SEM (JEOL, JSM-6301) Operation manual 2014 06 11

The turning on the SEM

1. Turn on the scanning image observation instrument with the **OPE POWER** switch at the rear of the instrument.
2. Rotate the **POWER** key switch to the **START** position, and release the hand from the key. (The key rotates to the **ON** position automatically.)
3. The **ACCEL VOLTAGE READY** lamp turns on at once. (The user should confirm the lamp turning on.)

*Please contact the staff, if the lamp does not turn on.

The sample exchange (The insert of the sample)

1. Place the sample in the sample holder (cylinder), and align the sample upper face and the upper side of the cylinder, using the height adjusting screw (tighten by the screw).
2. Screw the sample exchange rod to the sample holder, and tighten the rod.
3. Put the sample stage to the position where the sample is possible to exchange.
   Confirm the position for the sample exchange: X:25.0 Y:35.0 TILT:000 WD:39
4. Pull the exchange rod, and then fix the sample holder to the stopper.
5. Fit the exchange rod to the sample exchange chamber.
   While supporting the exchange rod by hand, press the vacuum operation button.
6. When the lamp is turned off, rotate anticlockwise immediately the knob of the gate valve of the sample exchange chamber, and then pull out the knob fully.
7. While looking the inner part of the chamber, push in the rod slowly, and fix the sample holder onto the stage.
8. Rotate anticlockwise the rod, and remove the rod from the sample holder.
   Pull out the sample rod from the chamber fully.
9. Push in the knob of the gate valve of the sample exchange chamber, and rotate clockwise the knob. This operation makes a clicking sound.
10. While supporting the exchange rod by hand, remove the rod by pressing the vacuum operation button.

The observation with the SEM

1. Press the **F2** function key on the keyboard.
2. Confirm the accelerating voltage being 0.0 kV (see the second line from the top on the right side screen).
   Turn on the **ACCEL VOLTAGE** switch. The extracting voltage is applied, and the emission

current flows (8 μA) (see the lowest part on the right side screen).

3. Rotate clockwise the **ACCEL VOLTAGE** knob slowly.
   If the emission current rises rapidly, conduct the aging until the stable current is attained.
   When the user observes the sample under low accelerating voltage below 5 kV, the user should set the desired accelerating voltage as follows.
   ① Move the cursor onto the accelerating voltage on the screen.
   ② Press the **INS** key, and type the value of the desired accelerating voltage.
4. Adjust the vacuum degree in the sample chamber to lesser than 7.5×10^{-6} Torr.
   (The black hand points the left area from the yellow line.)
5. Press the V7G button at the lower part of the instrument.

Note: During the observation, if the emission current decreases, press the **EMISSION CURRENT** button (This operation increases the emission current to 8 μA).
The user should perform this operation sometimes, until the stable current is obtained.

The photography method (using the photographic film)

1. Load the film into the camera, and remove the light shielding plate from the SEM.
2. Select the suitable diaphragm value, using the f number knob.
3. Display the selected image for the photographing, on the screen.
4. Focus the camera on the sample, using the **FOCUS** knob. (The focusing of the camera should be performed with higher magnification more than that for the photographing.)
5. If the user detect the astigmatism of the sample image, correct the astigmatism, using the **STIGMATOR(X) (Y)**.
6. Set the magnification for the photographing, and press the **PHOTO-ACB** button.
   Wait for several seconds to attain the suitable contrast and brightness.
7. Press the **PHOTO-LEFT** button for the photographing, and then wind the one sheet of the film.

The capturing of the sample image (save on the MO disk)

1. Insert the formatted MO disk (128 MB only) into the MO drive device, and select the unit for the saving of the image data (among 1-6 units).
2. Display the sample image on the CRT (screen), and perform the astigmatism correction and the image focusing.
3. Press the ACB button to adjust the brightness and contrast of the image.
4. Select the **SLOW** of the scan speed, and observe the image.
5. Press the **INS** key, and type **SLOW␣P3**.
   Press the **RETURN** key to scan once the screen by the scanning line.

6. Restore the scan speed to the **FAST** to save the image data on the MO disk.
   Notice: If the scan speed is not restored to the **FAST,** the data cannot be saved.
7. Press the **INS** key, and type the file name in the space following the **SAVE|A:**.
   Press the **RETURN** key to save the image data on the MO disk.

*To confirm the detail of the image capturing, refer to the manufactures instructions.

The axis adjustment

① The adjustment of the movable diaphragm of the objective lens, and the processing.

1. Set the magnification to 10,000 times, and move the marker object on the center of the CRT screen.
2. Focus the SEM on the marker object, and press the **WOBBLER** button.
3. To minimize the shaking of the marker object on the CRT, adjust the movable diaphragm using the fine adjustment knob (X, Y).

② The correction of the astigmatism

1. Minimize the blur in the image, using the **FOCUS** knob.
2. Minimize the blur in the image, using the **STIGMATOR(X)** knob.
3. Minimize the blur in the image, using the **STIGMATOR(Y)** knob.

If the blurry in the image (the astigmatism) is not corrected, repeat the process mentioned above (1-3).

③ The adjustment of the beam axis

1. Press the **EOS－MODE** button once to select the **SEM1** mode.
   Set the magnification to 1,000,000 times using the **MAGNIFICATION** knob.
2. While the ( ) value of the **CL COARSE** (**EOS** menu, **EOS-1**, **OPTICS**) is increased from 3×10^{-12} to 6×10^{-10} using the **PROBE CURRENT** knob, maximize the image brightness, using the **GUN ALIGNMENT (X, Y)** knobs.
3. Set the magnification to 6,000 times, and repeat the operations mentioned above (2).
4. While the ( ) value of the **CL COARSE** (**EOS** menu, **EOS-1**, **OPTICS**) from 3×10^{-12} to 6×10^{-10} is increased using the **PROBE CURRENT** knob, minimize the moving of the central object, using the **GUN ALIGNMENT (X, Y)** knobs. (When the current is increased, center the moved objects.)
5. Set the value of the **CL COARSE** to 1×10^{-11}, using the **PROBE CURRENT** knob, and then perform the adjustments of the movable diaphragm of the objective lens, mentioned above, ①.

6. Repeat the operations mentioned above (4 and 5), to adjust the object position on the CRT, until the object moving is restricted within 6 mm.

When necessary, perform the operation mentioned above, ②.

Note: The completed axis adjustments prevent the conspicuous moving of the object image, even if the PROBE CURRENT knob is rotated greatly.

Notice: When the current is unstable, the unstable current emission always induces the deviation of the optical axis. To solve the deviation, the axis adjustments should be performed repeatedly.

④ The adjustment of the beam axis (the alternative method)

1. Press the **EOS—MODE** button once, to select the **SEM1** mode.
   Minimize the magnification, using the **MAGNIFICATION** knob.
2. Set the **CL COARSE** value (**EOS** menu, **EOS-1**, **OPTICS**) to **7**, using the **PROBE CURRENT** knob.
   Maximize the image brightness, using the **GUN ALIGNMENT (X, Y)** knobs.
3. Decrease the **CL COARSE** value, and maximize the image brightness, using the **GUN ALIGNMENT(X, Y)**.
   Finally, set the **CL COARSE** value to **1**, to attain the maximum image brightness.
4. Set the **CL COARSE** value to **7** again.

Notice: When the current is unstable, the unstable current emission always induces the deviation of the optical axis. To solve the deviation, the axis adjustments should be performed repeatedly.

⑤ The **CL** correcting of astigmatism

1. Display the **EOS-1** at the right side of the CRT, and change the **STIGMA** from the **OL** to the **CL**.
2. Display the **EOS-2**, and change the **EOS MODE** from the **SEM** to the **ALP**.
3. Set the **SCAN SPEED** value to **2**.
4. To form the complete circle of the beam spot on the CRT, adjust the beam spot shape, using the **STIGMATOR (X, Y)** knob.
5. Change the **EOS MODE** of the **EOS-2** from the **ALP** to the **SEM**.
6. Display the **EOS-1**, and change the **STIGMA** from the **OL** to the **CL**.

Notice: For the observation by high magnification, perform the CL astigmatism correction, when

the OL astigmatism correction does not completely solve the astigmatism.
Adjust carefully the axis of the movable diaphragm of the objective lens.

The sample exchange (The sample removing)

1. Press the **V7G** button at the lower part of the instrument, and press the **ACCEL VOLTAGE** button (The indicator lamp is turned off.).
2. Rotate anticlockwise the **ACCEL VOLTAGE** knob, to diminish the accelerating voltage to 0.0 kV.
   As the alternative method, press the **INS** key, and type 0, and then press the **RETURN** key to diminish the accelerating voltage to 0.0 kV.
3. Confirm the sample stage position where the sample is possible to exchange.
   When the sample was rotated using the **ESR** unit, turn on the **INITIAL SET-ON/OFF** switch, and press the **START** button.
   The position for the sample exchange: X:25.0 Y:35.0 TILT:000 WD:39
4. Pull the exchange rod, and then fix the rod to the stopper.
   Fit the exchange rod to the sample exchange chamber.
   While supporting the exchange rod by hand, press the vacuum operation button.
5. When the lamp is turned off, rotate anticlockwise immediately the knob of the gate valve of the sample exchange chamber, and then pull out the knob fully.
6. While looking the inner part of the chamber, push in the rod slowly, and fit the tip of the sample rod to the screw hole of the sample holder. And, rotate clockwise the rod to fix the sample holder.
7. Pull out the sample rod with the sample holder from the chamber fully. And then, fix the holder to the stopper.
8. Push in the knob of the gate valve of the sample exchange chamber, and rotate clockwise the knob. This operation makes a clicking sound.
9. While supporting the exchange rod by hand, remove the rod by pressing the vacuum operation button.
10. Remove the sample holder from the sample exchange rod.

The completing of the operation

1. Perform the sample removing mentioned above.

2a. Attach the shading plate to the camera holder, and remove the photographed film from the camera.

2b. When the MO disk is used, remove the MO disk from the MO disk drive.

3. Turn off the scanning image observation instrument with the **OPE POWER** switch at the rear

of the instrument.

Note

This operation manual represents only the basic method for the SEM operation.

If the user wishes to understand the detail or the application of the SEM operation, the user should refer to the manufactures instructions, or contact the staff.

Please contact the staff immediately, if any problems for the SEM operation are generated.