FEI Quanta 200 – Environmental Scanning Electron Microscope (ESEM) – SE2, Rm 90E

Only trained users or those supervised by the lab manager are allowed to use this instrument. An exception is for students using the instrument for class, but must be supervised by a trained Teaching Assistant, approved by the lab manager

I. LOGGING IN:

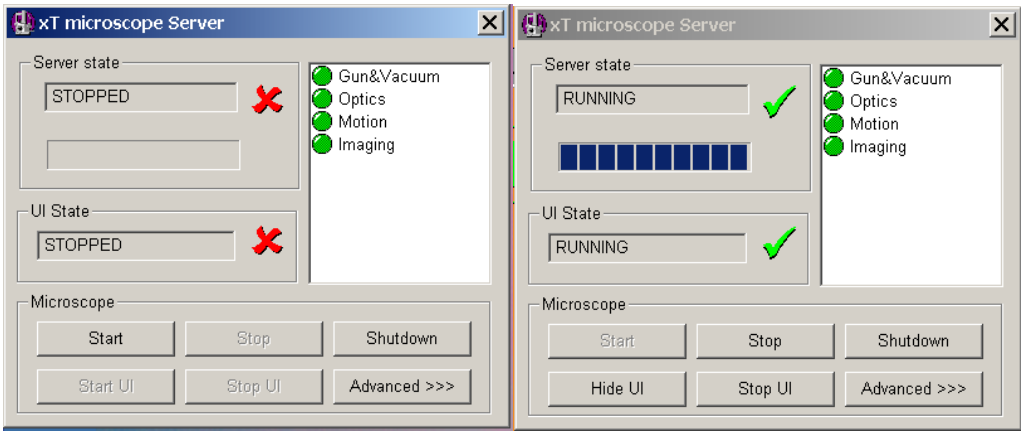
1. Sign into log sheet for FEI SEM (Name, Date, PI, Time in, etc.)

2. Checks:
-The green light on the FEI Quanta should be lit to be "ON".
-The compressed air (at the back of the room) is on (there is a pressure reading!)

3. Login to FEI computer using your UCM ID and password

4. Click on "xT Microscope Server" to open the program.

5. When the server pops up, click "Start" when all the lights are green for Gun&Vacuum, Optics, Motion, and Imaging. The Server State and UI State needs to be checked (RUNNING). Then, Close this window by clicking on the "X" in the top right corner of "xT Microscope Server" Window.

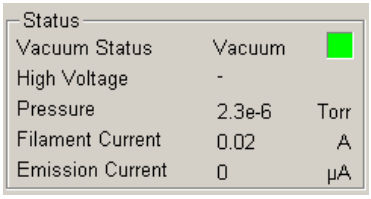


6. Login to with your UCM ID and password again when prompt for "xTm: Log On".

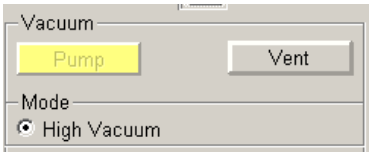
7. The program will ask if you want to home stage. Click "yes". *This re-centers the stage at the lowest Z height.* Wait for the stage to be homed. If you accidently click "no", then you can still home the stage by going to the Stage Menu and going down to "Home Stage".

II. SAMPLE EXCHANGE

8. Make sure that the stage is homed. Check that the vacuum is good (green light). There is a status bar at the bottom right corner.

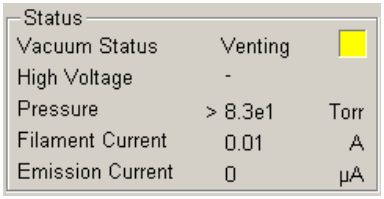


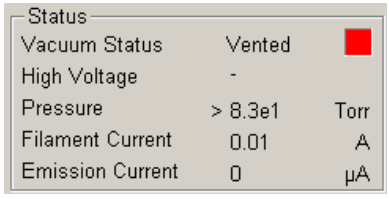
9. Vent the chamber by clicking on "Vent" on the top right corner to change the specimen. Click yes, when the prompt ask "Really vent the chamber?" *You might need to vent twice to open the chamber. You should hear the compressed air go on to vent the chamber.*



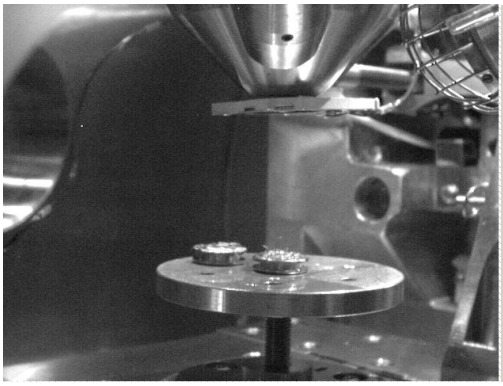
10. The vacuum status will transition from yellow to red. Once the Vacuum Status is "red", open the chamber and insert your specimen.

Caution: When using high voltage mode, all samples need to be conductive, grounded, dry, and stable in a vacuum. Otherwise, high voltage electron beam will damage the specimen and cause charging of your sample. Be sure to use gloves and the SEM stub holder to place your sample in the chamber. We need to keep the vacuum clean, any oil or material that degases will put more pressure on the pumps.

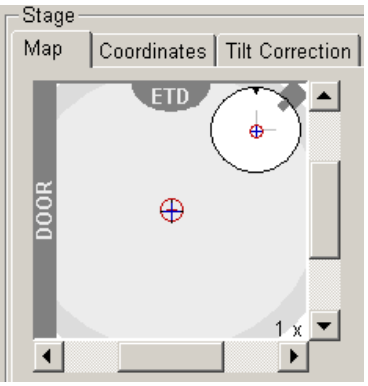




11. Take note of the position of your sample. If you look at the stage map, the IR camera is facing the door from the top right corner of the stage map. The ETD (Everhart Thornley detector) is north of your sample on the stage map. In the IR camera view, the ETD is located to the right. The stage map coordinates are based on the stage map.

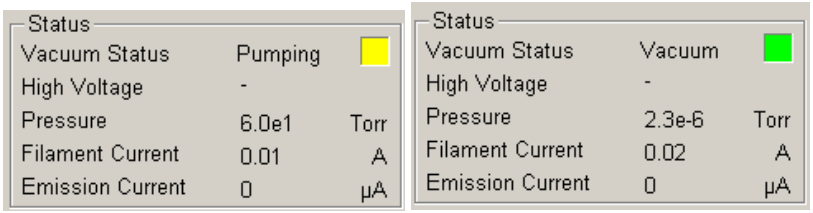


View from IR Camera (facing door)



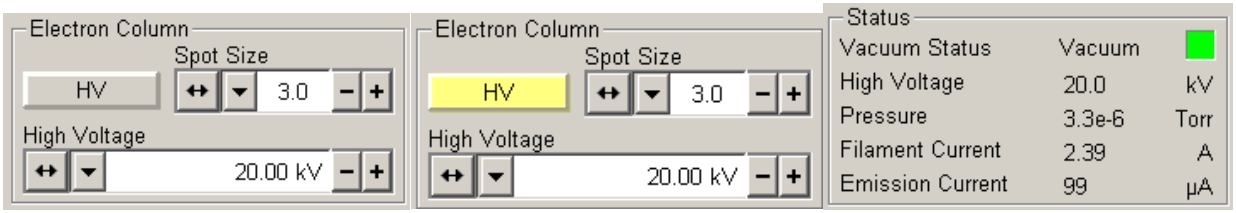
12. **Caution:** After placing your sample in the chamber, make sure your sample fits on the stage and does not hit any detectors inside.

Hold the door gently closed and press “Pump.” The status bar will change from yellow to green when the vacuum is ready.



III. TURNING ON THE GUN

13. Turn on the High Voltage by clicking on “HV”. It will turn yellow when on. Set your desired Voltage and Spot size: either using the drop down menu , the controls, or click on the icon to select your voltage and spot size specifically by moving the scroll bar. The status should show the high voltage, the filament, and emission current (indicates the electron gun is on) status. *If there is no value (???) for emission current, then the filament need replacement (contact the lab manager).*



IV. SELECTING A QUADRANT/DETECTOR

14. Select a quadrant to view your sample. There are three quadrants to view the sample with, and the last quadrant is the IR camera in the chamber. The quadrant you select will be highlighted blue on the bottom. Note: most parameters and controls will only work for the quadrant selected by your click. Make sure you select the correct quadrant.

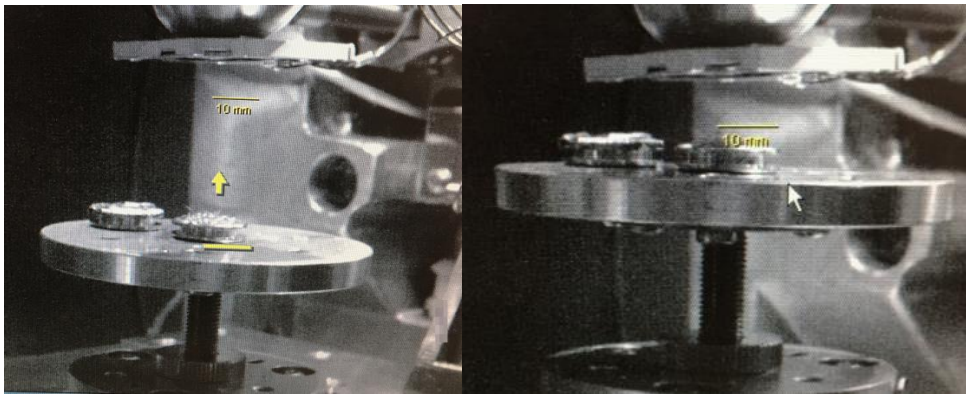
15. If the quadrant is stopped, then un-pause the quadrant by clicking on the “pause” icon ( ) in the tool icons at the top of the screen. . Similarly, if you wish to “pause” a selected quadrant, click on the pause icon while the quadrant is selected (blue). NOTE: IR CAMERA is off when it’s paused.

16. The default detector is the Everhart Thornley Detector (ETD). Select your detector by going to the Detector in menu and select either Everhart Thornley Detector (for secondary electron signal) or Sold State Backscatter Detector. Two quadrants can be active at the same time with different detectors used. Ie. Quadrant I can use the ETD, while Quadrant II can use Solid State Backscatter Detector.

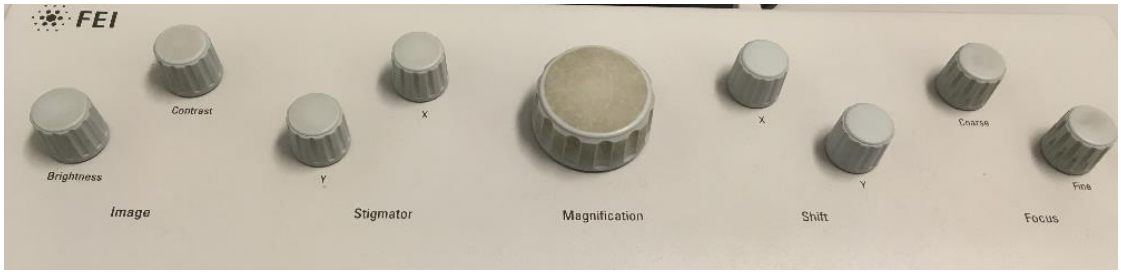
Note: Backscatter detector must be installed in top of the sample for BSE imaging. You can also go into the Detector Menu -> Settings to change detector bias and other parameters related to the selected detector.

V. COUPLING Z TO FWD

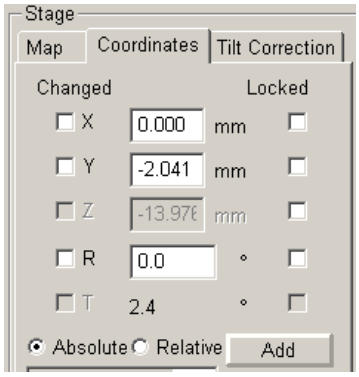
17. To aid focusing in the FEI Quanta 200, the "Coupling Z to FWD" protocol needs to be done.
    - **a.** First, bring the stage height up close to the 10 mm yellow line in the IR camera view. This can be done by selecting the IR camera quadrant and "scroll" clicking your mouse, then dragging the mouse up. A yellow arrow will appear for the direction the stage is moving. Alternatively, the z knob can be used to move the stage up manually. ***Caution: Avoid hitting the detector.***



    - **b.** Using the ETD, focus the highest point on the sample by using the coarse and fine focus knobs on the FEI panel. Zoom in using the magnification knob if needed. Get the image as sharp as possible. Adjust brightness and contrast as needed (using the knobs or scroll panels). Adjust scan speed for easy of focusing using  .



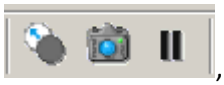
    - **c.** Click on the "Couple Z to FWD" icon () or go from the Stage menu to "Couple z to FWD". The prompt will ask if you have focused on the highest point on the sample. Click "yes" to complete the process.
    - **d.** If done correctly, the Stage Coordinates tab will now have the z parameter would not be grayed out as shown in the following page.



The "Z" value now reflects the "working distance" that is the focal length of the instrument. Working distance is the distance between the final lens in the SEM to the focal point of the electron beam. If the working distance and z value is the same, the sample will be in focus.

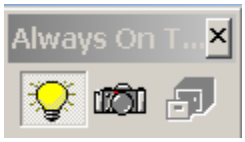
TAKING AN IMAGE

18. If you want to take a good image, you need to optimize your parameters. See the end of this document on how to optimize parameters. To also take a good image, you need to correct the focus and astigmatism at a high magnification than the magnification you wish to take the image at. ***Caution: Sample damage can results as you fine tune for focus and astigmatism, so focus and fix astigmatism at a location you're not interested in and then move to the region you're interested in (ideal for when the sample is flat).***

a. Find a region you wish to view (use the x and y knobs to move or scroll click and drag with your mouse on an active quadrant screen). You can also left click on the image to draw a box where you want to zoom in. (Use a higher magnification than you wish to capture)
b. Focus your sample with coarse and fine focus.
c. Use to the x and y stigmators as extra fine focus to sharpen the image (noticeable for magnifications greater than 1000X only). If desired, usie Reduced area (F7) or Scan -> Reduced area to have a smaller region to view.
d. Repeat the steps between focus and astigmatism to optimize image.
e. To check if astigmatism is corrected, go above focus, in focus, and under focus with the coarse focus knob. If the image streaks in one direction (ie. Up and down) while not in focus (ie. Above focus) and then streaks in the opposite direction (left and right) on the other side of not focus (ie. Under focus), then astigmatism has not been correct. Streaking of the image while out of focus is a sign of uneven lens strength (the cause of astigmatism).
f. Reduce magnification to size you want to capture. Click on the camera icon "Snapshot"  , next to the pause icon in "xT Microscope".

SAVING YOUR IMAGE

19. The xT Microscope UI allows you to take pictures, but does not let you save the images unless you use "xT Docu".

a. For saving images from the FEI Quanta, you need to have the "xT Docu" software turned on. This "xT Docu" software can be minimized by clicking on the "light bulb" in the menu icons at the top  . This minimizes the "xT Docu" window to 

Clicking on the light bulb will switch between the microscope software (xT microscope) and the imaging saving software (xT Docu).

b. Click on the camera icon in "xT Docu" that's next to the "light bulb" icon to transfer the image to xT Docu.

c. To show the data bar, to Image menu -> "Show Data Bar." Then, save the file in TIFF format to retain all data. All files should be saved on your PI's imf server. Ie. //imf-lab03/K-Nguyen. Do not use USB.

LOGGING OFF

20. Take the following steps to logout.

a. Log off on the Sign-up sheet, marking your kV and current used for this session. Note any issues. If serious, send the lab manager an email.

b. Turn off the HV.

c. Home Stage via Stage menu -> Home Stage

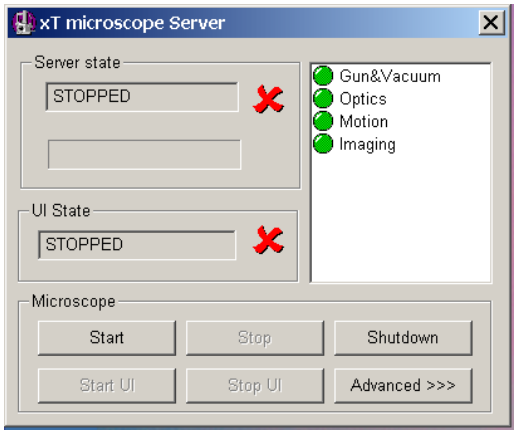
d. Vent the chamber (vent twice if needed) and remove your sample.

e. Pump your chamber to get the green status.

f. Close the "xT Docu" program and "xT Microscope" UI

g. Open "xT Microscope Server"

h. Click on "STOP" and wait for the Server state to be "STOPPED". Close the window.



i. Log off the FEI computer.

EMERGENCY SHUTDOWN

1. In xT Microscope Server, click on Shutdown (Green light will turn off)
2. Log off the computer.
3. Turn off compressed air (back wall, black knob)
4. Turn the breaker to OFF position (back wall)

START UP AFTER COMPLETE SHUTDOWN

1. Turn breaker switch to on (up position)
2. Turn on compressed air
3. Press the button on the FEI SEM (should lit green)
4. Login to computer and xT Microscope Server and Start.

Parameters

High kV

- Higher resolution
- Greater beam penetration
- Higher beam current
- Higher signal to noise
- More x-ray yield
- More sample damage

Low kV

- Lower resolution
- Less beam penetration
- Lower beam current
- Lower signal to noise
- Lower x-ray yield
- More surface detail (lowest kv)

Small Spot Size

- Higher resolution
- Lower beam current
- Lower signal to noise
- Less x-ray yield

Large Spot Size

- Lower resolution
- Higher beam current
- Higher signal to noise
- Higher x-ray yield
- More sample damage

Short Working Distance

- Higher resolution
- Less Depth of Focus

Long Working Distance

- Lower resolution
- Greater Depth of Focus

Small Aperture

- Higher resolution
- Higher depth of focus
- Lower beam current
- Lower signal to noise
- Less x-ray yield

Large Aperture

- Lower resolution
- Less depth of focus
- Higher beam current
- Higher signal to noise
- Higher x-ray yield