

HIM - Orion Nanofab

Standard Operating Procedure

*Revision: 1.0 — Last Updated: Nov. */2009, Revised by Nathanael Sieb*

Overview

This document will provide a detailed operation procedure of the *Equipment*. Formal Training is required for all users prior to using the system.

Revision History

#	Revised by:	Date	Modification
1	Mohamed Boucherit	06/15/2016	Second version
2			
3			
4			
5			

Document No. 4DSOP000X



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General Information

With imaging resolution of 0.5 nm, ORION NanoFab generates high resolution images of your sample. This equipment especially excels in imaging non-conductive samples due to charge compensation technology. Gain new insight from images with a 5 to 10 times greater depth of field compared to images acquired with FE-SEMs.

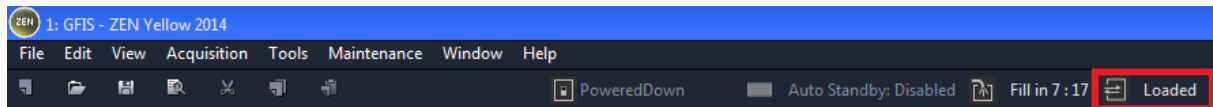
Operation

I- Unloading the sample holder

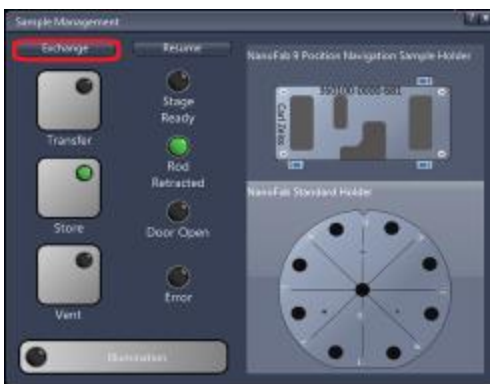
NOTICE: Unloading the sample holder is necessary if you want to insert or remove your sample.

A) Pump the airlock

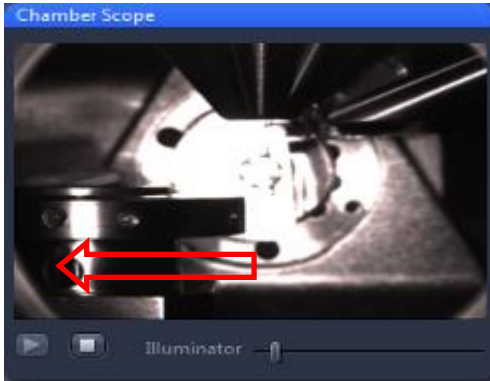
1. On the Tool Bar, click "Loaded" button.



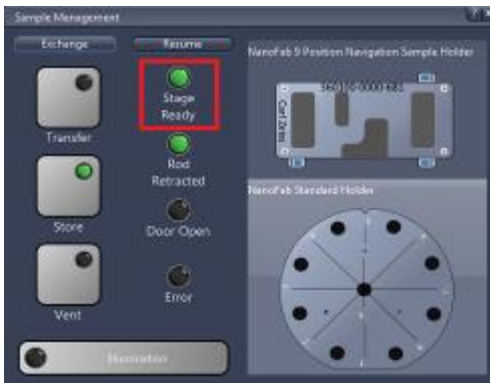
2. The "Sample Management" control panel appears, click on "Exchange" button.



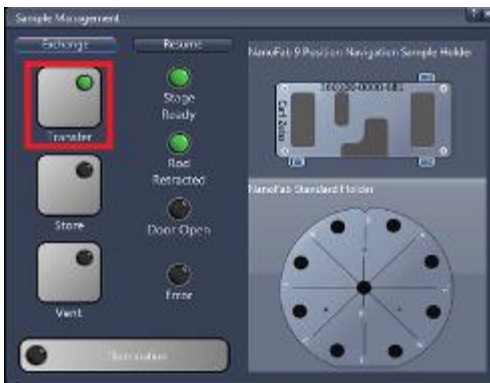
NOTICE: The stage moves from "Resume" to "Exchange" position. You can observe the stage movement through the "Chamber Scope" camera window. If the "Chamber Scope" camera is off, click "Image Start" Icon



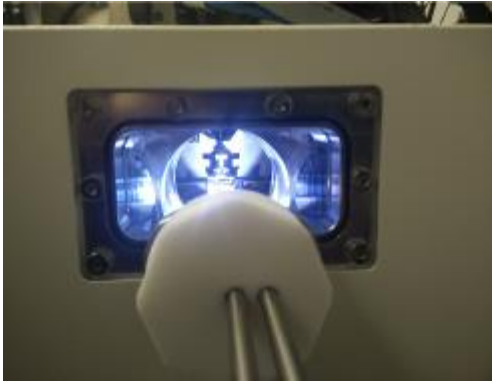
3. Wait until the "Stage Ready" indicator lights up.



4. Click the "Transfer" button. Wait until the "Transfer" indicator lights up.

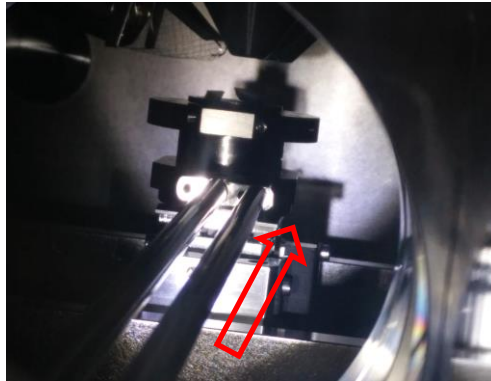
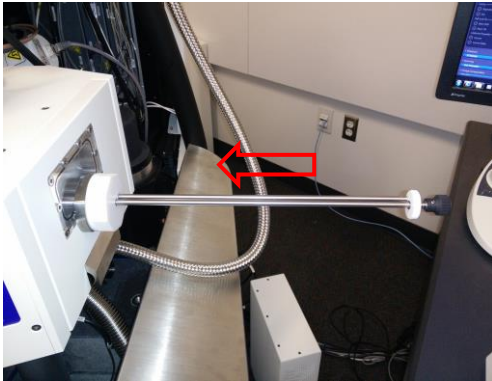


NOTICE: The gate valve opens. You can observe the process through the airlock window.



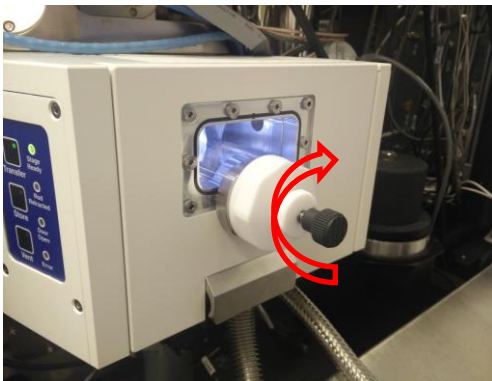
B) Transfer the sample holder from the sample chamber into the airlock.

1. Carefully slide the airlock rod into the sample chamber to the stop.



2. Attach the sample holder to the airlock rod by turning the fixing knob clockwise while observing the process through the airlock window. You can feel if the thread engages.

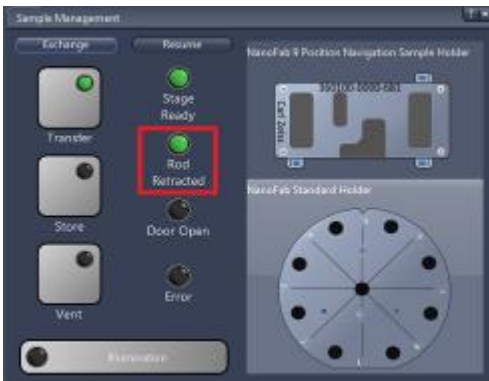
NOTICE: Do not overtighten the airlock rod.



3. Retract the airlock rod while observing the process through the airlock window.

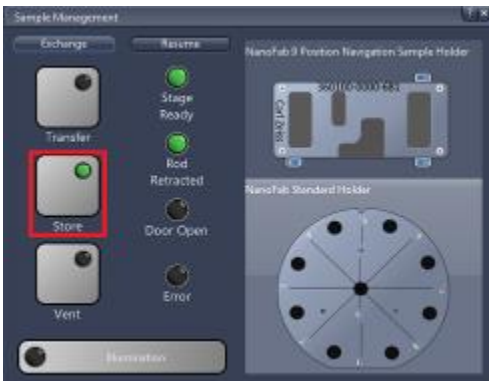


NOTICE: To the airlock rod stop, the "Rod Retracted" indicator lights up.



C) Vent the airlock.

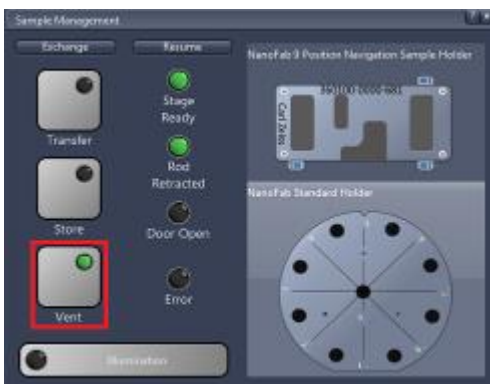
1. On the "Sample Management" control panel, click the "Store" button. Wait until the "Store" indicator lights up.



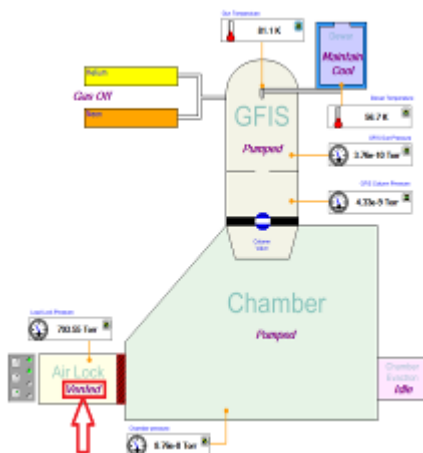
NOTICE: The gate valve closes. You can observe the process through the airlock window.



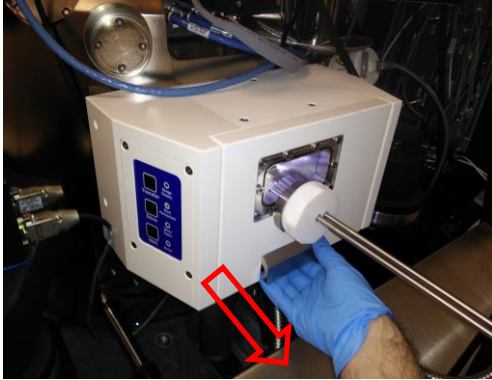
2. Click "Vent" button. The airlock chamber is ventilated with nitrogen. Wait until the "Vent" indicator lights up.



3. On the "Vacuum Dashboard" screen, wait until the "Vented" message displays on the "Air Lock" schematic.



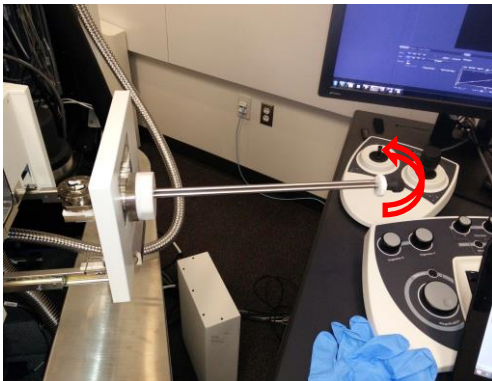
D) Take hold of the airlock handle and open the airlock door.



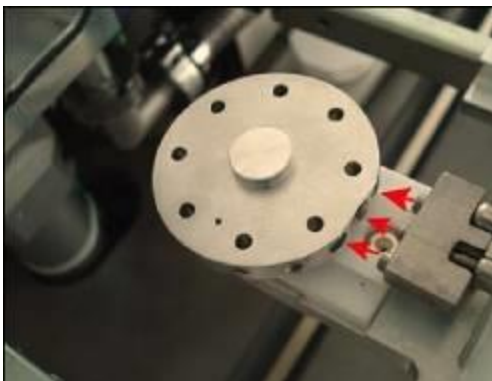
E) Remove the sample holder.

NOTICE: Wearing powder-free gloves is mandatory for the subsequent steps.

1. Detach the sample holder from the airlock rod by turning the fixing knob counter-clockwise.



2. Remove the sample holder from the dovetail fitting by carefully pulling towards the sample chamber.



II- Loading the sample holder

NOTICE: Always wear powder-free gloves when touching sample, sample holder or stage. Fingerprints contain hydrocarbons that can cause vacuum deterioration or prolonged pumping times.

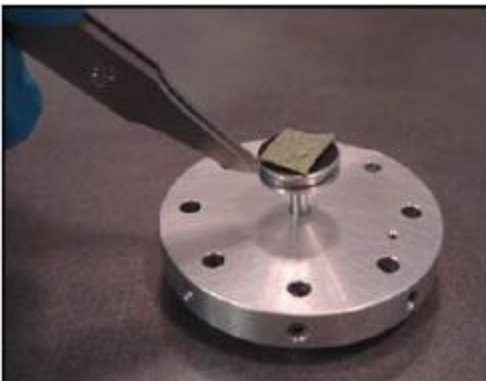
A) Prepare the sample holder.

1. Use carbon double-tape or similar, to attach your sample to the stub.

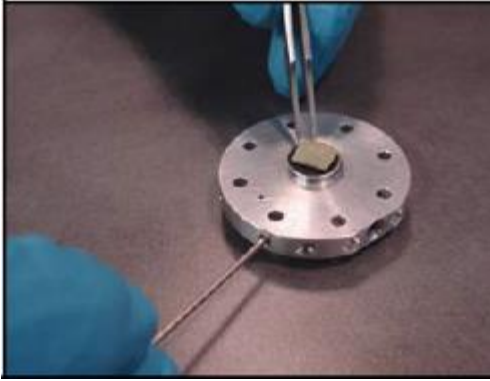
NOTICE: Ensure that the sample is in proper contact with the stub.



2. Insert the stub into the sample holder.



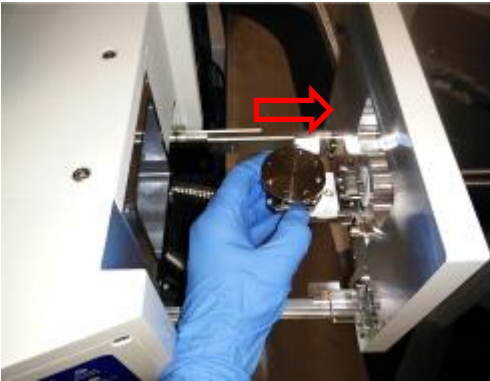
3. Fasten the stub to the specimen holder by tightening the location screw with the Allen wrench.



B) Mount the specimen holder.

1. Mount the prepared sample holder onto the dovetail fitting by carefully pushing towards the airlock door.

NOTICE: The airlock rod must align with the fixing holes of the sample holder.

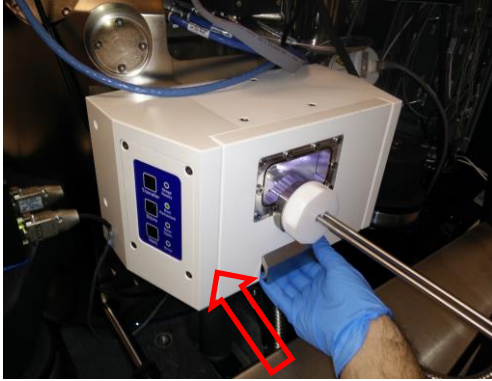


2. Turn the fixing knob clockwise, to attach the specimen holder to the airlock rod. You can feel if the thread engages.



NOTICE: Do not overtighten the airlock rod.

3. Close the airlock door.



NOTICE: On the Airlock Control Panel, verify that the "Door Open" orange LED switches off.

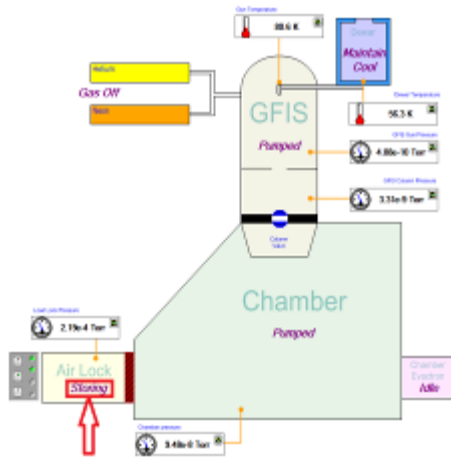


C) Evacuate the airlock.

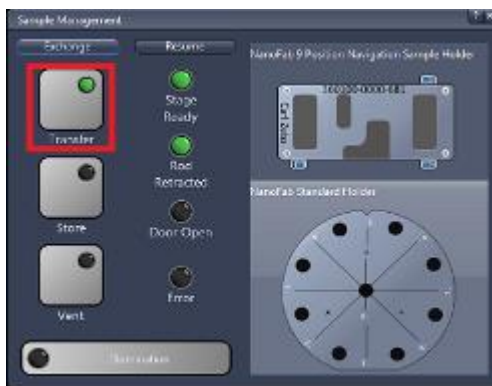
1. On the "Sample Management" control panel, click "Store" button. Wait until the "Store" indicator lights up.



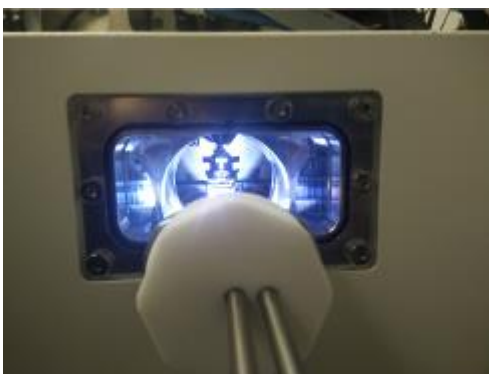
2. On the "Vacuum Dashboard" screen, wait until the "Storing" message displays on the "Air Lock" schematic. Wait until the pressure is below $<5 \times 10^{-3}$ torr.



3. On the "Sample Management" control panel, click the "Transfer" button. Wait until the "Transfer" indicator lights up.

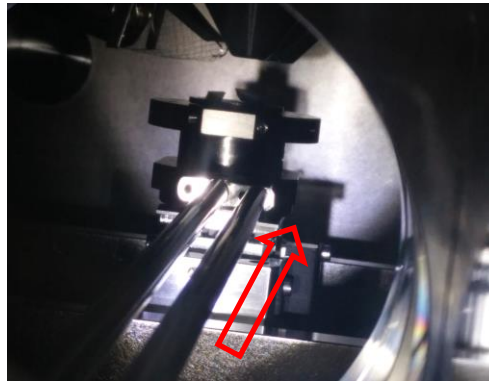
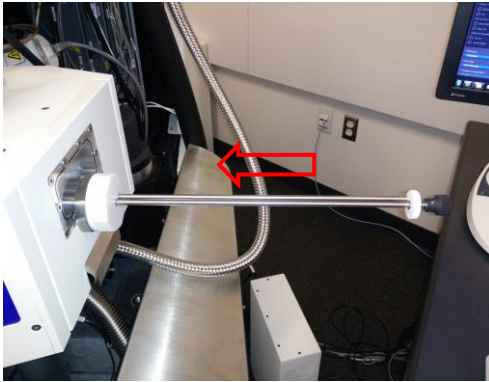


NOTICE: The gate valve opens. You can observe the process through the airlock window.

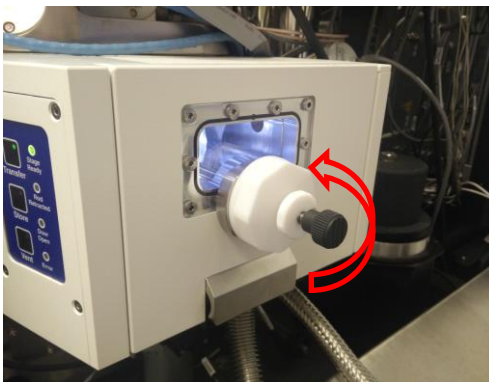


D) Transfer the sample holder from the airlock into the sample chamber.

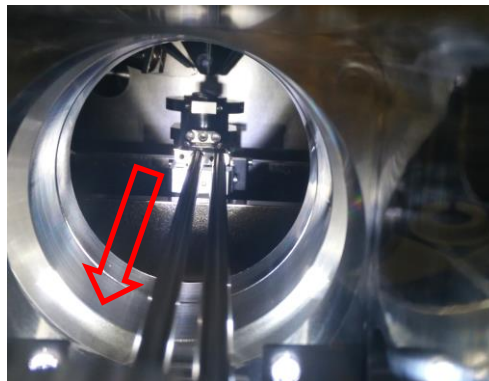
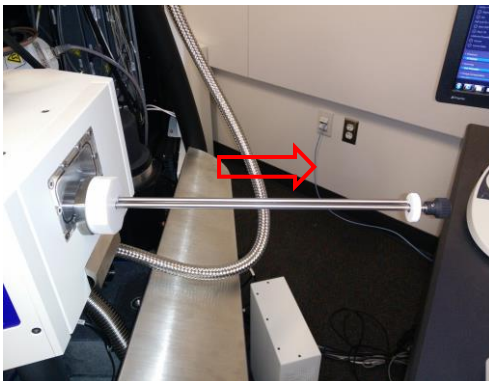
1. Mount the sample holder onto the dovetail fitting of the stage by carefully sliding the airlock rod into the sample chamber while observing the process through the airlock window. You can feel the resistance when the specimen holder slides into the dovetail fitting. Carefully push in the airlock rod up to stop.



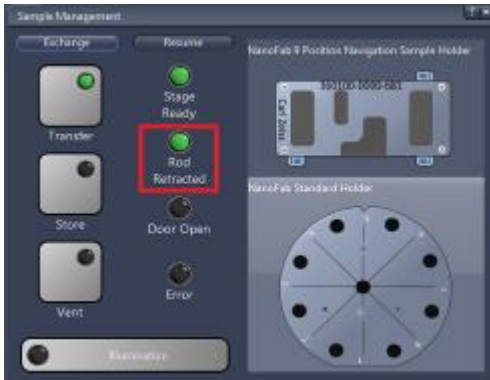
2. Detach the specimen holder from the airlock rod by turning the fixing knob counter-clockwise. Verify that the airlock rod is free by observing the process through the airlock window.



3. Retract the airlock rod while observing the process through the airlock window.



NOTICE: To the airlock rod stop, the "Rod Retracted" indicator lights up.



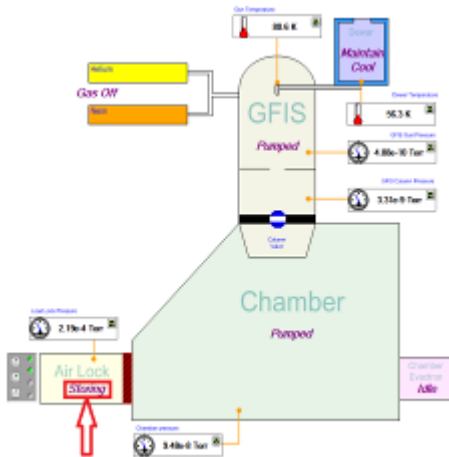
4. On the "Sample Management" control panel, click "Store" button. Wait until the "Store" indicator lights up.



NOTICE: The gate valve closes. You can observe the process through the airlock window.



5. On the "Vacuum Dashboard" screen, wait until the "Storing" message displays on the "Air Lock" schematic. Wait until the Chamber pressure is below $<5 \times 10^{-7}$ torr.



6. On the "Sample Management" control panel, click on "Resume" button.



NOTICE: The stage moves from "Exchange" to "Resume" to position. You can observe the stage movement through the "Chamber Scope" camera window.

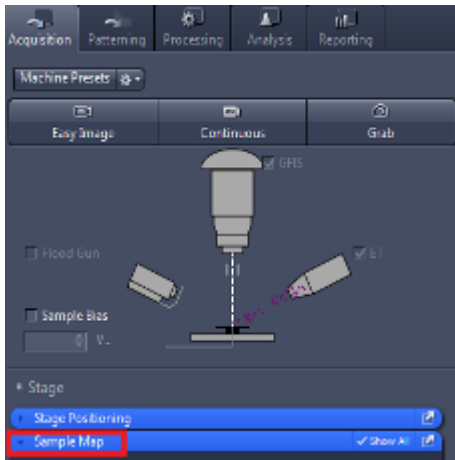


7. Close the "Sample Management" control panel.

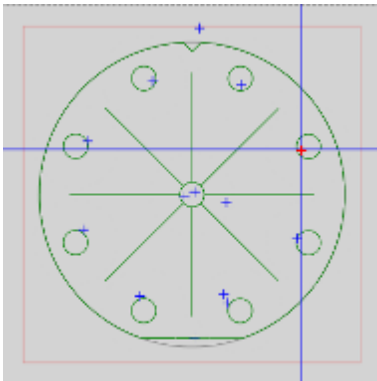
III- Locating the Stub

NOTICE: The ‘‘Sample Map’’ tool allows the sample holder navigation.

1. From the Left panel, select the "Acquisition" tab and expand the "Sample Map" section.



2. Move the stage to the stub position by double clicking on the "sample holder" map.



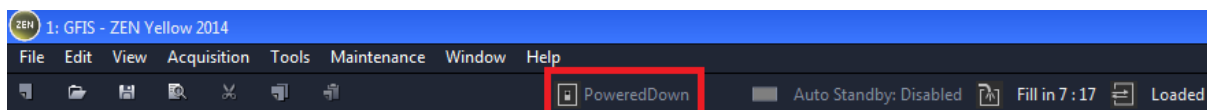
NOTICE: You can observe the stage movement through the "Chamber Scope" camera window.

3. Reduce the "Sample Map" section.

IV) Powering up the Microscope

NOTICE: The Helium Ion Microscope remains in Standby state at all times, except when imaging.

1. On the Tool Bar, click "Powered Down" button.

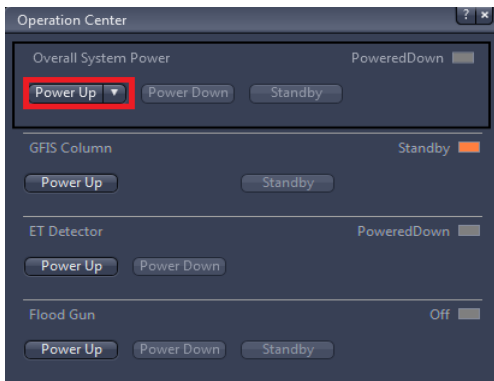


NOTICE: The "Operation Center" dialog opens.

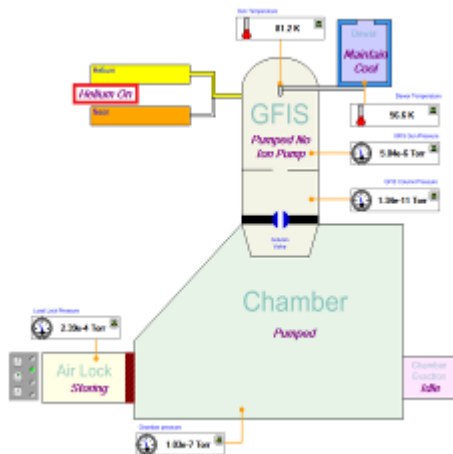


2. In the "Overall System Power" section, press the "Power Up" button to begin the power up sequence.

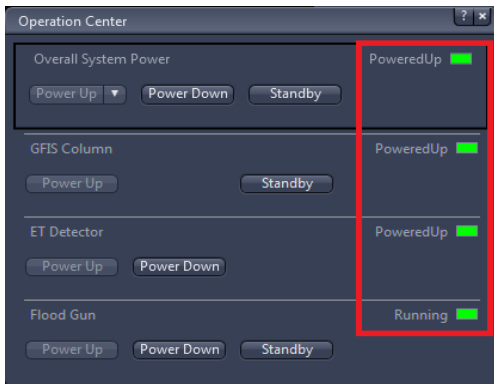
NOTICE: Each of the configured devices will be instructed to go through their power up sequences.



3. Go back to the "Vacuum Dashboard" screen, and wait until the "Helium On" message displays on the schematic.



4. Verify that all the indicators light up.



NOTICE: If the surface your sample is conductive, go to the "Flood Gun" section and press "Power Down".



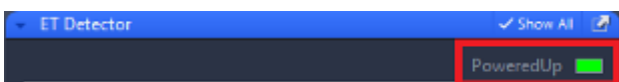
5. Close the "Operation Center" dialog.

V) Generate an image

A) Verify ET Detector is ON

1. From the Acquisition tab, expand the "ET Detector" tool.
2. Check that the Power Status indicator is green and reduce the "ET Detector" tool.

NOTICE: If this is not the case, go to "Operation Center" from the Tool Bar and click "Power up" in the "ET Detector" section (see section IV).



B) Verify GFIS Column is ON

1. From the "Acquisition" tab, expand the "GFIS Column" tool.
2. Check that the Power Status indicator is green.

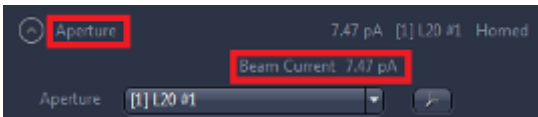
NOTICE: If this is not the case, go to "Operation Center" from the Tool Bar and click "Power up" in the "GFIS Column" section (see section IV).



C) Verify the beam current

Expand the "Aperture" section and check if the "Beam current" is above 5 pA for an aperture size of 20um and a spot control of 4.

NOTICE: If not, please do not operate further and contact immediately the staff in charge of the HIM microscope. There is chance that the "Trimer" atoms of the ion source has disappeared and the staff must perform maintenance to reform the Trimer.



D) Verify Normal Imaging mode is ON

1. Expand the "Imaging Mode" section and check if the Imaging Mode is on "Normal Imaging" state.



NOTICE: if not, click "View Sample" button to switch back to "Normal Imaging" mode.

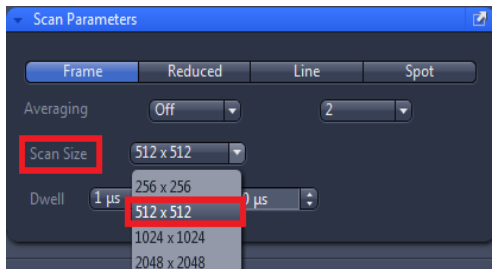


2. Reduce the "GFIS Column" tool.

E) Adjust image size

1. From the "Acquisition" tab, expand the "Scan Parameters" tool.

2. Fold-out the "Scan Size" drop-down list and select the desired image size in pixel (1024x)



F) Start imaging

1. From the keyboard panel, press the Start/Stop button to start imaging.

NOTICE: The ion beam starts scanning across the specimen. A live image is displayed in the imaging window.



2. Adjust the "T/Z" with the T/Z dual joystick while observing the process through the "Chamber Scope" camera window in order to avoid any collision.

NOTICE: If the stage is moved too high, the HIM column can be damaged!



3. Move the stage in ‘‘X and Y’’ directions using X/Y dual joystick to find a detail on your sample surface.

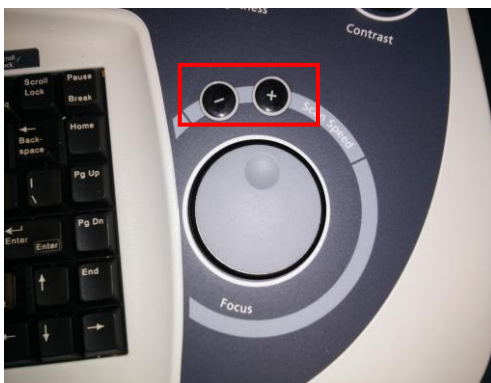


NOTICE: Fine stage movement in X and Y direction can be achieved using ‘‘Pan X and Pan Y’’ turning knobs from the keyboard panel.



G) Adjust scan speed

Adjust scan speed using the - / + ‘‘Scan Speed’’ buttons from the keyboard panel.



NOTICE: Scan speed is shown as ‘Scan Dwell Time’ in the imaging window.
 More you push (-) button, the slower the ion beam scans across the sample.
 More you push (+) button, the faster the ion beam scans across the sample.

H) Adjust magnification and focus

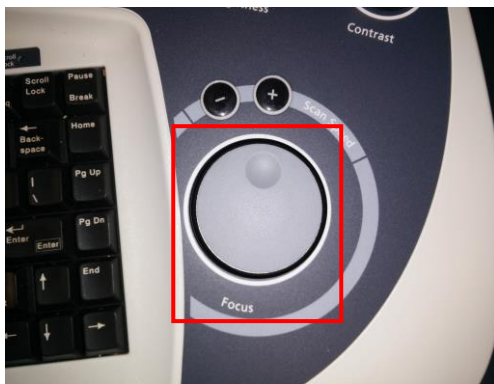
1. Adjust the magnification using the ‘Magnification’ turning knob from the keyboard panel.

NOTICE: The current magnification is indicated as ‘GFIS Field of view’ in the imaging window.



2. Adjust the focus using the ‘Focus’ turning knob from the keyboard panel.

NOTICE: The current working distance is indicated as ‘Working Distance’ in the imaging window.



I) Adjust contrast and brightness

Adjust the image contrast using the ‘Contrast’ turning knob from the keyboard panel. Adjust the image brightness using the ‘Brightness’ turning knob from the keyboard panel.



J) Optimizing the Image

1. Magnify and focus the detail using the respective turning knobs from the keyboard panel.
2. Adjust the contrast and brightness of the detail using the respective turning knobs from the keyboard panel.
3. Correct astigmatism using the ‘‘Stigmation X and Y’’ turning knobs from the keyboard panel until you obtain the sharpest image.



4. To grab a picture, press the ‘‘Grab’’ button from the keyboard panel.



VI) Save an image

1. From the Menu Bar, select File/Save As

NOTICE: The Save As dialog opens.

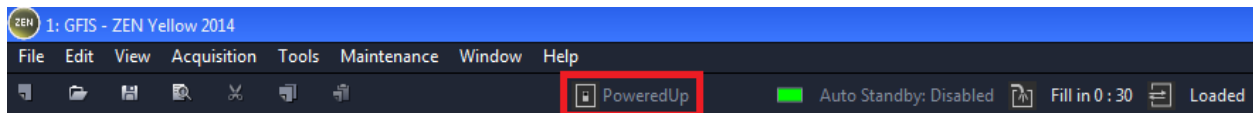
2. Enter a path and a file name.
3. Click Save.

IV) Powering Down the Microscope

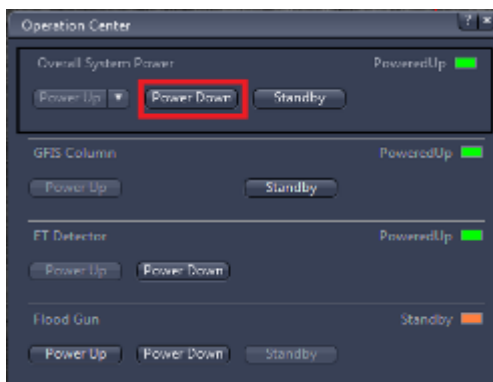
NOTICE: The Helium Ion Microscope must be switch to Standby state when you finish your experiment.

1. On the Tool Bar, click "Powered Up" button.

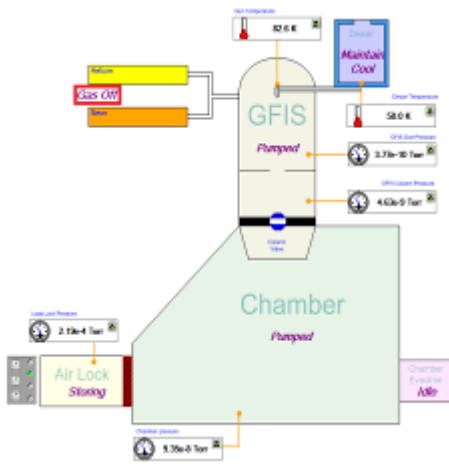
NOTICE: The "Operation Center" dialog opens.



2. In the "Overall System Power" section, press the "Power Down" button to begin the power down sequence.

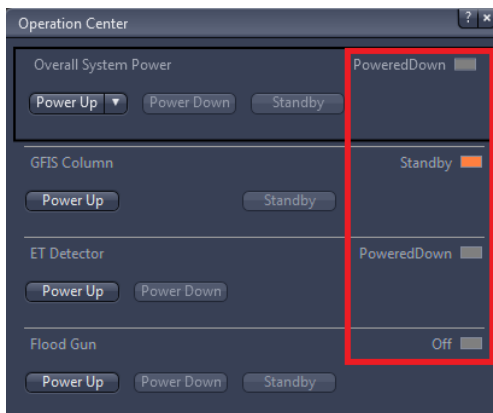


3. Go back to the "Vacuum Dashboard" screen, and wait until the "Gas Off" message displays on the schematic.



4. Verify that all the indicators switch off.

NOTICE: Each of the configured devices have been instructed to go to their power down state, except for the GFIS Column which need to remain in standby state in order to conserve the "Trimer" atoms of the ion source.



5. Close the "Operation Center" dialog.

References and Files

Carl Zeiss help and training notes.

Contact Information

Questions or comments in regard to this document should be directed towards Dr. Mohamed Boucherit (boucherit@4dlabs.ca) in 4D LABS at Simon Fraser University, Burnaby, BC, Canada.