FEI 430 NanoSEM Operating Procedure

Description:

The FEI 430 NanoSEM is a field emission scanning electron microscope with ultra high-resolution imaging, Electron Beam Lithography, and platinum deposition capabilities.

To keep the machine in good working order for yourself and others, common courtesy and cleanliness are a must. Any breach, accidental or otherwise should be reported immediately to ensure the fastest repair/remediation time.

Always:

-Wipe off tools with solvent before using them on clean parts.
- Wear Gloves when touching ANYTHING inside the vacuum system.
- Exercise extra care when working on and around the stage, it is relatively fragile.

Never:

-Image magnetic samples with the Immersion Lens
-Put Liquids or powders in the system
- Put Materials that will outgas in the system
    - Un-baked (wet) PMMA/Photoresist
    - Solvents/Liquids/oils
-Touch any part of the high-Vacuum system with your bare hands
    - Anything you touch is contaminated with body oils, which outgas and attract dirt.

Checks:

1. The chiller should be set at 71°F ±3°. If not at the set point, check the cooling water supply and return hoses from the wall.

2. Green light on front of SEM panel should be on.

3. Nitrogen and CDA to the tool regulator should be set to 10 lbs.


4. Cooling water flow between 20-40 liters/hour (orange tabs)


5. Make sure the roughing pump is running.

6. Override the air handler for the time you will be using the microscope.

Sample Loading:

1. Turn on the SEM Monitor
    - The computer should be logged on. If not, login with username: user password: user

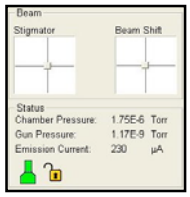
    - Make sure you are on the correct screen. To run the microscope you must be on the Control PC.

Left: Support PC Right: Control PC

    - To switch from one computer to the other, simply move the mouse to the edge of the screen.
        - If this doesn't work, press the button on the "Adderview" box

2. Log in using the username and password that was created for you.

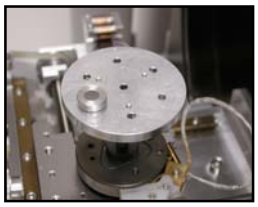
3. Check the pressures and the emission current.
    - Chamber Pressure 10^{-6} Torr
    - Gun Pressure 10^{-10} Torr
    - Emission Current 206 µA



4. Press "VENT" to vent the chamber. Click "YES" on the dialog box that appears.
    - The system may ask you to HOME the stage. If so, click ok and watch the CCD screen. Homing the stage allows the computer to know where the stage is at.

5. After one minute of venting, the chamber door will hiss and is ready to open. Open the door slowly while watching the CCD screen.

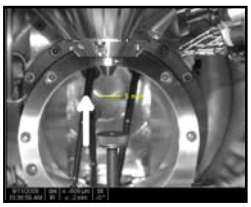
6. Carefully place the sample stub on one of the holes in the stage.

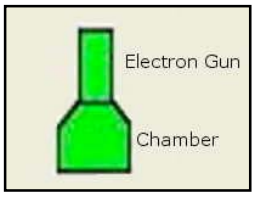
7. When the sample is mounted, close the chamber door while watching the CCD display. Make sure there is enough clearance above the sample, if not intervene if the sample is about to crash into the column.

8. With one hand on the door, press the “PUMP” button to pump the chamber to its correct vacuum.

9. While the chamber is pumping down, bring the highest part of your sample to the marked 5mm working distance line by center clicking near the bottom of the screen and dragging the mouse upwards.
    - 5mm working distance is the eucentric height. At this distance tilt will not change the focus as much as it will at other distances. This is also the safe minimum working distance that will produce better resolution images.

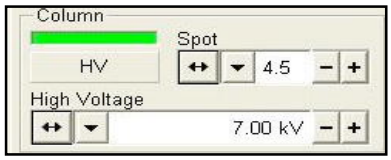


10. When the chamber is pumped out the SEM icon will turn green. You are now ready to turn on the beam.



Imaging:

1. Once the sample is loaded, turn on the High Voltage by clicking the ”HV” button.



2. Set spot size and High Voltage to acceptable values for your sample.

3. The screen should be divided into 4 quadrants. If not, press F5 to go to quadrant mode.

4. The upper left quadrant should be the ETD, click on it and press F5 to make that quadrant full screen.

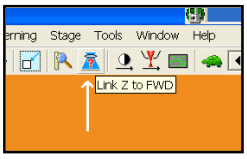
5. Press F6 or the live/pause button to unpause the screen.

6. Focus the image. Focus can be completed by right clicking the mouse and moving it left and right or by using the fine and coarse focus knobs.

7. Zoom (magnify) onto the highest part of your sample. Zoom in to about 2,000x.
    - Magnification can be adjusted by turning the Magnification zoom knob or the Magnification slider on the user interface.

8. Focus again on the highest part of your sample.

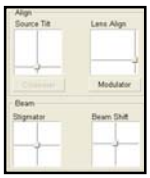
9. When the image is in focus click on the “Link Z to FWD” button.
    - Clicking this button links the WD (displayed on the image screen) with the Z distance shown on the user interface under Stage Control menu.
    - This will allow the software to know the distance from the top of the highest part of your sample to the bottom of the column. This will also prevent an accidental collision between the column and your sample.



    - Your working distance should now be the same as the Z height under the stage menu.
    - Warning: If this link is incorrect, there is a chance the sample could be inadvertently crashed into the column.

Alignment:

1. Check the Source Tilt by clicking the “Crossover” button. The crossover spot should be relatively centered to the green X on the screen.
    - Click the “Crossover button again to deactivate it.
    - You should not have to make any adjustments to the Source Tilt but checking the alignment is good practice.



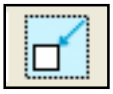
2. Center an object in the middle of the screen and press the “Modulator” button under the Lens Align box.
    - The image should wobble in and out of focus but should not shift. If it does shift, adjust the Lens Align by clicking in the box and moving the mouse in the X and Y direction until the shift is gone.
    - Click the “Modulator” button again to deactivate it.

3. After setting Source Tilt and Lens Align correctly:
    - Alternate between Focus and Stigmation
    - Adjust kV and/or spot size if needed to obtain a sharper image
        - Adjustment to kV will change Lens Alignment
        - Re-adjust Lens Align when change kV

Taking a Picture:

1. Focus and stigmate area of interest at a higher magnification.
    - Changing Scan Rate can help increase resolution or allow easier focus

    - Using Reduced Scan (RDC) allows changes to be seen easier and faster.
        - This will increase the accuracy of your focus and stigmation at higher magnifications.
        - Click the RDC button; change the position or size if the box if desired.



    - Try moving around to different areas on your sample before taking a final image, charging and chemical effects in small areas can distort images.

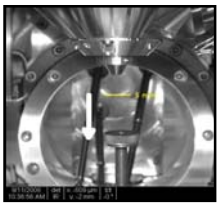
2. When you obtain an acceptable image, Press F2 to take a picture.
    - This will start a slow scan of your image.
    - At the end of the slow scan, a “Save Image” box will appear.
        - Save your image in your named folder in the Shared Data folder.

3. When you are done imaging your sample, pause the live image (F6)

4. Switch to quadrant mode (F5) and turn off the High Voltage.

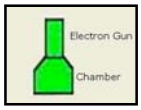
Unloading:

1. Press “Vent” under the Vacuum menu.
2. Watch the CCD to ensure the stage automatically moves the ‘Z’ down to a safe distance from the column.
3. Center the stage by pressing Ctrl+0 (zero)



   - Note: If you center the stage while the Z is moving down, the stage will begin to move back up towards the pole piece. Press Esc on the keyboard or Stop on the User Interface to stop the stage.

4. When the door begins to hiss, slowly pull it open while watching the CCD display.
5. Remove your sample stub with the stub forceps.
6. Watch the CCD while closing the chamber door.
7. Press “Pump” while holding the chamber door closed.
   - Wait until the chamber is at the correct vacuum before logging off.
   - While waiting for vacuum, clean up the sample prep supplies and area.
   - Clean up any spills and throw away any waste.
8. When the vacuum icon turns green, check the chamber pressure to make sure it is back at 10^{-6} torr.



9. Log out of the xT microscope server by going to File>logout.
10. Copy your images from the Support PC to your flash drive.
    - **Never** insert a flash drive into the Control PC.
11. Turn off the monitor.
12. Log in the logbook:
    - Date; Name; Time In/Out; Procedure Used (Imaging or EBL); KV used; and if there were any problems while using the NanoSEM.
13. Turn on the air handler if it is still overridden.
14. Turn off the room lights and log out of door to exit.