**THERMAL EVAPORATOR OPERATION**

This procedure explains the basic operation of the Edwards Thermal Evaporator (AUTO 306 Vacuum Coater with Turbomolecular Pumping System and FL400 chamber) located in the NCF cleanroom (SI 026).

PRIOR TO ENTERING THE CLEANROOM

1. Turn on chiller located along the far wall of the cleanroom maintenance room. The thermal evaporator should not be turned ON until the chiller temperature has dropped to 16ºC (after 20-30min).
2. Fill the 2L Dewar flask stored in the cleanroom pass-through with liquid nitrogen (from SI 028 or ChemStores). Return the filled Dewar flask to the pass-through and retrieve once in the cleanroom; wipe the exterior of the flask using dry wipes and the IPA (isopropanol) bottle located on the shelf.

IN THE CLEANROOM

1. Locate the User’s Log (cleanroom notebook) and record your “Name/lab affiliation” and “Time In”. Additional information will be recorded after deposition is completed. Also, use the cleanroom computer to log in with your IU username and passphrase and fill out the instrument billing spreadsheet.
2. On the Thermal Evaporator unit, press the green power (**I/O**) button ON.
3. Wait for the instrument to initialize. Once the display indicates “STANDBY”, press the blue **RESET** button.
4. Press **START** on the touch screen and wait for the status display to indicate “PUMP READY”. *The system will first back the turbo, and then begin to accelerate the turbo pump. Note that it might take 10-20 min before the status updates to “PUMP READY”. If this does not happen within 20 min, press* ***stop*** *and then the* ***start*** *button again, as the turbo acceleration has had an error.*
5. Once the system indicates “PUMP READY”, add liquid nitrogen to the cold trap located on the left hand side panel of the tool (stop when liquid nitrogen seeps through the bottom of the cold trap).
6. On touch screen, press **VENT** (this takes about 2 min).
7. Open chamber when vented. *Note that no excessive force should be used when opening the door: lift the handle and use minimal pressure (e.g., two fingers only) to test if a gentle pull will open the door.*
8. Examine the chamber. Use the shop vac to remove as much of the metal flakes off the side walls and bottom of the chamber as possible. Check your gloves for metallic particles and change your gloves as needed to prevent spreading particulates to the rest of the cleanroom.
9. Position your samples onto the holder sample plate as symmetrically as possible (use outside positions first). Add the target metal to the appropriate basket (basket should be mounted on one of the four position turrets). Select metallic grains/bits of small and consistent size (~2mm for Cr). Stack the metal pieces along the edge of the basket to ensure contact with the filament. This will help maintain a consistent deposition rate. Make sure that the first metal to be evaporated is under the shutter. Verify that the post holding the basket is nested in the curved part connecting to the live electrode.
10. Close chamber and press **SEAL** on the touch screen.
11. **A.) If you want to proceed without a plasma cleaning procedure**, press **CYCLE** on the touch screen. You should hear the roughing pump turn on and rough down the chamber. After about 2-3 min the high vacuum valve will open and the turbo pump will pump the system down to high vacuum. This last step might take 45-60min (if leaving the cleanroom during this waiting period, make sure that the display indicates “FINE PUMPING” before stepping out).

B.) If you want to use a plasma cleaning step, press the **procedure** button on the touch screen. The roughing pump followed by the turbo pump will pump down the chamber. After reaching a certain pressure the system will switch over to **throttled pumping** mode, which automatically leaks a pre set amount of a leak gas into the chamber. This

creates the low pressure atmosphere of the leak gas that allows the plasma discharge. Switch **LT/HT** knob to **HT** and adjust the current control knob to achieve desired current in the plasma discharge. Clean for desired time (less than 5 min) and turn off the current control knob and switch **LT/HT** knob back to 0. After 5 min of throttled pumping, the system will automatically continue to pump down the system.

1. When the chamber reaches 2x10-6 torr (after 45-60 min), deposition can be started.
2. Press the **PROGRAM** button on the rate/thickness monitor and use the knob to select a film. Then press the **NEXT** button to scroll through and check the parameters (the density of source metal, tooling factor (140), Z-ratio, and your desired final thickness in kA). Make sure that you press the **NEXT** button to save any changes. Press **PROGRAM** button again to exit. (Make sure to double check that final thickness was set correctly).
3. Press both grey buttons **(~POWER** on the left first and then **START** on the right) in the Rotary workholder control to start the sample rotation before deposition.
4. Switch the **LT/HT** knob from 0 to **LT** and, while looking into the chamber, increase the current very slowly using the power knob with digits until you see the metal glow/melt. Make sure to allow enough time for temperature adjustment/stabilization when raising the current by small increments (e.g., 0.5 V). The metal should start glowing around “2”. For Chromium, the current should be set to “3”; the basket should be glowing white for Cr deposition (note that it might be difficult to distinguish the basket’s color if the shielding microslides on the door are already coated).
5. Once the metal is glowing and melting and the sample is rotating, press the **ZERO** button to re-initialize the thickness monitor. Then press the **SHUTTER** button on the rate/thickness monitor to open the shutter and start deposition.
6. Monitor and control the rate of deposition with the current control knob (black knob with digits). It should be between 1-10 Angstroms/sec. For Chromium, the recommended deposition rate is 2A/s or lower.
7. Record the pressure value indicated on the touch screen during deposition and the deposition rate in the User’s Log.
8. Once the set thickness is achieved, the shutter will automatically close. Turn down the current knob to zero very slowly; stop the sample rotation (**START** button then **POWER** button). Finally, turn the **LT/HT** knob to 0.
9. If you want to deposit a layer of a second metal, rotate the source selection knob located below the door to rotate the source turret. Proceed with deposition as per steps 15-21.
10. When all desired films have been deposited, allow the chamber to cool for 15-20 min before opening the chamber, which will minimize oxidation of the samples, basket and residual Cr pellets.
11. Record the remaining crystal life (%) in the User’s Log.
12. Press **SEAL** and then **VENT** on the touch screen. Wait for a few minutes, open chamber and take out samples.
13. Vacuum metal flakes and other debris from the door area, bottom of chamber, turret and base plate. Also, carefully vacuum the (red) seal on the inside of the door. If the protective slides over the chamber window area heavily coated, replace with new ones. Do not remove the Cr basket from the chamber.
14. Close chamber and press **CYCLE** on the touch screen.
15. When the pressure reaches 10-5 torr (after the display switches to “FINE PUMPING”), press **SEAL.**
16. At this point, it could take a few hours for the system to evacuate any residual water vapor so the tool should not be stopped yet. Either leave the tool in that state until the next day or wait 3-4 hours before pressing **STOP** on the touch screen. The system will then decelerate the turbo pump for ~5 min.
17. When the touch screen reads “system status: STANDBY”, press the green **I/O** button to turn off the instrument.
18. If the instrument has been turned off, wait at least 30 minutes and then turn off the chiller in the cleanroom maintenance room. Otherwise, leave the chiller turned ON until the next day.