

User Guide to Operating the JSM-6510LV SEM

By Susheng Tan

Nanoscale Fabrication and Characterization Facility, Petersen Institute of NanoScience and Engineering,
University of Pittsburgh, 348 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA 15261

Office: M104 Benedum Hall; Phone: (412) 383-5978; Email: sut6@pitt.edu

I. Start the ChamberScope

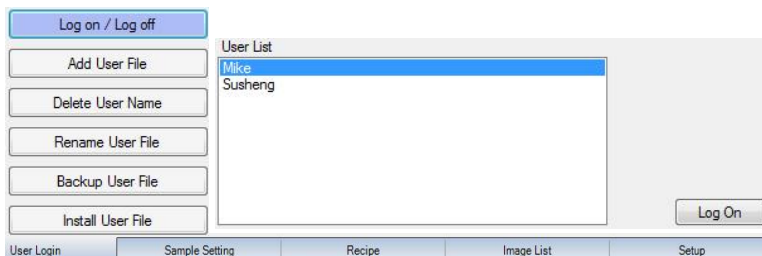


II. Start the SEM Main Menu



III. 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.





IV. Specimen Exchange

1. 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.

2. Vent the specimen chamber.

- a. Click the HT icon  to change it to OFF .
- b. Click **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- e. After the light of the **VENT** button turns **ON**, the stage can be withdrawn to remove the specimen holder.

3. Setting the specimen.

- a. Click the **Setting** button.
- b. If the specimen protrudes above the holder, make sure to input the protruding sample height above the holder in the dialog box.
- c. Set the specimen holder onto the specimen stage.

4. 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.

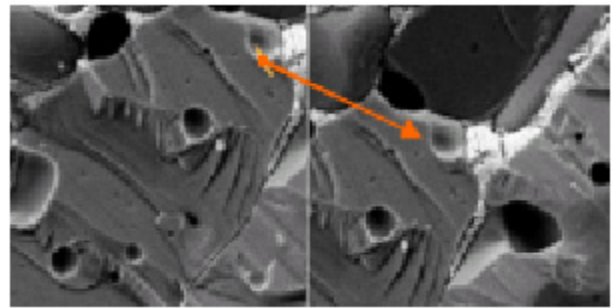
e. Click the **OK** button. The observation condition will be set.

5. 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.
 1. If the sample without coating or containing water is observed as it is, the vacuum mode must be set to the low-vacuum mode.
 2. After the mode is selected, a message will appear. Follow the instructions in the message to change the vacuum mode.

V. Observing a Specimen

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**.
Double-click the left mouse button at any position in main screen. The double-clicked position moves to the center of the screen.
 4. set it at necessary magnification.
 5. Adjust the image quality by using the Contrast  , Brightness  , Focus  and Stig (X, Y)   buttons.



Notes: Observation Condition:

A). Difference of image quality depending on the value of the accelerating voltage

Generally, the more fine structure of the specimen surface appears when using a low accelerating voltage than using a high accelerating voltage.

B). 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 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).

C). 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.

D). Observation of the nonconductive specimen and charge up

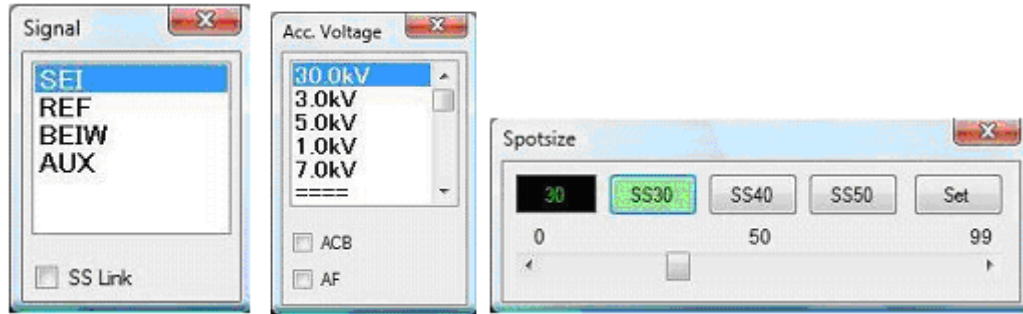
When you irradiate a large current (high accelerating voltage and large spot size) electron beam on a nonconductive specimen, sometimes, electrons accumulate, in other words, charge up on the specimen. For such a specimen, you can reduce the charge-up to observe the specimen by using a low accelerating voltage or the low vacuum (LV) mode. Also, you can increase the emitted electrons by tilting the specimen, resulting in reducing the charge-up.

VI. Operating the Image

SEI 30kV WD15mm SS30 x75,000

Setting the Signal:

1. Click the signal **SEI**, the accelerating voltage **30kV**, working distance **WD15mm**, or spot size **SS30** in the image data display.
2. The relevant setting window is displayed.
3. Double-click on the desired setting in the list.



Signal	Data display
SEI	SEI (Secondary electron image)
BEIW	BEC (Backscattered electron composition image)
	BET (Backscattered electron Topographic image)
	BES (Backscattered electron shadow image)
AUX	AUX
REF	REF (Reflected electron image)

VII. Setting the Scan Rate:



Item	Explanation	Note
Scan 1	For searching field of view and adjusting image quality.	You can select the averaging coefficient and scan rate. A exposure marker can be displayed.
Scan 2	To observe the image.	You can select the averaging coefficient and scan rate.
Scan 3	To observe the image detail.	You can select the averaging coefficient and scan rate.
Scan 4	To observe the more detail than the one at Scan 3 and acquire the image.	You can select the scan rate.
Photo	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.

VIII. Adjusting the Image Contrast/Brightness/Focus/Stig XY

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).

Contrast	Brightness	Focus	Stig X	Stig Y	30	250	1000	10000	75000
					Mag -			Mag +	

Adjusting the image magnification continuously by scrolling the middle mouse wheel.

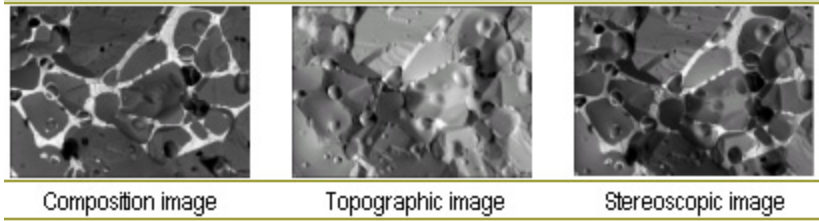
IX. Moving the Field View

- Moving the stage in the vertical (Z) and tilt (T) directions: *use the ChamberScope to monitor Z and/or T to avoid crash the specimen into detector and/or lens.*

X. Observing 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.



- Vent the specimen chamber, and then set a specimen.
- Display a secondary electron image (SEI).
- Click the signal **SEI** in the image data display.
- Double-click the **BEIW** in the Signal setting window.
- Click one of **Compo**, **Topo** and **Shadow** button in the BEI.

At **Shadow**, the shadow level can set with the combo box (1 - 10, EX_Ultra 3-dimensional impression). And, adjustment of the Gain can change to **Auto** (it can set automatically according to the Spotsize and Acc Voltage) or Manual (**High**, **Medium**, **Low**, **Analysis**).




- Adjust the Contrast and/or Brightness to optimize the quality of the backscattered electron image.

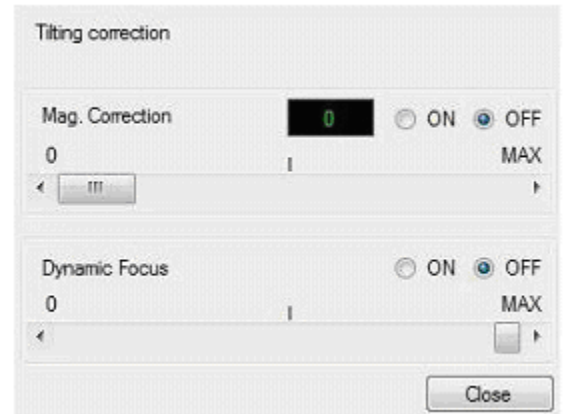
Guideline of the observation condition

	Criterion	Tendency	Caution
WD	10 - 20mm	Image is brighter at shorter WD	Take care lest detector hits 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.	

XI. Tilt correction

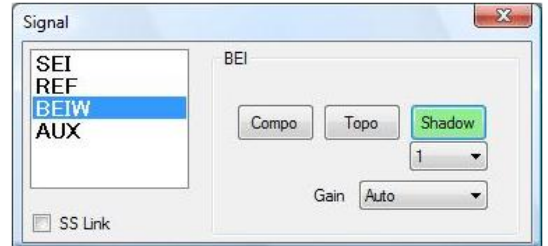
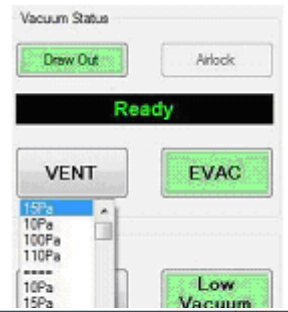
If the focus is not adjusted at both edges of the field of view for a tilted specimen, adjust the focus using the slide bar.

- Adjust the focus at the center of the Live image.
- Click the Tilt icon , or select Menu bar **Tools** → **Tilt Correction**.
- The Tilt correction menu is displayed.
- Select the ON/OFF radio button in the Dynamic Focus or Mag. Correction to **ON**.
- Click the Scan 3 icon  or the Scan 4 icon .
- 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**.



Low Vacuum Mode Observation

1. Set a specimen.
2. Click the **Low Vacuum** button in the Vacuum .
The vacuum mode is switched from high vacuum to low vacuum, and starts evacuating the specimen chamber.
3. Set the accelerating voltage to **15 kV**.
4. Set the pressure of the specimen chamber to **30 Pa.** or the value you desired 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, the flashing stops.
6. Set the spot size to **30 - 60**.
7. Switch the Signal to **BEIW**, and click the **Shadow** button.
8. Set the shadow level to **1**.









9. Click the HT icon  to get HT ON .
10. Click the Scan1 icon .
11. Click the , the  or 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 or not a charge up occurs 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.

Table. Relationship between pressure, charge up and brightness

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