

FEI NanoSEM 230 Operating Procedure

Safety Precautions

1. Always wear a pair of clean gloves to prevent contamination of the specimen and column.
2. Ensure that the spacing between the top of the specimen and the final lens is more than 10 mm.
3. Do not slam the chamber door during closure. Close the chamber door slowly and ensure that there is no obstruction.
4. Ensure that the stage is back to 0° tilt before venting the chamber.
5. Do not force open the chamber door when venting. Pull the chamber door lightly to open when unloading / exchanging specimens.
6. Do not touch the exterior of the column during operation to prevent any possibilities of electrical shock.

Operating Procedures

1 Specimen exchange

- 1.1 Place the specimen on the specimen holder using carbon tape.
- 1.2 If the electron beam is on, click on the **HV** button (refer to figure 1 – Beam Control page) to switch off the beam.

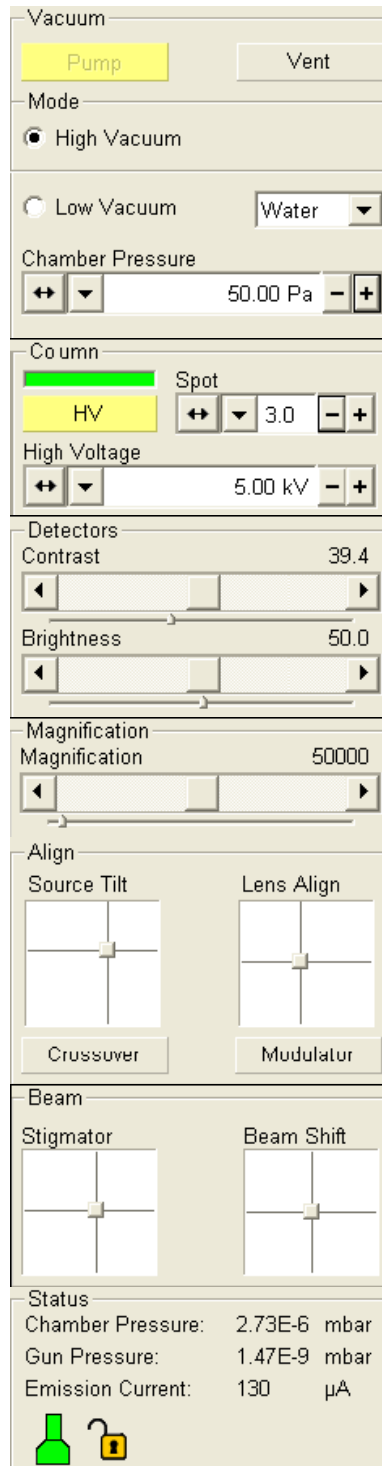


Figure 1 – Beam Control page

- 1.3 Ensure that the stage is at 0° tilt.
- 1.4 Click on the **Vent** button (refer to figure 1) to vent the chamber.
- 1.5 A confirmation dialogue box will appear (refer to figure 2). Click on the **Yes** button to start venting.

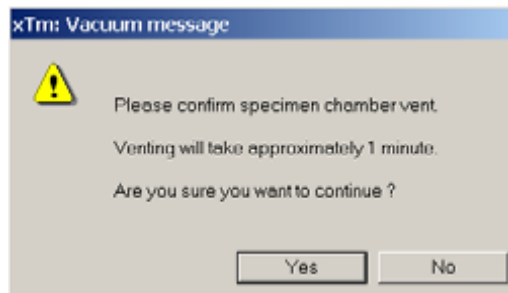


Figure 2 – Confirmation Dialogue window

- 1.6 When vented, open the specimen chamber and placed the specimen into the specimen holder. Secure the specimen stub with an appropriate hex-wrench.
- 1.7 Ensure that the sample height is 10mm or more away from the final lens.
- 1.8 Click on the **Pump** button (refer to figure 1) to pump down the chamber. Hold the top of the door during the first few seconds of pumping. The colour of the chamber will change to green once the chamber pressure is below 2.00E-4 mbar.

2 Imaging procedure

- 2.1 Click on quadrant 1 (top-left quadrant, refer to figure 3) and select **ETD** for the installed Detectors

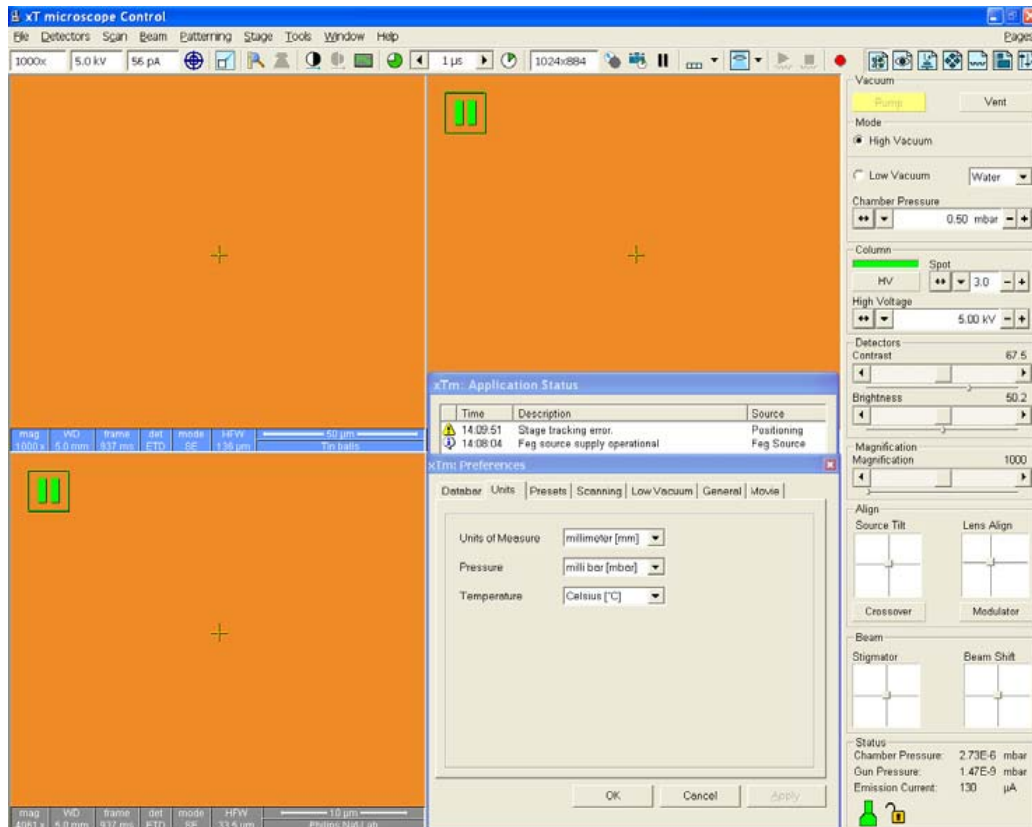


Figure 3 – Main Window

- 2.2 Select the Accelerating voltage relative to specimen type. Select low kV (1 to 10kV) for surface imaging, beam sensitive samples and slightly charging samples. Select high kV (10 to 20kV) for conductors and high resolution.
- 2.3 Select spot 3 for imaging.
- 2.4 Select fast scan rate of dwell time about 0.1us.
- 2.5 Select average 2 to 4 frames for fast filtering.
- 2.6 Select mode 1 (also referred as Field-Free, High Resolution mode, refer to figure 4) for finding the area of interest or when working with magnetic samples.

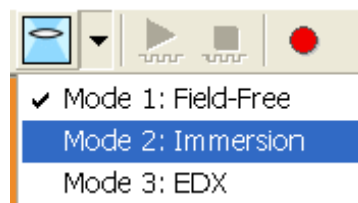






Figure 4 – Mode selection

- 2.7 Click on the **HV** button (refer to figure 1) to ramp up the high voltage.
- 2.8 Begin image scanning by press **F6** or click on the Pause icon  in the toolbar (refer to figure 3).
- 2.9 Focus and optimize the image by correcting the contrast, brightness and astigmatism. For automatic contrast and brightness adjustment, press **F9** or click on the Auto Contrast Brightness icon  in the toolbar (refer to figure 3).
- 2.10 Find a feature of interest with distinct edges on the specimen and focus adjustment to the maximum image quality. To focus, move the mouse cursor over the SEM image in the active quadrant. Press and hold the right mouse button. The mouse cursor will change to double-ended arrow indicating the focus function. Move the mouse from side to side until the image is sharp before releasing the mouse button.
- 2.11 Repeat step 2.10 until the magnification is at least 3000X.
- 2.12 Set the Z coordinate value to actual electron Free Working Distance (FWD) (**Link Z to FWD**) by clicking on the icon  or press on the keys **Shift** and **F9** (**Shift + F9**) at the same time. This icon will change to  indicating that Z is properly linked to FWD. It should be safe to change the working distance by setting a Z coordinate (refer to figure 5).

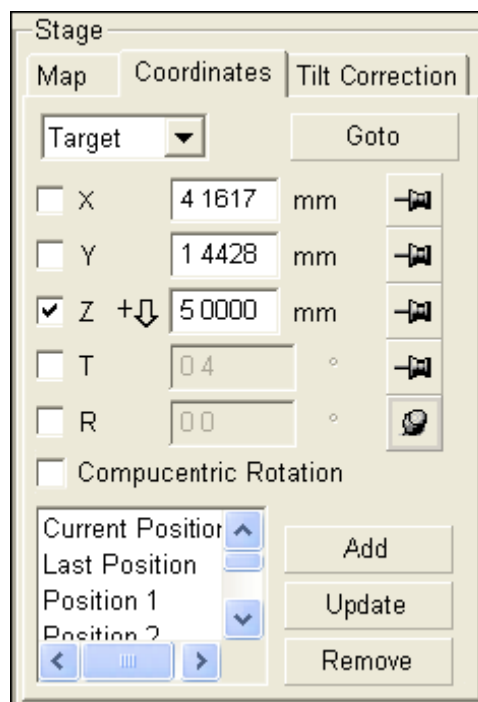


Figure 5 – Coordinates tab

- 2.13 Type 5 (mm) for Z coordinate.

- 2.14 Correct the astigmatism of the image when directional distortion change of 90° between the two out-of-focus conditions is observed.
- 2.15 To correct the astigmatism, focus the image as well as possible (refer to step 2.10). Bring the image just slightly out of focus. The image appears to become sharper in one direction whereas in perpendicular direction image distortion increases – blurring or stretching of the image occurs.
- 2.16 Defocus in the other direction to observe the opposite astigmatic distortion.
- 2.17 Focus to the midpoint between the two directions.
- 2.18 Press **Shift** key and hold the right mouse button down while in the active quadrant. This results in a 4-armed cross appearing on the screen with the cursor at its center. Still holding the right mouse button down, move the cursor around the screen to achieve maximum sharpness. Release the right mouse button when the maximum sharpness is achieved.
- 2.19 Repeat steps 2.15 to 2.18 as necessary.
- 2.20 For ultra high resolution imaging, select mode 2 (also referred as Immersion, Ultra-High Resolution, refer to figure 4).
- 2.21 For image capturing, press **F2** to activates a single preset high resolution slow scan which pauses at the end of the frame. The resulting image can be stored with the **File / Save or Save As** function (refer to figure 3).
- 2.22 At the end of the session, select mode 1 (refer to figure 4) and follow steps 1.2 to 1.8 for specimen exchange or removal of specimen.