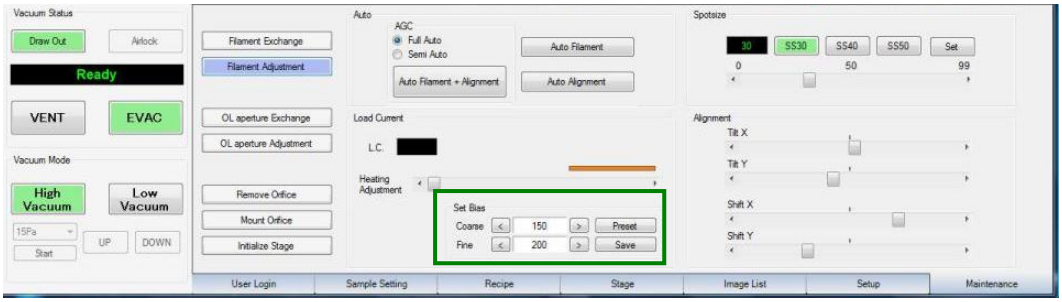
CAUTION !

If you set the slide bar to the right of the saturation point (into orange-colored area), an over-current will occur, causing the life of the filament to be reduced.

11. Adjust the L.C （Load Current） value.

    Adjust the L.C value depending on the accelerating voltage.

Acc.V（kV）	L.C(μA)
30, 25, 20, 15	Approx. 85
10	Approx. 90
5	Approx. 140
3.0	Approx. 120
2.5	Approx. 110
2.0	Approx. 100
1.5	Approx. 80
1.0	Approx. 70



Bias Adjustment

12. Find the target object on the image, and set the magnification to ×10,000. Then adjust the image focus.

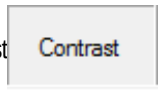
13. Click the Wobble icon 

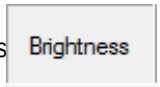
, or select the menu bar **Tools** ⇒ **OL Wobbler**.

14. Adjust the X and Y knobs of the movable aperture so that the image movement becomes minimum (does not move up and down, left and right).

When you want to change greatly the Spotsize (SS), continue to perform the adjustment after the Step 15.

15. Increase the Spotsize (SS) slowly from **30** and set it to**90**.

    While you Increase the spot size SS (for example,···near SS60), if the image disappears, adjust the slide bars of Alignment adjust – Shift X and Y so that the image becomes bright at any time. Also, use the Contrast 

and Brightness 

buttons to adjust the image, if required.

16. At the Spotsize (SS) **90**, adjust slide bars of Alignment adjust-Shift X and Y so that the image becomes bright.
17. Return the spot size SS to **30**, and adjust the slide bars of Alignment adjust – Tilt X and Y so that the image becomes bright again.
18. Click the Wobbler icon 

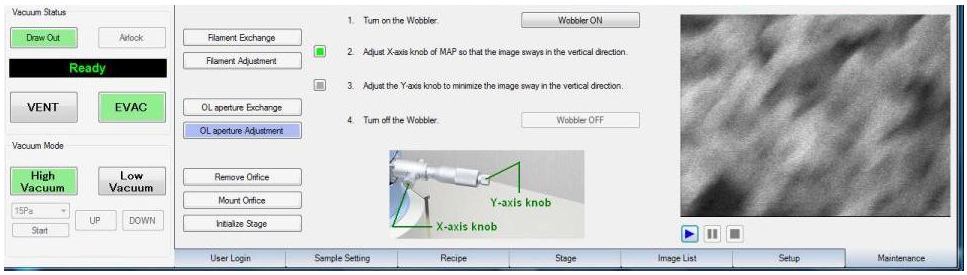
, and adjust the X and Y knobs of the movable aperture so that the image movement becomes minimum (does not move up and down, left and right).
19. Repeat steps from 15 to 18.

4.23.2 OL Aperture Adjustment

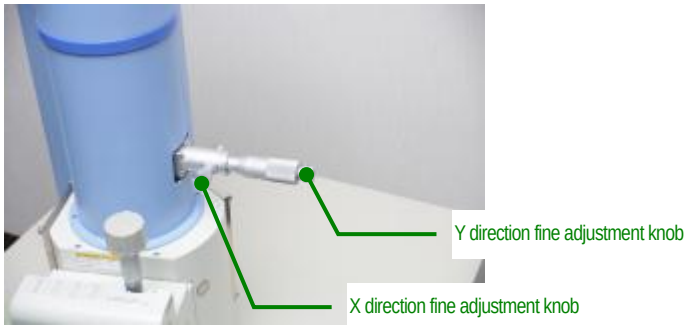
If the movable aperture diaphragm is shifted from the optical axis, even if the focus is adjusted, a sharp image may not be obtained, or an image may be limited by the field of view. In order to prevent this, check the movable aperture after having performed the following works, and adjust the movable aperture if needed.

- When the OL aperture was changed over, or the aperture foil was replaced.
- When you changed the accelerating voltage largely.
- When you changed WD largely.
- When you changed the spot size largely.

1. Set the magnification to about ×10,000 and adjust the focus of an image.
2. Click the **Maintenance** in the Operation menu tab.
3. Click the **OL aperture Adjustment** button.



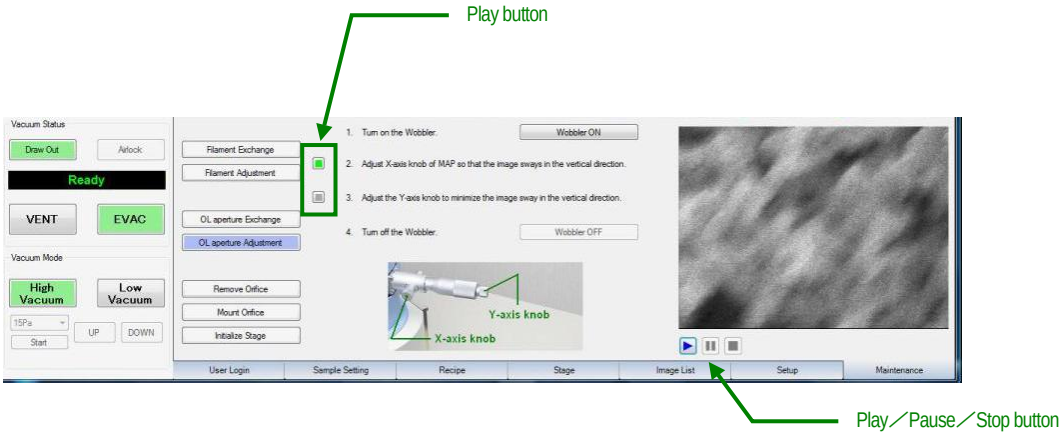
4. Click the **Wobbler ON** button.
5. At this time, if an image does not wobble vertically and horizontally, omit next step. If the image wobbles vertically and horizontally, proceed to step 6.
6. Adjust the image using the X, Y direction fine-adjustment knobs for the movable aperture, so that the wobbling of the image becomes minimum.



7. Click the **Wobbler OFF** button.
8. Repeat steps 4 to 7.

You can look at an animation of the OL aperture adjustment work.

When you click the **Play** button shown below, an animation according to each explanation is played.



4.23.3 Astigmatism Correction Adjustment

Astigmatism is not noticeable at low magnification (about ×1,000), however if you increase the magnification to a high value, the image appears to get sharp in a certain direction before and after the focal point, making it difficult to perform accurate focusing (image with astigmatism). If there is no astigmatism, blurring occurs uniformly in all directions before and after the focal point due to, hence the image can be accurately focused (image without astigmatism). Astigmatism can also occur after the work below was carried out, so correct it if necessary.

- If the OL aperture was changed over, or the aperture foil was replaced.
- If the accelerating voltage was greatly changed.
- If the WD was greatly changed.
- If a magnetic sample is being observed

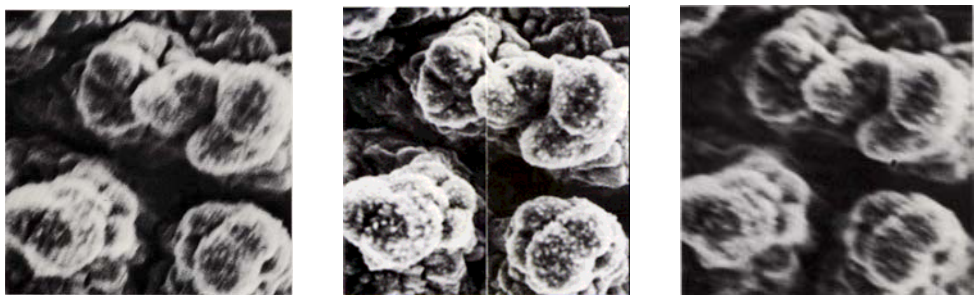


Image before astigmatism correction

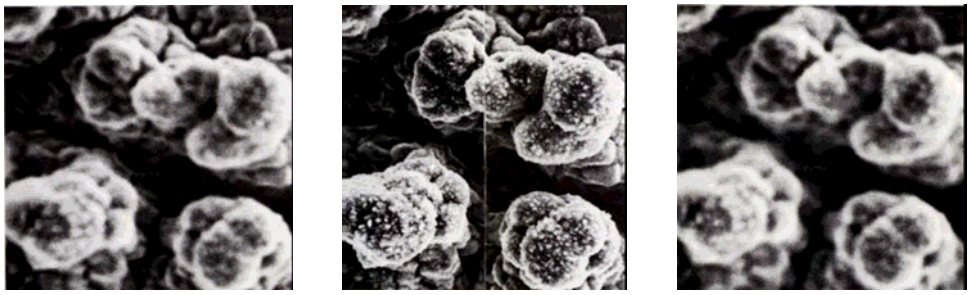
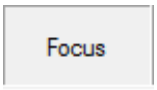
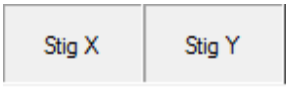


Image after astigmatism correction

1. Set the magnification to a value slightly higher than the magnification used for the current observation.
2. Adjust the focus of an image using the Focus  button
3. If the image appears (Ref.; Image after astigmatism correction) before and after the focal point (blurring occurs), there is no astigmatism, so omit the following steps.
4. Adjust the StigmX and SatigmY buttons  so that the image becomes most sharp.
5. Click LENS Reset icon  , or select the menu bar **Tools** ⇒ ***Lens Reset***,
6. Repeat steps 2 to 5.

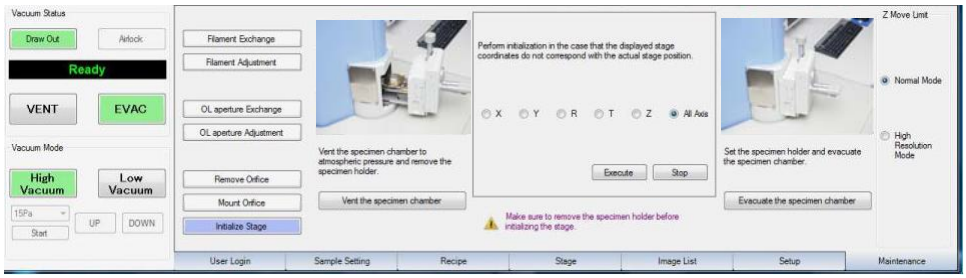
4.23.4 Stage calibration(if the motorized stage is installed)

It depends on the frequency of the instrument use, however it is recommended to perform the initialization of the stage once a week. In addition, please perform it when malfunction occurred by stage movement.

CAUTION !

Before you initialize the stage, remove the specimen holder.

1. Click the **Maintenance** in the Operation menu tub.
2. Click  the **Initialize Stage** button
3. Set the specimen tilt angle (T axis) to 0 degree.
4. Click the **Vent the chamber** button, and remove the specimen holder.



5. Select an axis to initialize and click the **Start** button.

   The specified axis starts moving, and an initialization completes when it stops moving. When you want to stop the initialization of the stage coordinates, click the **Stop** button.

6. Set the specimen holder and click the **Evacuate the chamber** button to evacuate the specimen chamber.
7. Select the **Z Move Limit**.

   Normal mode

   Z axis can not be moved to less than 8 mm to prevent collision. Please use at the normal observation mode.

   High Resolution mode

   Z axis is movable up to 5 mm. Please use when you observe an image at high magnification. Make sure that the specimen does not hit the various detectors when the top of the specimen protrudes from its holder.

4.24 X-ray analysis by EDS

Refer to the EDS instruction manual for the operation of EDS unit

Five kinds of analyses is possible with this instrument.

Item	Purpose of use
Mapping	Perform all the elements mapping in the whole area of the image display area.
Spot analysis	Perform the spectrum acquisition of the spot position set up on the image.
Line analysis	Perform the spectrum acquisition in line set up on the image.
Area analysis	Perform the spectrum acquisition of the area (rectangle area) inside set up on the image.
Sequential analysis	Perform sequentially the spectrum acquisition of the points reserved with ***Spot analysis*** or ***Area analysis***.

CAUTION !

In the below cases, spectrum data cannot be acquired, analysis position (spot, line and area) cannot be set, and sequential analysis cannot be reserved.

- Scan1
- The large／small image indication
- The image file
- Menu bar ***Image*** is being operated

The spectrum acquisition is not started if the WD (height of sample surface) is not setup to 10mm. Make sure to set the WD to 10mm.

4.24.1 Mapping

Perform all the elements mapping in the whole area of the image display area.

In the motorized stage is not attached to the instrument; Acquire the image by using the Menu bar **Analysis** ⇒ **Send Image to Analysis Station** or 

icon when you wish to analyze the new field of view.

(Recommended)

1. Displays a live image or freeze image. (640×480 pixels)
2. Select the menu bar **Analysis** ⇒ **Acquire X-ray Mapping**, or click the X-Map icon 

.
3. Start the spectrum acquisition as soon as the freeze image is transferred to the Analysis Station.
4. To stop it, click the monitoring dialog **Cancel** button.

   To start it again, select the menu bar **Analysis** ⇒ **Acquire X-ray Mapping**, or click the X-Map icon 

.
5. When the spectrum acquisition is completed, the image returns to the previous one before the acquisition starts.

   The acquired spectrum data is saved together with the image and position data into the field if the field of Analysis Station is the same. If the field is different, the acquired spectrum data is saved together with the image and position data into the new field.

   If the motorized stage is not attached, the acquired spectrum data is saved together with the image and position data into the current field

4.24.2 Spot／Line Analysis

Perform the spectrum acquisition of the spot／line position where it was set up on the image.
If the motorized stage is not installed and you wish to analyze the new field, acquire the image by using the Menu bar **Analysis** ⇒ **Send Image to Analysis Station** or 

icon . (Recommended)

1. Displays a live image or freeze image. (640×480 pixels)

   If the precise position is required for the analysis, it is recommended to display the freeze image.

2. Set the analysis spot／line.

   Set the mouse cursor on the point where you want to analyze on the image, and click  the right mouse button. Click the pop-up menu **Spot Analysis／Line Analysis**.
   ⇒ The yellow cross marker (For line analysis ; horizontal marker) is displayed.

3. The spectrum acquisition starts as soon as the freeze image is transferred to the Analysis Station.

   To stop it, click the monitoring dialog **Cancel** button.
   To start it again, click the pop-up menu **Spot Analysis／Line Analysis**.

4. Change the analysis position as necessary. （only spot analysis）

   Perform Step 2 operation again during the spectrum acquisition. In this case, the previously acquired spectrum data and position information are not saved.

5. When the spectrum acquisition is completed, it returns to the previous state before acquisition.

   The acquired spectrum data is saved together with the image and position data into the same field if Analysis Station filed is the same. If different field, the acquired spectrum data is saved together with the image and position data into the new field.

   If the motorized stage is not installed, the acquired spectrum data is saved together with the image and position data into the current field. ⇒ The cross-marker／Horizontal marker changes to the light blue.

6. Erases the cross-marker／Horizontal marker.

   Click the menu bar **Analysis** ⇒ **Clear History**.

   Other method ;

   - Change the magnification
   - Move the stage position
   - Perform the movement of the field of view by Image Shift.

4.24.3 Area Analysis

Perform the spectrum acquisition of the area (inside rectangle area) on the image.
If the motorized stage is not installed and you wish to analyze the new field of view, acquire an image by using the Menu bar **Analysis** ⇒ **Send Image to Analysis Station** or 

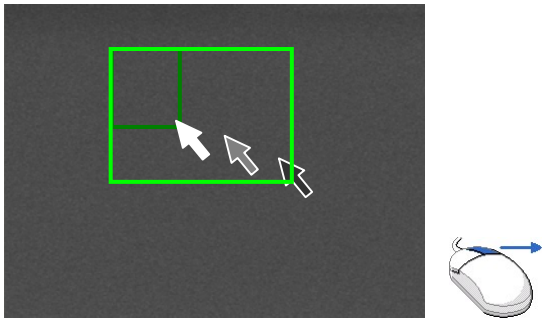
icon. (Recommended)

1. Displays a live image or freeze image. (640×480 pixels)

   If the precise position is required for the analysis, it is recommended to display the freeze image.

2. Setup the analysis area.

   Set the mouse cursor on the point which you want to analyze on the image, and draw the rectangle area with dragging the right mouse button. ⇒ The green rectangle area is displayed.



Drawing the rectangle area

3. Click the right mouse button  , and click the pop-up menu **Area Analysis**.

   ⇒ The color of rectangle area changes to the yellow.

4. The spectrum acquisition starts as soon as the freeze image is transferred to the Analysis Station.
   To stop it, click the monitoring dialog **Cancel** button. To start it again, click the pop-up menu **Area Analysis**.

5. When the spectrum acquisition is completed, the previous image is displayed.

   The acquired spectrum data is saved together with the image and position data into the same field if Analysis Station filed is the same. If it is the different field, the acquired spectrum data is saved together with the image and position data into the new field.
   The acquired spectrum data is saved together with the image and position data into the current field if the motorized stage is not installed. ⇒ The color of rectangle area changes to the light blue.

6. Erases the rectangle area.
   Click the menu bar **Analysis** ⇒ **Clear History**.

   Other method ;

   - Change the magnification
   - Move the stage position
   - Perform the movement of the field of view by Image Shift.

4.24.4 Sequential analysis

This program performs sequentially the spectrum acquisition of the points reserved with ***Spot analysis*** or ***Area analysis***.

If the motorized stage is not installed and you wish to analyze the new field of view, acquire the image by using the Menu bar ***Analysis*** ⇒ ***Send Image to Analysis Station*** or 

icon. (Recommended)

1. Displays a live image or freeze image. (640×480 pixels)

   If the precise position is required for the analysis, It is recommended to display the freeze image.

2. Reserves a spot or an area.

   Acquires the freeze image to the Analysis Station as soon as the first analysis point (spot or area) is reserved.

   Reserve a Spot

   Set the mouse cursor on the point where you want to analyze on the image, and click the right mouse button. Click the pop-up menu ***Reserves a Spot***.

   ⇒ The red cross-marker (marker) is displayed, and the reservation of the position is finished.

   Reserve an Area

   Set the mouse cursor on the point where you want to analyze on the image, and draw the rectangle area (marker) by dragging the right mouse button (⇒ the green marker (marker) is displayed).

   Click the right mouse button, and click the pop-up menu Reserves an Area. (⇒ The color of the marker changes to red, and the reservation is completed)

3. Select the menu bar ***Analysis*** ⇒ ***Sequential Analysis***, or click the Series icon 

.

   The sequential analysis dialog appears. Refer to the instruction manual for EDS.

4. Click the **Start** button in the sequential analysis dialog.

5. Starts the spectrum acquisition in the opposite order of reservation.

   To stop it, click the monitoring dialog **Cancel** button.

   The color of marker changes to right blue when the spectrum acquisition is finished or interrupted. (The red marker is displayed until the spectrum acquisition is started.)

   To start it again, click the **Start** button in the sequential analysis dialog.

6. When the spectrum acquisition is completed, the previous image before acquisition started is displayed.

   The acquired spectrum data is saved together with the image and position data into the same field if Analysis Station filed is the same. If it is the different field, the acquired spectrum data is saved together with the image and position data into the new field.

   The acquired spectrum data is saved together with the image and position data into the current field, if the motor drive stage is not attached.

   ⇒The marker changes to light-blue.

7. Erases the marker.

   Click the menu bar **Analysis** ⇒ **Clear History**.

   Other method ;

   - Change the magnification
   - Move the stage position
   - Perform the movement of the field of view by Image Shift.

4.25 Trouble Shooting

4.25.1 Evacuation System

Symptoms	Cause	Countermeasures
Power is not supplied	The power board switch is OFF	Turn ON the power board switch
	100V AC is not being supplied	Verify the 100V AC
	The safety device operated because of a water failure	Close the message (COOLING WATER FAILURE), and turn off the main power. （Exit SEM program ⇒ turn OFF the computer ⇒ turn OFF the MAIN POWER keyswitch） Flow the cooling water for five minutes. Restart the instrument. （Refer to 4.1）
	The safety device operated because of a power failure	Turn OFF the MAIN POWER keyswitch and wait until power is restored. Make sure that the water is being fed, and restart the instrument. （Refer to 4.1）
	The Water Leak Sensor (WLS) operated because of a water leak (When an optional WLS is installed)	Close the message (COOLING WATER LEAKAGE DETECTED). Turn off the main power and turn off the main cock of the cooling water. Then, contact your JEOL service office.
The RP (oil rotary pump) does not start when the instrument is started The VENT and EVAC switch lamp blink	The RP thermal protector operated because of the over-current	Turn OFF the MAIN POWER keyswitch. Make sure that the room temperature is between 15 and 25°C, and the water is being fed. Push the RP manual reset button to start the instrument.
	The RP fuse blown out because of the over-current	Shut down the instrument, and contact your JEOL service office.
When the RP has stopped while the instrument is running The VENT and EVAC switch lamp blink No-image is displayed Warning message is displayed	The RP fuse blown out or the thermal protector operated because of the over-current	Shut down the instrument, and contact your JEOL service office.

WARNING !

Do not touch the RP motor when the RP has stopped while instrument is running.

You may get burn in the hand because the RP motor is very hot.

Symptoms	Cause	Countermeasures
Evacuation does not take place, or takes a long time to complete	Loose parts	Tighten up loose parts
	A sample containing a lot of gas or moisture is installed	Remove moisture from a sample, or replace it (Refer to 4.3)
	Inferiority of O-ring or packing (Twist, wrong position, contaminated with dust, being torn)	Check the twist and wrong positions. Check whether a O-ring and packing are contaminated with dust. Adjust a twist. Return it in the right position. Remove dust. When the O-ring or packing is torn, call serivice center (Refer to Chapter 5)
	The wehnelt has just been cleaned	Wait for a while
	RP (rotary pump) or DP (diffusion pump) oil has deteriorated	Shut down the instrument, and contact your JEOL service office.

4.25.2 Image observation

Symptoms	Cause	Countermeasures
L.C value (load current) is unstable	The electron gun misaligned	Re-align the electron gun （Refer to 4.23.1）
	The filament has a whisker	Replace the filament （Refer to 5.4）
	The filament is mis-centered	Re-center the filament （Refer to 5.4）
	The wehnelt is contaminated	Clean the wehnelt （Refer to 5.4）
	The wehnelt has just been cleaned	Wait for a while
L.C value is abnormal, or too small/too large	Bias adjustment is not perform	Perform bias adjustment （Refer to 4.23.1）
An image does not appear	The HT icon is OFF or Wait	Click the HT icon to get ON
	An auto function does not operate	Turn HT ON, make sure whether the filament is heated. And, try again automatic functions (ACB, AF, etc.). （Refer to 4.5）
	The signal is not SEI	Set the signal to SEI （Refer to 4.6）
	The image has excess or insufficient contrast and/or brightness	Adjust it with image adjustment tool Contrast and Brightness buttons （Refer to 4.6）
	The electron gun misaligned	Re-align the electron gun （Refer to 4.23.1）
	The filament heating insufficient	Align the electron gun, or adjust bias （Refer to 4.23.1）
	The movable aperture misaligned	Align the movable aperture （Refer to 4.23.2）
	The filament is burnt out	Replace the filament （Refer to 5.4）
An image does not appear in LV mode		Set the appropriate sample (specimen holder), and evacuate in HV mode. Set the Z-axis (WD) to 10mm. Click the HT icon to get ON. Select ***Semi Auto***, and click the ***Auto Filament + Auto Alignment*** button. (Maintenance; Adjusting a filament) Click HT icon to get OFF. Try again with LV mode. （Refer to 4.11）

Symptoms	Cause	Countermeasures
An image has no sharpness	The image has astigmatism	Correct it with **Stigm X** and **Stigm Y** buttons. (Refer to 4.23.3)
	The image has insufficient contrast and/or brightness	Adjust it with **Contrast** and **Brightness** buttons. (Refer to 4.7.5)
	The spotsize is too large	Reduce the spotsize (Refer to 4.7.3)
	The electron gun misaligned	Re-align the electron gun (Refer to 4.23.1)
	The accelerating voltage is too low	Increase the accelerating voltage (Refer to 4.7.2)
	The movable-aperture foil has deteriorated	Replace the movable aperture foil (Refer to 5.6)
	The inside of electron optical column is contaminated	Call service center
The image does not focus in the vertical direction	The sample is set to high tilt angle	Eliminate the tilt of sample (Refer to 4.8) Correct with "Dynamic Focusing correction" (Refer to 4.13)
There are noise, roughness, and distortion on the image	The sample has acquired electric charge	Re-evaporate a sample Decrease the accelerating voltage (Refer to 4.7.2) Decrese the spotsize (Refer to 4.7.3) Fine-adjust the pressure in the specimen chamber (Refer to 4.11)
	The spotsize is too small	Increase the spotsize (Refer to 4.7.3)
	The accelerating voltage is unsuitable	Change the accelerating voltage (Refer to 4.7.2)
	The image has astigmatism	Adjust it with **Stigm X** and **Stigm Y** buttons (Refer to 4.23.3)
	The image has excess or insufficient contrast and/or brightness	Adjust it with **Contrast** and **Brightness** buttons (Refer to 4.7.5)
	The sample is not properly fixed	Properly fix the sample
	Loose parts	Tighten up loose parts
	External magnetic field	Keep it away from the instrument
	The movable aperture foil has deteriorated	Replace the movable aperture foil (Refer to 5.6)
	The inside of electron optical column is contaminated	Contact your JEOL office
The image appears with poor brightness compared with the previous time The image brightness changes in a cycle	The scintillator tip has deteriorated	Contact your JEOL office

Symtoms	Cause	Countermeasures
An image be veiled in haze of white	Halation is caused	Select menu bar **Tools** ⇒ **Neutralizer**. ※ It is effective only SEI
A live image can be recorded	A main screen becomes full-screen live display	Cancel the full-screen live display
	A image size becomes without 640 × 480 pixels	Select scan mode to Scan3 or Scan4 (scan speed ; 10s)

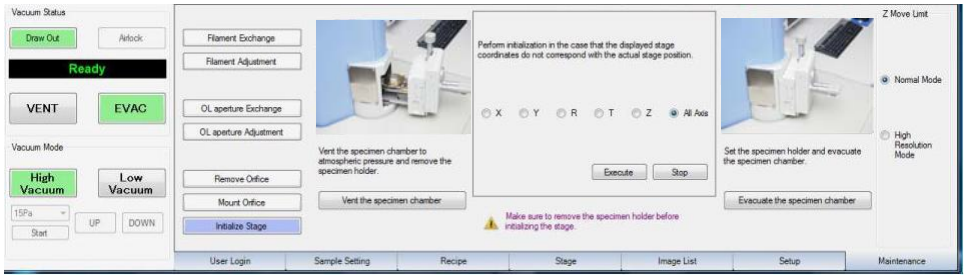
4.25.3 What should be done in these cases?

4.25.3.a When the coordinates display of the motor drive stage differs from the actual position

If the following phenomena occur while using this instrument, execute the stage initialization.

- When the actual position of the specimen stage differs from the coordinate display of the stage control window and the graphic display position
- Because of the shift of the specimen exchange position, you cannot change the specimen.

1. Click the **Maintenance** of the operation menu bar.
2. Click  the ***Initialize Stage*** button.
3. Set the specimen tilt angle (T axis) to 0 degree.
4. Click the ***Venting the chamber*** button, and remove the specimen holder.

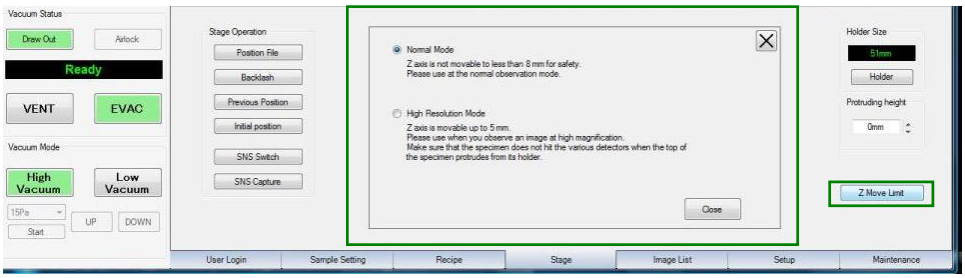


5. Select an axis you want to initialize, and click the ***Start*** button.

   Moving of the specified axis starts, and when it stops, initialization is completed. When you want to stop the initialization of the stage coordinate, click the ***Stop*** button.
6. Mount the specimen holder on the specimen stage, and click the ***Evacuating the chamber*** button.

7. Set the ***Z axis Moving Limit***.

   a. Click the ***Stage*** of the operation menu tab.
   b. Click the ***Z Move Limit*** button.
   c. Select ***Normal Mode*** or ***High Resolution Mode***.
   d. Click the ***OK*** button.



Normal mode	Z axis can not be moved to less than 8 mm to prevent collision. Please use at the normal observation mode.
High Resolution mode	Z axis is movable up to the 5mm. Please use this when you observe an image at high magnification. Make sure that the specimen does not hit the various detectors when the top of the specimen protrudes from its holder.

Z Axis Moving Limit

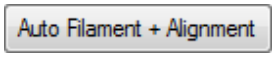
4.25.3.b When a message appears using an optional ALS

When one of the following operations is made, a message appears. Proceed to do the steps according to the message. In addition, be sure to shut down the instrument before you contact the service office.

- When you set the airlock valve to **OPEN** while evacuating the main unit.
- When you set the airlock valve to **OPEN** while evacuating the airlock chamber.
- When the pressure does not decrease to 30 Pa (low vacuum mode: 100 Pa) or less even if 3 minutes or more has passed after starting the evacuation of the airlock chamber.
- When you open the airlock chamber door while evacuating the airlock chamber.
- When the malfunction of the airlock system occurs.

4.26 Running message list

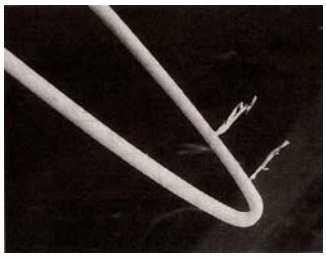
The running message is displayed on the top of the main screen.

Operation	Running message	Remarks
Click the 	Photographing	
Click the 	Freeze	
Click the 	Auto Focus running	
	Auto Focus＋ACB running	Setting ⇒ Auto and Preset Mag. Tick the ACB check box.
Click the 	Auto Stigma running	
	Auto Stigma＋Auto Focus running	Setting ⇒ Auto and Preset Mag. Tick the AF check box
	Auto Stigma＋ACB running	Setting ⇒ Auto and Preset Mag. Tick the ACB check box
Click the 	ACB running	
Click the 	Auto Gun Alignment running	Maintenance ⇒ Filament Adjustment ⇒ Auto Filament＋Auto Alignment
Click the 	Auto Filament Saturation running	Maintenance ⇒ Filament Adjustment ⇒ Auto Filament
Click the 	Auto Gun Alignment running	Maintenance ⇒ Filament Adjustment ⇒ Auto Alignment
Click the 	Beam Blank ON	
Select the **Tools** ⇒ **OL Wobbler**, or click the 	OL Wobbler ON	

4.27 Warning Message list

If the trouble occurs as follows, an error messages appears and beeps buzzer (Continuity／three times) sound.
Please proceed according to the message.

Contents of message	Countermeasures
COOLING WATER FAILURE Water stops	Turn off the main power and supply cooling water for more 5 minutes before restarting the microscope （Refer to 4.1）
DP TEMPERATURE LOW DP temperature is low	Wait for a while When the DP temperature does not rise even if it waits for about 15 minutes, DP HEATER FAULT message appears. Shut down the instrument, then call service center
COOLING WATER LEAKAGE DETECTED Water leaks An optional water leak system (WLS) is being used	Shut down the instrument and turn off the cooling water, then contact your local JEOL service office.
DP HEATER FAULE DP heater being burnt out	Shut down the instrument and contact your local JEOL service office.
EVACUATION FAILURE Vacuum error occur	Vent the specimen chamber to atmospheric pressure, and check the O-ring and/or packing (twist, wrong position, etc) Remove twist, correct position and re-evacuate the specimen chamber When the O-ring or packing is torn, call service center
RP STOPPED RP stopped	Shut down the instrument and contact your local JEOL service office.
FILAMENT BURN-OUT The filament electric current (L.C value) not flowed even if the filament heating becomes 80H or more	Replace the filament (Refer to 5.4)
HT is OFF or FILAMENT is not heated When the automatic function is operated with HT off or the filament heating scroll bar is set to 80H or less.	Set HT to ON or adjust filament saturation

Contents of message	Countermeasures
FILAMENT FAILURE (When L.C value flowed more than 150 μ A)	Check the filament Remove the filament from the wehnelt in the gun chamber. Check whether "Whisker" on the filament does not occur.  Whisker If the whisker occurs, replace the filament because the instability of gun emission is caused. (Refer to 5.4)
Insufficient filament heating	Please adjust the filament heating properly or click the **Auto Filament** button
VACUUM SYSTEM FAILURE Vacuum system stops	Shut down the instrument and contact your local JEOL service office.
VENT DISABLED Prohibition of vacuum control in the "VENT Lock signal" input An optional vacuum status interface （VSIF） is being used	Please start after resetting the VENT-Lock signal.
VALVE CONTROL FAILURE Valve control error occurs in the LV mode	Please readjust the pressure mechanism.
EXTERNAL CONTROL DISABLED When the connection was cut during the external control An optional external scan interface （ESIF）is being used	Check connections or input an external control signal
Stage contact with lens detected An optional motor drive stage is being used	Wait for a while till the stage is moving to a safe position. Vent the specimen chamber, check the damage of the sample, OL and BEIW. There is damage･･･Contact your local JEOL service office. There is no damage･･･Ensure to see the movement of the sample, and try again. ※ When the specimen surface is protruding above the specimen holder, input the amount of correction.

5

Maintenance

Refer to the EDS instruction manual for the maintenance of the EDS detector.

5.1 Parts the must be maintained

A JEOL engineer performs the maintenance work of DP oil, RP oil in the table. Please, contact JEOL service office.

Parts	Cleaning interval
Filament・Wehnelt	L.C value (load current) is unstable L.C value not rise with filament heating Error message appears
Anode・liner tube	Once every 1 to 2 years Cleaning is it toward the aperture (cap shaped) in the tip of the liner tube. Stop cleaning if trash and dirt don't seem to be conspicuous except for the liner tube.
Movable aperture (MAP)	When the astigmatism increases, preventing a bright image from being obtained
Orifice (6510LV, 6510LA) Sleeve (6510, 6510A)	When the astigmatism increases, preventing a bright image from being obtained
O-ring・packing	When evacuation cannot take place or requires a long period.
DP oil	Once every 3 to 5 years（Recommended）
RP oil	Once every 1 year（Recommended）

5.2 Cleaning materials

Cleaning materials	Purpose of use, and Note
* Cleaning liquid	Use cleaning liquid that has high cleaning performance, is of high purity, nearly harmless to humans, non flammable, and volatile. Follow the precautions indicated on the container of the cleaning liquid. Ensure that the room is adequately ventilated, and do not place your fingers in the liquid. (be sure to ware working gloves) Use cleaning liquid to remove common dust and abrasive. Normally, cleaning liquid is used by moistening a piece of gauze or a cotton stick with it. Small parts that have been cleaned can be effectively finished off by immersing them in a beaker filled with cleaning liquid. (you can obtain even better results by using ultrasound cleaner)
Work gloves	Use polyethylene film gloves. This prevents parts from becoming soiled, and also protects the skin on your hands and fingers.
Gauze	Use gauze that is clean and does not generate impurities when immersed in cleaning liquid. Use gauze for rubbing parts with an abrasive and also for wiping away dust and stains using cleaning liquid.
Cotton stick	Use cotton sticks that are clean and do not generate impurities when immersed in cleaning liquid. Use cotton sticks for rubbing parts with an abrasive and also for wiping away dust and stains using cleaning liquid. (fine parts, holes, etc.)
Cotton wool, toothpick	Use clean cotton wool after wrapping it around a toothpick. Use it for rubbing parts with an abrasive, and also for wiping away dust and stains using cleaning liquid. (fine parts, holes, etc.)
* Metal abrasive	Use a paste type abrasive that can be easily removed by cleaning liquid. Use it when dust and stains cannot be removed with cleaning liquid. Never use an abrasive on threaded parts or intricate parts. Also, take care that abrasive does not get onto parts that are not normally cleaned.
Beaker	Use a stainless steel beaker. Do not use a glass beaker because it is liable to break. Pour cleaning liquid into the beaker and use it for finishing off fine parts that have been cleaned.
Hand blower	You can also use a safe, clean container that enables inert grass to be blown out.
Tools	Use the tool included among the accessories or commercially available tools. Replace screwdrivers and other tools that are visibly damaged.

* When a cleaning liquid and metal abrasive are need, please, contact your JEOL service office.

! Percaution in maintenance work

- Do not adopt an unreasonable posture when working for maintenance.
  An unreasonable posture becomes the cause which a waist and so on hurts.
- Do not use an organic liquid when wiping off the dust of exterior of the instrument.
  Wipe off it with dried cloth after removing the dust. If it is very dirty, wipe it with wet cloth and then dry cloth.
- Do not dismount, disassemble with bare hands. Be sure to use polyethylene film gloves or the like.
  The internal parts are precision-machined. Use special care so as to prevent them from contamination.
- Use tools in the proper way, and avoid using undue force to tighten screws.
- When you handle tools, use special care not to drop them on the parts and damage them.
- When parts is to be secured with two or more screws, screw all of them lightly in until they are blocked and them tighten one after another a little at a time.
- Carefully remove and remount parts without exerting undue force.
  Forcing parts in or out could cause eccentricity which might make it impossible to remove and remount the parts.
- Store removed and disassembled parts is readily identifiable groups.
  Put small parts such as screws in laboratory dishes. For long-term storage, use a desiccator to prevent oxidation.
- Place disassembled parts on a rugged workbench covered with aluminum foil.
- For heavy parts, place additional material under the mat and make sure that no screws, etc. are left behind.
- Place a cover or an exposed portion that does not require disassembly. Cover such a portion with an aluminum foil to keep out dust.

5.3 Cleaning method

! WARNING

When handling cleaning liquid, be sure to use polyethylene film gloves.
There is a risk of acquiring a skin disorder depending upon the particular kind of cleaning liquid used of the sensitivity of your skin, so be sure to read the precautions concerning liquid before using it.

Cleaning A—Wiping off dust and stains with cleaning liquid

Please apply ***Cleaning A*** in the part that are not very dusty satiny, or parts that cannot be rubbed

- Wipe flat surfaces and outside surface of parts, and also threaded parts, with a piece of gauze, or the like, moistened with cleaning liquid. Wipe dust and stains off the vicinity of holes and the inside surfaces of parts using a cotton stick (of a size that matches the area to be cleaned), or the like, moistened with cleaning liquid. Never clean parts made of plastic or other material that is likely to be dissolved by the cleaning liquid.
- Clean oil and grease off small parts and also clean intricate parts by pouring the cleaning liquid into a beaker then immersing the parts. You can obtain even better results by using an ultrasound cleaner. Replace the cleaning liquid from time to time according to the extent to which it becomes contaminated. After cleaning the parts, remove them from the beaker and quickly remove any cleaning liquid adhering to them by using blower brush.

Cleaning B—Rubbing with metal abrasive

Please apply ***Cleaning B*** in the part that are very dusty and also parts that can be rubbed.

- Coat flat surfaces and outside surface of parts with a small quantity of abrasive using gauze, or the like. Rub the vicinity of holes and the inside surfaces of parts using a cotton stick (of a size that matches the area to be cleaned) or the like, coated with a small amount of metal abrasive. Do not use a lot of force when rubbing a parts in the vicinity of a hole. Also, do not rub parts excessively. Never rub threaded parts with metal abrasive.
- If you have done ***Cleaning B***, repeat ***Cleaning A*** couple of times to completely wipe all metal abrasive off.

5.4 Filament replacement and cleaning

! WARNING

Do not touch the wehnelt immediately after the filament breaks because it is not you may receive a burn.

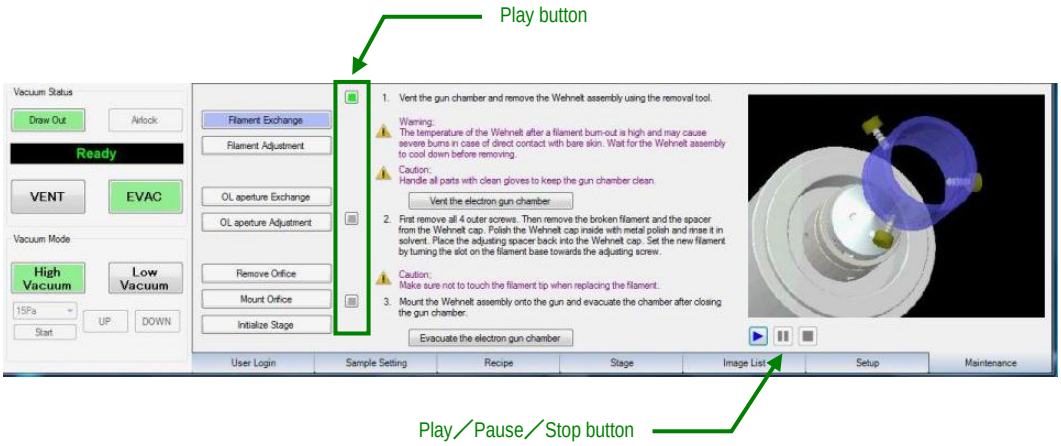
Before removing the wehnelt for about one hour, then remove it using a dedicated tool.

! CAUTION

- Do not open the electron gun except the maintenance work (filament replacement, etc.)
  It has possibility that dust and so on goes into the electron optical column when the electron gun is opened unreasonably and that a trouble is caused.
- When installing the filament, take care not to touch the tip of the filament.
- When closing the electron gun, take care not to slip the O-ring out of position.
- When closing the electron gun, take care not to get your fingers crushed between the electron gun and electron optical column.

You can look at an animation of the filament exchange work.

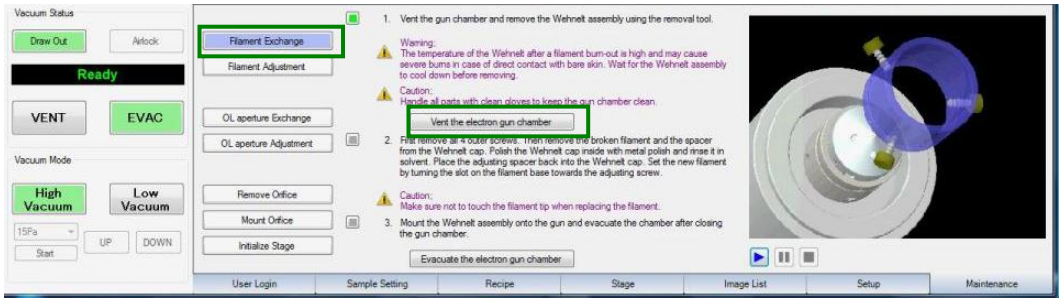
When you click  the **Play** button, an animation according to each operation procedure is replayed.



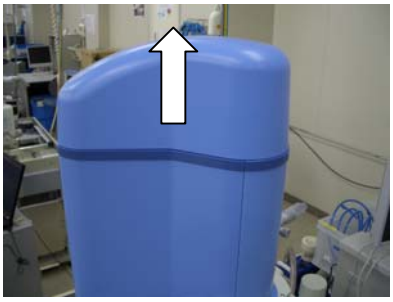
1. Click **OK** button to close the message dialog.
2. Click the **Maintenance** in the Operation menu tab.
3. Click  the **Filament Exchange** button.
4. Click the **Vent the electron gun** button for venting the electron gun chamber to atmospheric pressure.

! CAUTION

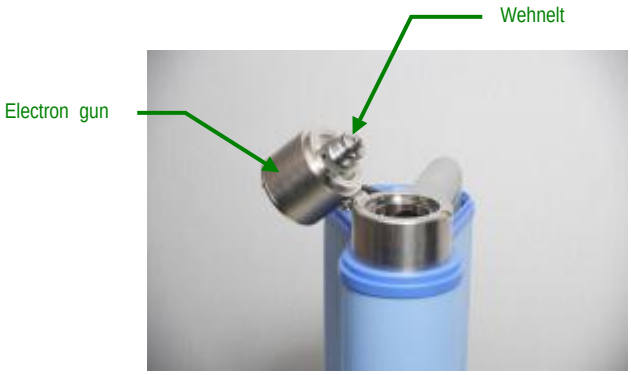
Before removing the wehnelt, wait approximately one hour to get it cool.



5. Lift the column top cover, and remove it



6. Open the electron gun, and remove the wehnelt.



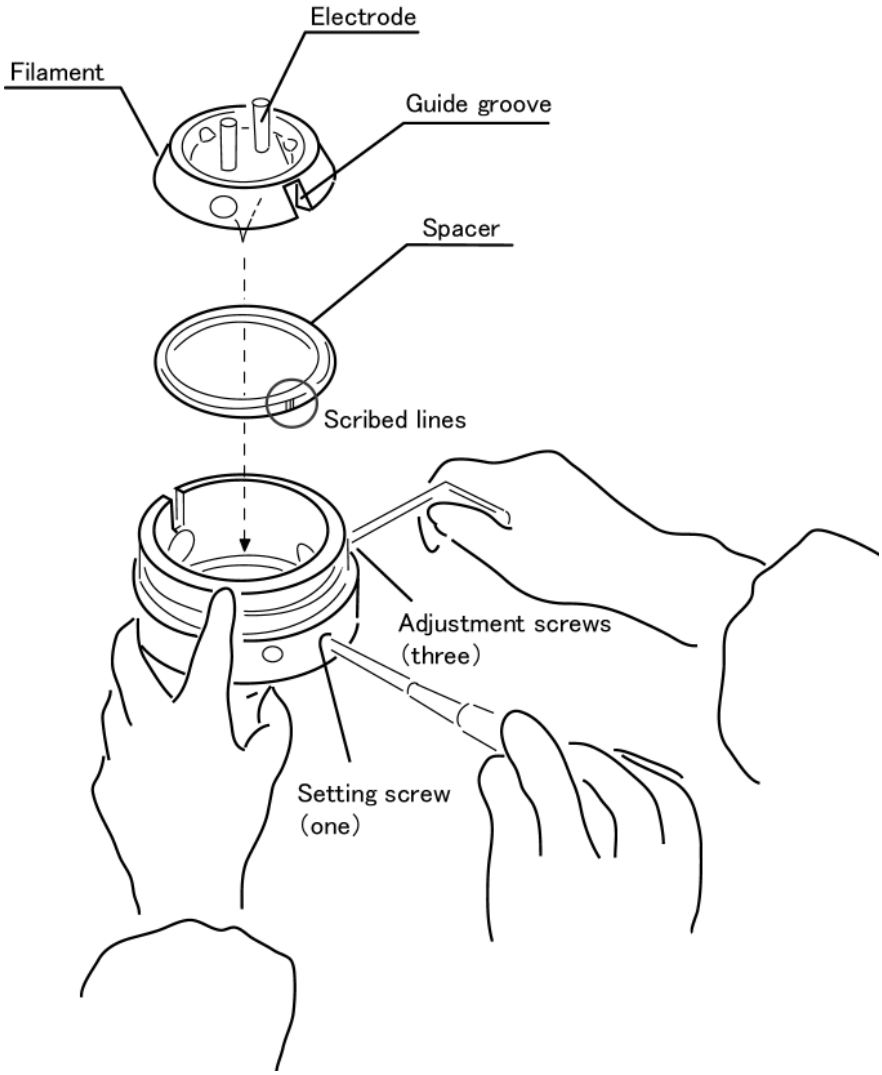
7. Set the wehnelt removal tool in such a way that the three screws of the wehnelt removal tool will align with the smooth faces on the sides of the wehnelt and tighten the screws

8. Pull the wehnelt removal tool straight to remove the wehnelt from the electron gun and then loosen the screws to remove the wehnelt removal tool.

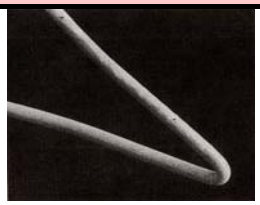
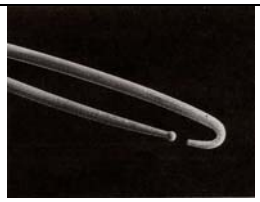
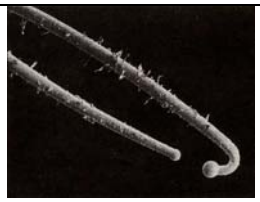
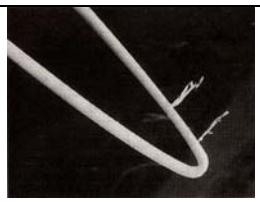
   Closes the electron gun after removing the wehnelt. At this time, take care not to slip the O-ring out of position.

9. Disassemble the wehnelt, and remove the filament.

   Grasp the electrode of the filament when removing the filament.



Tip of the filament condition

Tip of the filament condition	State
	Un-use
	Ordinary broken When the filament is used well at a long time.
	Abnormal broken When the over load current is flowed to the filament.
	Whisker Since the load current becomes to instability, it is necessary to change the filament with a new one.

10. Clean the cap, and other parts (by referring the 5.3 section), then install a new filament

    Re-install the filament in the opposite sequence to removal.

11. Check the filament position (centering).

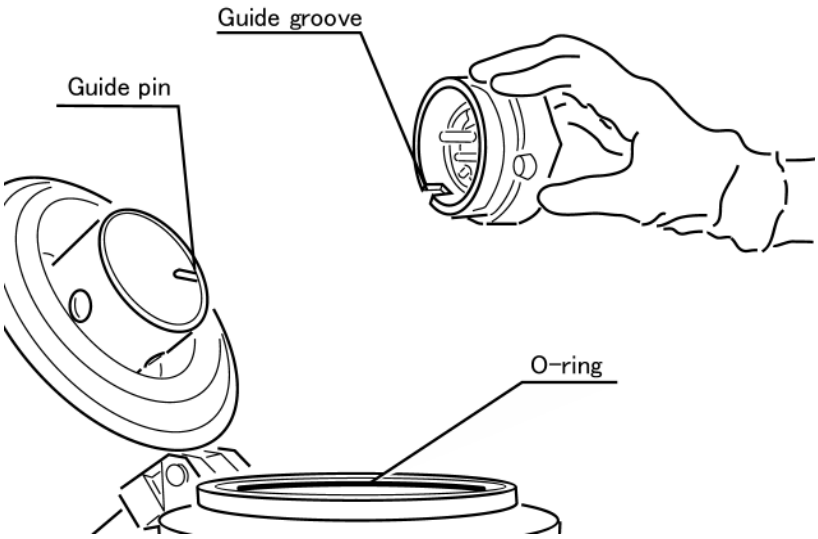
    Show the wehnelt from the side, if the tip of the filament is protruding, replace the spacer.

Relation between the spacer and filament

Number of scribed lines	Thickness (mm)	Brightness	The life of filament
3	2.1	Medium	Normal
4	2.2	Low	Long

12. Open the electron gun, Install the wehnelt.

If there is dust and so on the wehnelt, remove it with hand blower.
Align the guide groove on the wehnelt with the guide pin on the electron gun, then push in the wehnelt unit it clicks into position.



Install the wehnelt

13. Close the electron gun.

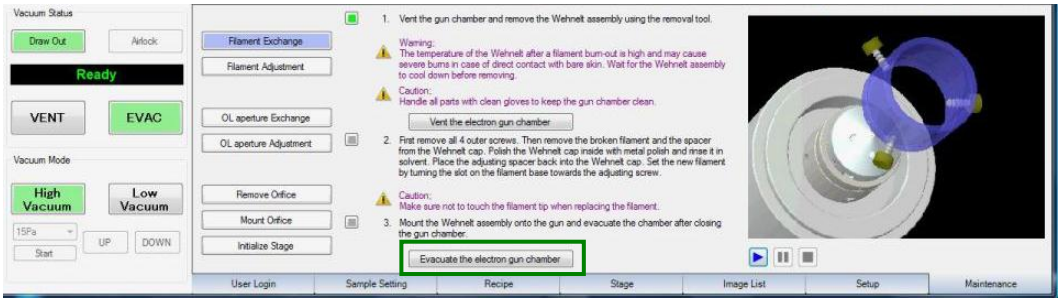
Please, check the O-ring condition before closing the electron gun.

- If the O-ring is dusty, carry out cleaning A, then adequately dry the O-ring. Next, coat the O-ring with the minimum necessary amount of ＊vacuum grease.

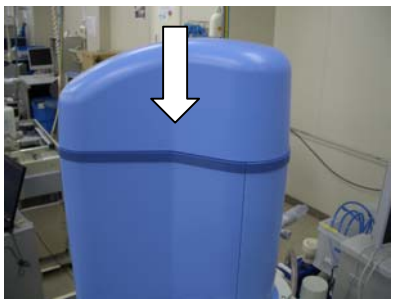
  When the vacuum grease is need, please contact your JEOL service office.

- If the O-ring is damaged or torn, you must replace it, so contact your local JEOL service office.

14. Click  the ***Evacuate the electron gun*** button for evacuating the EOS column.



15. Install the column top cover.



16. Click HT icon 

to get HT ON 

.

17. Perform the auto gun alignment. （Chapter 4 －4.22.1.a）

5.5 Cleaning the anode and liner tube

! WARNING

Do not touch the wehnelt immediately after the filament breaks because it is not you may receive a burn.

Before removing the wehnelt for about one hour, then remove it using a dedicated tool.

! CAUTION

Turn OFF the MAIN POWER key switch after venting the electron optical column to atmospheric pressure.

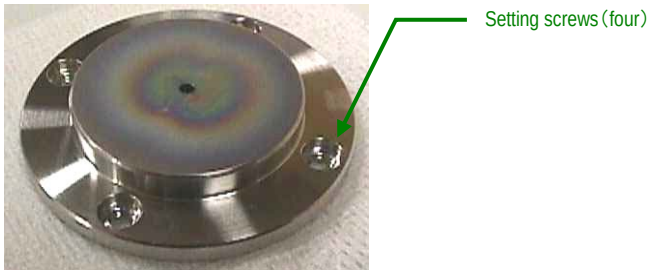
When closing the electron gun, take care not to slip the O-ring out of position, or get your fingers crushed between the electron gun and electron optical column.

1. Open the electron gun and remove the wehnelt.

   Stores the removed wehnelt in such a way that it is not exposed to dust.

2. Turn ***OFF*** the MAIN POWER key switch, and remove the anode.

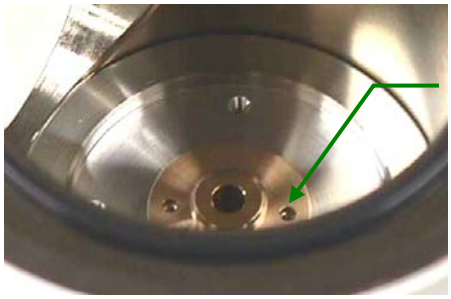
   Remove the setting screws. Screw the suitable screw into the screw hole for removing the anode, and pull it out vertically.



3. Remove the liner tube

   Remove the setting screws (two). Screw the “liner tube extraction tool” and pull the tool vertically.

Liner tube extraction tool



As for important by operation step3, it is [pull the liner tube out slowly and vertically, and return it again].

A “slow” reason is to prevent two O-ring being torn to keep the vacuum of the liner tube.

And, cleaning is it toward the aperture (cap-shaped) at the tip of the liner tube.

Stop cleaning if you look through the liner tube and trash and dirt don't seem to be conspicuous.

4. Clean the anode and liner tube by referring the 5.3 section.
5. Re-assemble the anode and liner tube.

   Perform re-assembly work in the opposite sequence to that in which you disassembled or pulled out the anode and liner tube.
6. Install the wehnelt, then evacuate the electron optical column.

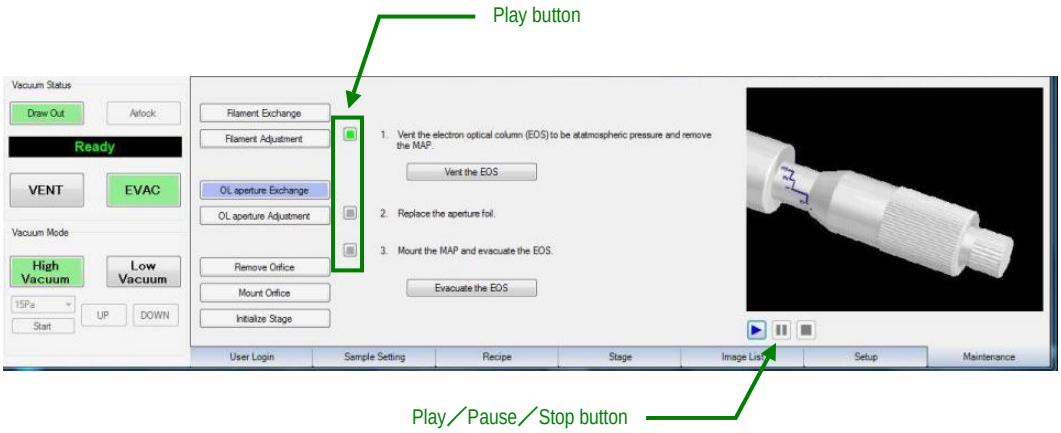
5.6 Cleaning the movable aperture

! CAUTION

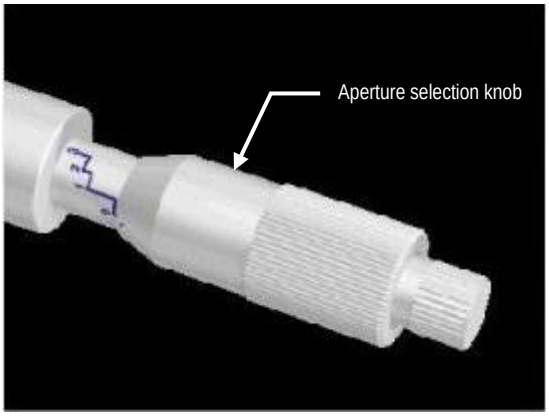
- When removing or installing the movable aperture, take care that the tip of the movable aperture does not touch the electron optical column.
- When pushing the aperture foil fixing plate, take care not to touch with bare hands.
- When installing the aperture foil, take care not to deform or damage it.
- It is necessary to change the aperture foil to a new one. When an new aperture foil is need, please, contact your JEOL service office.

You can look at an animation of the OL aperture foil exchange work.

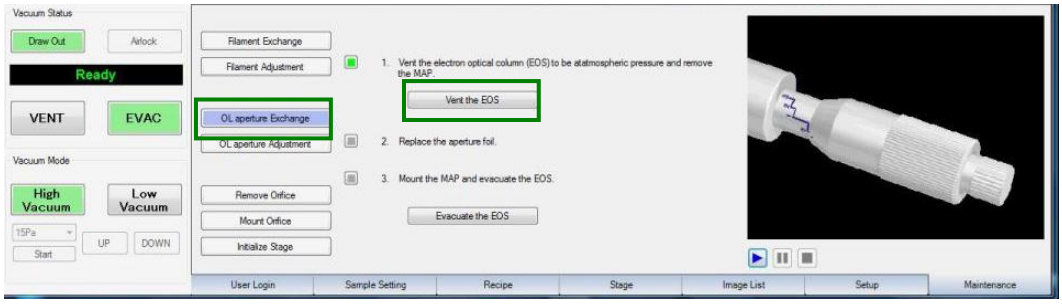
When you click  the **Play** button, an animation according to each operation procedure is replayed.



1. Set the aperture scale to **0** using the aperture selection knob.

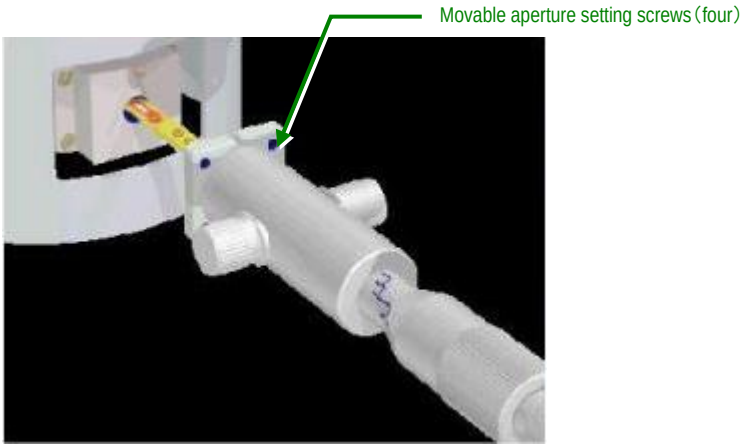


2. Click the **Maintenance** in the operation menu tab.
3. Click the **OL aperture Exchange** button.
4. Click the **Vent the EOS** button for venting the EOS column to atmospheric pressure.

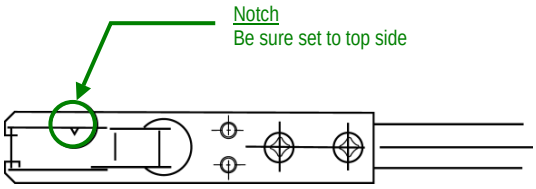


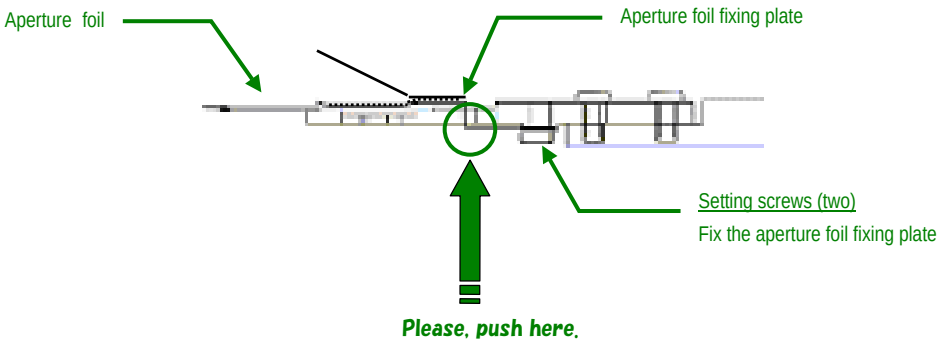
5. Remove the movable aperture.

   Cover the mounting port of the movable aperture to prevent ingress of dust.

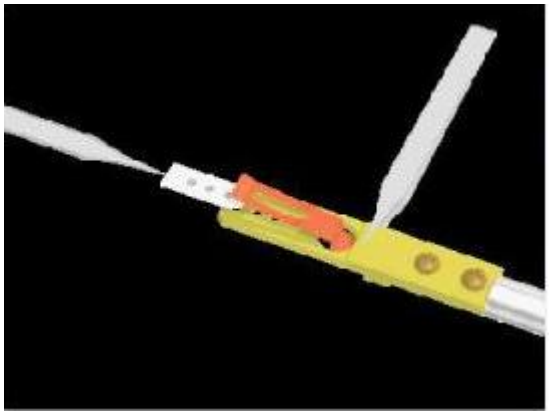


6. Push the aperture foil fixing plate, and take out the aperture foil



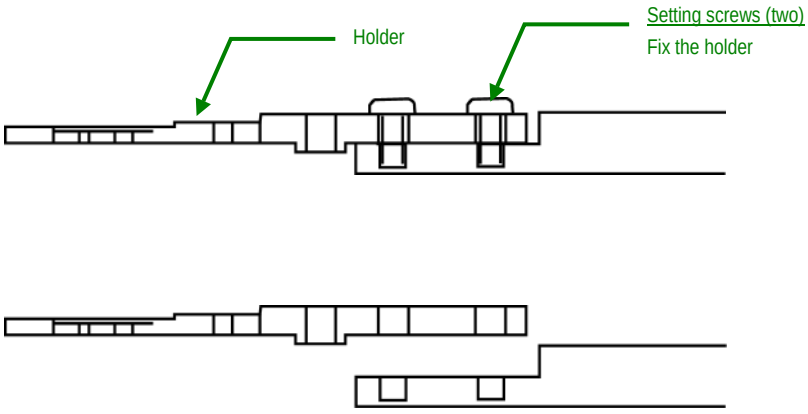


Tip of the movable aperture



7. Carry out the Cleaning A.

When the tip of the MAP is very dusty, disassemble it and carry out Cleaning B. Re-assemble the aperture in the opposite sequence to disassembly.
About cleaning method of Cleaning A and Cleaning B, see Section 5-4.



8. Push the aperture foil fixing plate, and install a new aperture foil.

It is necessary to change the aperture foil to a new one. When an new aperture foil is need, please, contact your JEOL service office.

9. Install the movable aperture, and click the ***Evacuate the EOS*** button.

If there is dust and so on the tip of the aperture, remove it with hand blower.

Next, executes the Movable Aperture Adjustment （refer to Chapter 4_4.23.1.b）

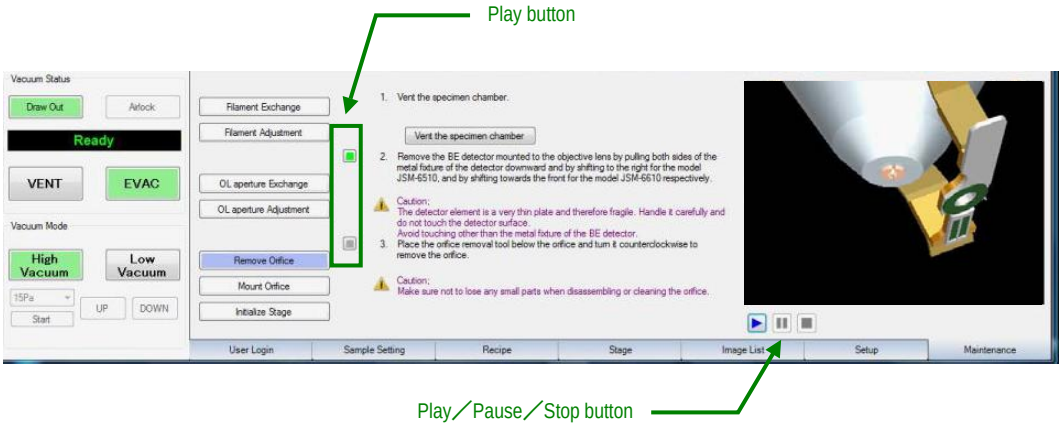
5.7 Cleaning the orifice and sleeve

CAUTION !

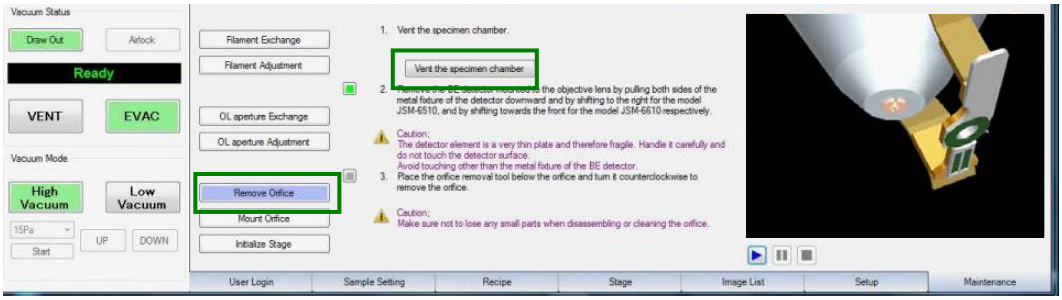
- When moving the BE detector holder, take care not to touch the detection element.
- When removing or installing the orifice (sleeve), take care not to touch any parts inside the specimen chamber.
- When installing the aperture foil, take care not to deform or damage it.
- It is necessary to change the aperture foil to a new one. When an new aperture foil is need, please, contact your JEOL service office.

You can look at an animation of the orifice exchange work.

When you click  the **Play** button, an animation according to each operation procedure is replayed.

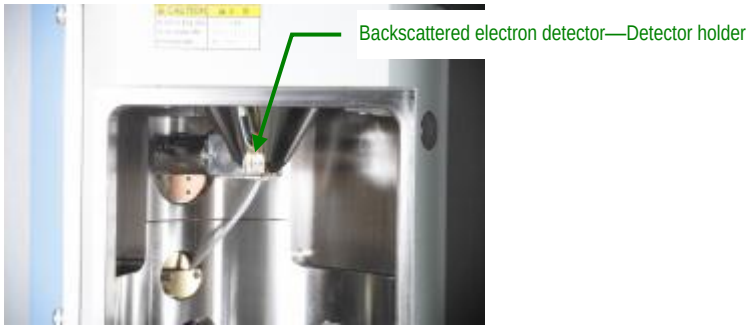


1. Click the ***Maintenance*** in the operation menu tub.
2. Click the ***Remove Orifice*** button of the Maintenance operation guidance.
3. Click the ***Vent the specimen chamber*** button for venting the specimen chamber to atmospheric pressure.



4. Slowly withdraw the specimen stage.

   When an optional backscattered electron detector (BEIC or BEIR) is attached, pull the backscattered electron detector until it stops to the front.



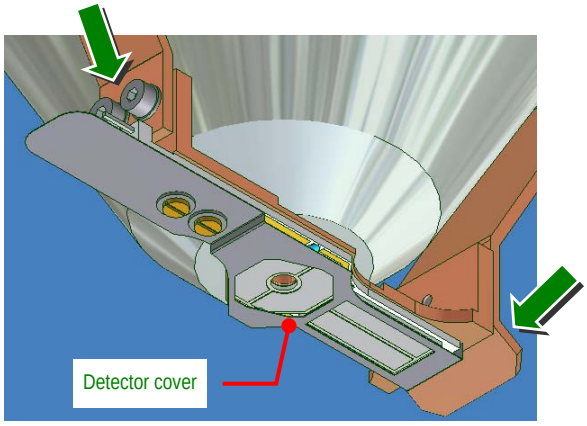
Interior of the specimen chamber

5. Slightly moves the detector holder.

Slightly push down the detector holder, and Move the detector holder to the right-side not to touch the bottom of OL as much as possible

When you move a detector holder, hold the part to show in a round mark of a figure, and move it.

After finishing the movement of the detector holder, slowly release your hand.



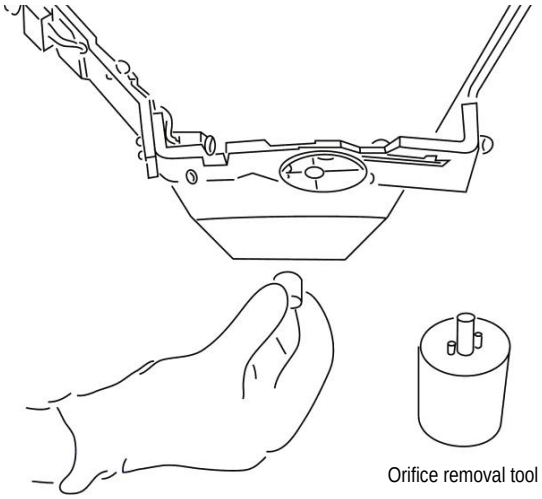
Whole of the detector holder

! CAUTION

The detector cover shown in a figure is made of the very thin material. Keep it mind that it will bend easily and will change if it touches by hand.

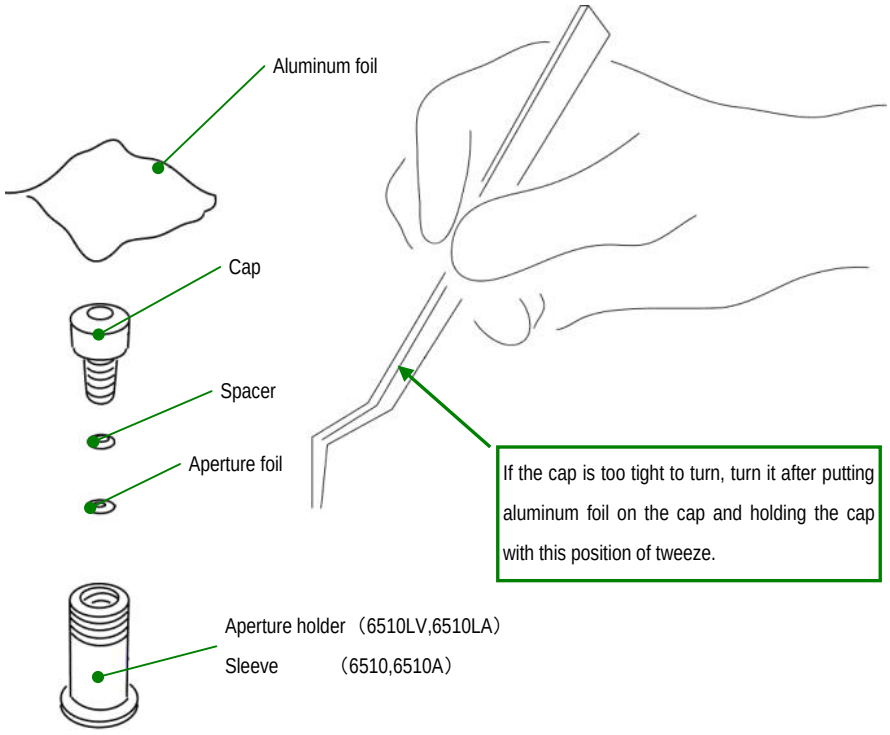
6. Remove the orifice or sleeve using the orifice removal tool

Viewing the tool from the underside, turn it counterclockwise and remove the orifice or sleeve.
After removing it, evacuate the specimen chamber.



7. Disassemble the orifice, then clean (by referring the Section 5.3) these parts as shown in the figure.

Reassemble the orifice or sleeve. Perform re-assembly work in opposite sequence to that in which you disassembled.



＊ It is necessary to change the aperture foil to a new one. When an new aperture foil is need, please, contact your JEOL service office.

8. Vent the specimen chamber to atmospheric pressure, and install the orifice or sleeve.

   Click the **Mount Orifice** button in the **Maintenance** in the operation menu tub, and click the **Vent the specimen chamber** button

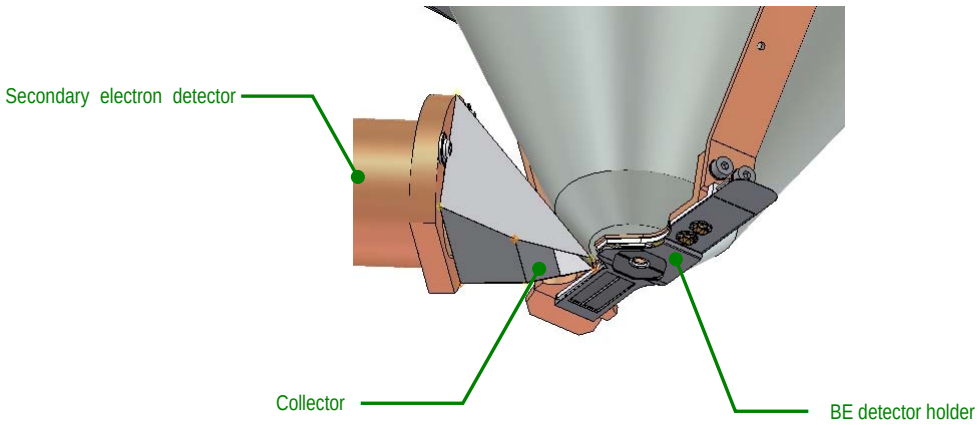
   Mount the orifice or sleeve on the removal tool. Viewing the tool from the underside, turn it clockwise and install the orifice or sleeve.

9. Attach the detector holder again.

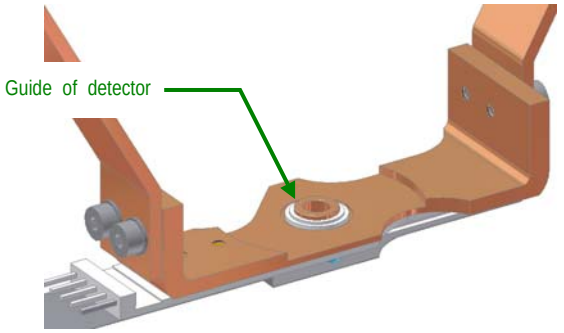
CAUTION !

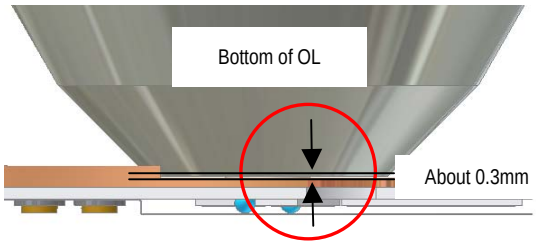
When attaching the BE detector holder again, take care not to touch the collector of the secondary electron detector.

It will bend easily and deform because the collector is made of the very thin material. If the collector will deform, a image quality may be deteriorated.



In case you attach the detector holder again after cleaning the orifice., check that the guide of detector holder has gone into the hole of bottom of OL correctly. (If it attaches correctly, the horizontal gap of between the detector holder and bottom of the objective lens will not be generated.
However, an about 0.3mm space is generated between the bottom of objective lens and detector holder even if it attaches correctly.





10. Evacuate the specimen chamber.

5.8 Accessories and tools

Name	Details	Pcs.
Wehnelt cap removal tool		1
Standard specimen	ZnO; zinc oxide	1
Jeweler's screwdriver	Hexagon	1
Electron gun filament		6
Liner-tube removal tool		1
Fuse	37202000411(0.2A UL) 、0.2A	2
Fuse	313 005MXP(313 005)、5A	3
Fuse	326 008MXP(326 008)、8A	1
Fuse	326 010MXP(326 010)、10A	4
Fuse	326 020MXP(326 020)、20A	1
Socket		1
Spacer	2.2mm	1
Clockwise wrench	Precision	1
LV （low vacuum） related parts		
Specimen stub for LV	φ10＊10	5
Specimen stub for LV	φ10＊5	5
Specimen stub for LV	φ32＊10	1
Specimen stub for LV	φ32＊5	1
Orifice removal tool		1
Screwdriver	For Pirani	1

JEOL service office

If you need to consult with JEOL about the instrument maintenance, please contact your nearest subsidiary company.

Or presume a JEOL homepage in such cases as the information about the product, the inquiry besides that if having an order in the center of the nearby service.

http://www.jeol.co.jp/	Japan
http://www.jeol.com/	USA
http://www.jeoleuro.com/	Europe