Operating Procedure for DB StrataTM 235 Dual-Beam Focused Ion Beam (DB-FIB)

Preparation:

- Login system via the computer control located in the hallway on the first floor.
- Enter username and password on the FIB Log-on computer.
- Mount small sample onto an aluminum specimen holder using a conductive media such as carbon tape, pre-metal coating might be need for insulating materials)

Before Loading Specimen:

- Open program by double clicking the XP2.29 Icon if it is not already open.
- The control window on the right can be changed using one of the three buttons located in the upper right of the screen-click the key button to check vacuum status.
- Make sure that the chamber pressure is better than $2X10^{-5}$.
- Click second icon to check stage position-if the z-position is not at -12500 um then change it to this level.

Loading Specimen:

- Go back to the key control panel and click VENT and wait for the chamber to reach atmosphere pressure.
- Put on gloves and pull open the chamber door after the "vacuum status" shows "idle".
- If there is a specimen in the chamber remove it by loosening the allen screw.
- Similarly insert new specimen, ensuring that it is well below the minimum height (using metal measuring tool, the bottom edge gives the maximum height of sample is allowed).
- Click PUMP, cancel error message, and wait for a vacuum of better than 2×10^{-5} Torr.

Start-Up:

- Make sure that High Tension is on.
- Click Beams On button to turn both the electron and ion beams on.
- For normal usage the spot size should read 3, electron beam energy of 5 keV, and ion beam energy of 30 keV.
- Check that the emission current has stabilized at 2.2 μ A—if it has not then slightly adjusting the extractor and the suppressor might help—if it is still not possible then Dr. Nan Yao can assist with heating the source.
- Also, the box reading Emission Current-maintain preset, should be checked (in yellow color).

Obtaining an Image:

- Click E-Beam button and start continuous scan (leftmost button).
- Use focus, brightness, and contrast knobs to obtain an image at low magnification.
- Increase magnification and focus on a small feature.
- Minimize stigmatism using two manual knobs at 5 kx or above.

• Scan rate can be adjusted by clicking on 2nd button from left.

Moving Sample to Working Distance of 5 mm

- Focus on a feature at around 2000X and observe the working distance at FWD.
- Iteratively adjust the sample height higher until FWD reads around 5 when the sample is focused—note that the z-position reading is the absolute position in microns—if you want to move the sample up 1 mm then that value has to be increased by 1000 <u>µm</u>.

Adjust Sample to Eucentric Height:

- Focus on an area near the area of interest and move a recognizable feature to the center (magnification ~1500X).
- Tilt the sample 15 degrees and observe the motion of the feature.
- Use the z-knob and x-knob on the chamber to move the feature back to the center.
- Tilt the specimen to 30 degrees and again use the knob to move the feature to the center.
- Now increase the magnification (~6500X) and tilt to 45 degrees and adjust.
- Continue this process until the feature does not move upon tilting and end the tilting process at 52 degrees which orients the sample perpendicular to the ion gun.

Calibrating the relative positions of the e-beam and ion-beam images:

- Find a recognizable feature and center it in the e-beam image.
- Set ion beam to low current around 30-100 pA and turn on beam.
- Adjust the brightness and contrast of this image and find the feature.
- Use the image shift knobs to move this feature to the center.
- Note: make sure under E-Mag the couple magnification option is selected and use reduce ion beam exposure time to minimize the beam damage.

Micromachining with the Ion Beam:

- Click Ion-Beam button.
- Find the area to cut and take an ion beam image.
- With the image frozen, use one of the tools to outline the area to be cut.
- Set the parameters such as box size, cutting depth, overlap, etc. to minimize cutting time.
- Choose a program (si.mtr is the most common).
- Set Ion Beam current for cutting.
- Recheck focus of ion beam.
- Click start button to begin process.

Depositing Pt Layer:

- Take an ion image of the area to be coated.
- In the GIS box click the button next to MD to start the heating process-the indicator will turn red when it is finished.
- Click "IN" next to MD to insert needle (in second menu) and make sure FWD reads around 5 mm before inserting needle.

- Grab another ion image to ensure that the sample has not moved.
- Use the tools to outline the area to be coated (solid box).
- Set the file to pt_tem.mtr.
- Set ion beam current to 300 pA.
- Check to make sure ion beam is focused and click start.
- When it is finished, remove the needle and switch heat off.

Taking and Saving an Image:

- In E-beam mode select single scan.
- Focus then choose the desired scan speed.
- To save, make sure the window is highlighted and go to Save Image.
- Create a file in PRZ-HTYXWG\FIB user image and save in that file.
- Copy all the files to Z: Drive which maps to a share folder on the computer outside the FIB room for file transfer (see extra note on the FIB computer for details).

Shut Down:

- Stop image collection.
- Set the tilt back to zero.
- Return the z-position to $-12500 \mu m$.
- Select largest aperture on ion beam.
- Set ion beam to highest current 20,000 pA.
- Click Beams Off.
- Click Vent, unload sample, and evacuate chamber.
- Wait until "Vac OK" status appears before leaving.
- Turn off high tension.

Remember:

Sign the logbook and LOGOUT from the Login system in the hallway.

* Please contact Nan Yao (8-6394, 120 Bowen Hall) first if you need to manually adjust the stage height.