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Center for Functional Nanomaterials Brookhaven National Laboratory	NUMBER REVISION 0.1
Subject: Basic instructions for using the JEOL 6500 SEM (including NPGS)	DATE 04/18/2007 PAGE 1 OF 4

(*n.b.* login is itdhelp, password is *V#2001*)

- Loading sample
  - Please use gloves to handle holders. Affix sample to one of the various holders using clips, carbon tape or silver paint
  - To vent loadlock chamber
    - press and hold **VENT** button until it flashes
    - unhook hinge and open door when vented
  - Put holder into clip. The holder only fits in one way, make sure it is flush with the guide.
  - After holder is in place, close door, close latch and evacuate by pressing **EVAC** button – hold down until it starts flashing
  - When the flashing stops and **EVAC** light is steady, the loadlock is properly pumped down.
  - Insert sample by lowering arm and pushing straight in *all the way*. You can use the IR camera by turning the light and screen on and adjusting the brightness.
  - Wait until the **HLDR** light is illuminated and then retract rod *all the way* past the collar and then return to 90 degree position.
  - Open the vacuum gauge on GUI on computer with button **PVG** (Penning vacuum gauge). Gun chamber can be opened when the vacuum reading is at $1x10^{-3}$ Pa or better.
- Starting off
  - Open valve by pressing **Gun Chamber Close** button on front of SEM unit. When the light is *on* the chamber is closed. Press button and after a second, the light should go off. If it does not, it is because the vacuum is not low enough – the system is interlocked.
  - If the screen seems frozen, there is a possibility that the **Freeze** button is illuminated – press the button to unfreeze.

- Set voltage, current, etc. via the Column GUI button (blue hourglass shape). (you can do this before loading sample… at any time, really). If you are just imaging, you will probably use 1, 5 or 15 kV based on the material of your sample; usually a medium probe current (e.g. 6) is good for imaging. [Lithography is done with 30 kV – see litho manual for current info].
- After Valve is opened, you need to turn on the **SEI Detector** via the column GUI. It may read that the detector is on, but it turns off every time the valve is closed.
- Set the holder type in the **Sample Exchange** GUI.
- Set working distance – for high resolution use WD = 4mm.
- After setting the working distance, you can change the Z-stage value to bring the sample into focus. For WD = 4, start by switching Z to 5. Use Alt-Z to hold WD constant and adjust the stage position with **FOCUS** knob on something.

- Imaging
  - There are multiple ways to move the stage:
    - Type values in boxes (X,Y,Z, R (rotate), T (tilt) in lower right-hand side
    - Joystick (note: you can rotate the top of the joystick to rotate sample)
    - Point to a spot on the screen with mouse and **right click** – this moves whatever you are pointing at to the center.
    - You can also electronically shift the image by pointing at something, **left-clicking** and dragging the screen around. You can reset the digital shift with the button on the top.
  - Brightness and contrast can be adjusted using knobs on the console. The **ACB** button does an automatic contrast/brightness correction and is usually sufficient.
  - There are four scan speeds. Two **Quick** and two **Fine** – these can be accessed and toggled using the buttons on the console.
  - Use the **RDC** to use a reduced scan which is useful for focusing and stigmating the beam.
  - Focus and correct for astigmatism using the knobs on the console.
    - The knobs scale with magnification, so start at low mag for coarse focus and continuously zoom in and focus for finer focusing.
    - **Y stig** corrects for Cartesian type astigmation and **X stig** corrects for diagonal.
  - The stage map can be found by clicking the **Stage Map and Control** button.
    - Click on the **Stage Map** tab
    - Click on the **Point Files** button
    - If there are previously saved points in the window, you can clear them by right-clicking and selecting Delete all points.
    - Now you can save points by clicking **Record** – the point where the stage is at that moment will be recorded.
    - Return to a previously recorded spot by double-clicking it.
    - You can also move to a spot by right clicking anywhere in the field.
    - Make sure you have selected the correct holder from the **Specimen Exchange** GUI.
    - Use slider bar to zoom in and out.

        - One useful strategy is to find all four corners of your sample and mark their positions – this will give you a good orientation as to where you are on the sample.
        - Point files can be saved to simple text files if desired.
- Saving images
    - To save an image, set up the image and go to finest scan. Before the scan is complete, hit the **Freeze** button.
    - You can access the Image File Handler via the button, the menu dropdowns or by right-clicking.
    - Images can be saved as JPG, TIF or BMP. I recommend saving as TIF. Make your own directory.
    - **Saving** an image does not imprint the scale bar or any info, but can be recalled later for further annotations, contrast adjustments, etc.
    - **Exporting** imprints scale bar and other info but cannot be altered later (within the SEM software).
    - I recommend using **Save & Export** (until we run out of disk space).
- Finishing up
    - When you are done with your sample, first close the gun valve by hitting **Gun Valve Close** once again (it should illuminate).
    - Move your sample to the exchange position by going to Specimen Exchange GUI and hitting **Exchange**
    - Turn off the SEI Detector.
    - When the sample is at the exchange position, you may remove it.
        - Push the rod all the way in and then slowly retract.
        - The **HLDR** light should turn off. If it didn't you did not grab the sample.
        - Pull the sample all the way out.
        - Hold down **Vent** button until it starts flashing and unhook the hinge.
        - Remove sample.
    - Evacuate loadlock once again, even if you are loading another sample.
    - If you are going to look at another sample, jump back to loading the sample above and start over.
    - If you are done for the day:
        - Set voltage to 1 kV
        - Set current to **Small**
        - Make sure loadlock is under vacuum
        - Make sure the IR/camera is off.

- Misc. Lithography Notes
    - When doing lithography, you almost always use 30 kV
    - Use a Faraday cup to get the right current
        - Use the chart to determine a coarse Probe current setting.
        - Then go to Faraday cup.
        - Turn on picoammeter
        - Zoom into FC/hole all the way so all current is collected.
        - Use **Fine** slider bar to get the exact desired current
    - Use Stage Map to find corners of sample
    - If you are using focus correction, you should focus at each corner of the sample.
    - Blanker use
        - Put blanker in by pressing **Blank** under **Blanker Position**
        - Put blanker in *before* doing focus and stigmation – it will make a difference
        - Blanker defaults to turning the beam off. Hit **Blank** to turn off beam (it will say "beam blanking on"), hit **On** to turn on beam (it will say "beam on" – this is a bit confusing). There is no need to ever hit **Off**.
    - After focusing, aligning, etc. be sure to set the magnification correctly and switch control over to **NPGS** – switch toggles by lifting before switching over.