Checklist for Hitachi SU8700 Operation

GENERAL

- The UHR-SEM lab is a high visibility lab and must be kept clean and neat so please clean up behind yourself
- Use gloves when handling samples, sample stubs, the sample shuttle, tweezers, tools, and any other object that is going into the SEM or will touch anything that is going in the SEM.

SAMPLES

- Sample stubs should be clean and free of residual hydrocarbons.
- Samples should be minimally volatile and free from contaminants, i.e., the sample is clean and won't outgas
- If the sample is an insulator, then the region of interest should be located as close to the center of the stub as possible
- Samples are generally mounted using a piece of carbon tape, which is a conductive double-sided adhesive
    - Sample holders with mounting clamps are available
- There are multiple sample stub options including wafer and cross-section and pin mount adapters
    - See Chuck if you are not sure how to mount your sample or want to use a holder that is not out in the lab

SAMPLE LOADING

1. The system should be left with the Exchange specimen window open and there should be a green bar next to EXC in the upper right corner of the GUI. If this is not open, click on the EXC button in the upper right of the GUI to move the stage to the sample exchange position
    - The Exchange specimen window will open when the sample moves to the EXC position
2. Mount SEM stub on the shuttle, screw the stub on until it is tight
3. Adjust the height by releasing the locking collar and turning the threaded rod – tighten locking collar after adjustment
4. Check the sample height with the gauge so there is (minimal) clearance between gauge and the highest point of the sample
5. Push the AIR button to vent the loadlock
6. Open the loadlock door, push the shuttle onto the transfer arm, turn the handle to the LOCK position, and close the loadlock door
7. Push the OPEN button on the side of the loadlock – the loadlock will automatically evacuate and open the gate valve
8. After the gate valve opens, push the shuttle onto the stage using the transfer arm
    - Watch what you are doing through the loadlock door window
    - When the sample is in position on the stage, the SET light should illuminate
    - After the SET light is on, turn the end of the arm to the unlock position and withdraw the arm fully
9. Push the CLOSE button to close the loadlock door
    - The beam cannot be turned on if the loadlock door is open
    - Leave the loadlock under vacuum
10. In the Exchange Specimen window, choose the appropriate sample stub size and click on Finish
    - If the correct size is not shown, choose the next size larger stub
11. A window will appear asking if the user wants to collect an SEM MAP image
    - Auto (recommended) will automatically collect an image of the sample stub
    - Manual will move the stage to the correct position and allow the user to manually set the camera's brightness and contrast settings
    - Cancel will not collect an image
12. Once the SEM MAP is collected, the stage will automatically go to the HOME position
    - Home position, in mm: X = 0, Y = 0, R = 0, T = 0, Z = 8
13. Confirm vacuum is in the 10^{-4} Pa range by observing the vacuum in the STATUS CODE window on the front of the microscope before turning on the beam
14. If it is not open, the SEM MAP can be opened from the Menu (upper right corner)
    - The display may be set to 4 screen mode with the SEM MAP in one of the quadrants
15. Double click on the sample of interest in SEM MAP to place the sample under the beam
    - In practice the registration of the SEM MAP and the actual position under the beam may differ, confirm the correct position using the SEM image

IMAGING

1. In the Optics control tab on the right side of the screen the operator can set the accelerating voltage, spot intensity, and WD
    a. If you don't know what to do, start with a 2 kV Vacc, a 30 spot intensity (in normal probe current mode), No 2 (50um) objective aperture (APT), and a 4 mm working distance
    b. For more information on how to choose SEM operating parameters, see Chuck or Toby, or better yet, take Chuck's SEM short course
    c. The operator can observe which aperture is currently inserted
    d. The operator can also choose Deceleration or Specimen bias mode – see Chuck for more information
    e. VP mode can be chosen from Vacuum settings for observing insulating samples at high voltage (EDS!)
    f. Deceleration mode is useful for insulating samples
    g. Specimen bias mode allows for pure BSE imaging
2. Set the desired stage Z position in the Stage tab in the upper right of the GUI
    a. If the sample fits under the height gauge and the correct stub was chosen, then the sample should not be able to hit the pole piece or insertable BSE detector
    b. A good starting point for Z stage position is 4 mm
    c. Short working distances make better resolution but worse depth of field
    d. The minimum Z stage position for the insertable BSE detector is 5 mm
    e. In deceleration mode, best results will come from a WD of 5 mm or less
    f. For high resolution images, start with a WD or 4mm or less
    g. For EDS, the correct WD is 6 mm (data collection from 8 to 4.5 mm)
3. Turn on the beam by clicking the ON button
    a. The Off button will initially be green with a blue box next to it
    b. When the On button is pressed, it will turn red with a green box next to it
4. Click on the Run button (center top of the GUI) to start scanning
5. Choose the desired detectors for the individual quadrants
    a. Available SE detectors: Upper (in column) and lower (in chamber) detectors (UD and LD)
    b. Available BSE detectors: Middle (in column) and insertable (comes in below the pole piece)
    c. UVD is for SE imaging in VP mode
    d. If you don't know, pick UD, MD, and LD (none or SEM MAP or chamberscope in fourth quad)
6. Find the region of interest, click on Auto contrast and brightness, focus, correct astigmatism, and zoom until you have a reasonable image
7. Align the electron-optical column
    a. First, align the beam – place the beam in the center of the cross-hair pattern – can be done at any magnification
    b. Second, align the aperture in standard mode (at or above 30 kX in magnification)
    c. Last, align the aperture in high resolution mode
    d. Stigmator X and Y can also be aligned in the alignment window
8. Perform the final focus and astigmatism correction – make the image as good as possible at this point
9. To collect an image, click on the camera (capture) icon
    a. To set the capture scan rate, open the Capture settings window from the main menu
    b. In this window there are tabs that allow:
        i. The capture scan rate to be adjusted
        ii. Set the file type, name, image number and save location and if the user wants to save automatically after the images are collected or to display a save as dialog window

FINISHING YOUR SESSION

1. Confirm that data entry and raster rotation are turned off, then turn the beam off
2. Freeze the scan – If VP mode was used switch back to SEM (high vacuum) mode now
3. Retract any movable detectors (BSE and/or EDS and/or EBSD)
4. Click on EXC to move the stage to the sample exchange position
5. Push the OPEN button on the side of the loadlock to open the gate valve
6. Confirm that the transfer rod handle is set to UNLOCK
7. Push the transfer rod in to engage the sample shuttle and turn the handle to the LOCK position
8. Carefully pull the transfer rod back to remove the shuttle
    a. Observe this process through the window
    b. Retract the arm until it clicks into place
9. Push the AIR button
    a. The gate valve will close and the system will vent
10. Remove the shuttle and your sample
11. Push EVAC to leave the loadlock under vacuum
    a. Leave the Exchange Specimen window open in the SEM software
12. Leave the empty shuttle in the appropriate shuttle container on the prep bench
13. If you work longer than your reserved time, please check out using the Lab Management system