Standard Operating Procedure (SOP) for Shared Equipment:
Electron Beam and Thermal Evaporator

Approved materials for use in this chamber: Au, Cr, Pd, Ni, Cu, Ti, Pt, Ag, In, Al
New materials have to be approved and tested – contact ‘super user’

The stand-by mode of the system is:
- Mechanical pump on.
- Water chiller off.
- Controllers in the instrument rack: filament, high voltage, sweep controller and key switch: all off.

Preparing Chamber for Deposition:

1. Make sure the following is off before venting the system:
   - High voltage on the instrument rack
   - Water chiller
   - Sweep controller

2. Vent the system: (1st, make sure the pressure in both N2 tanks are >100 psi).
   - Open N2 tank labeled “venting”.
   - Turn off the vacuum by switching off the “mechanical pump switch” on the front of the evaporator.
   - Wait ~15 min (green LED should turn on). It should be atmosphere (~750 torr). Wait additional 5 min after the LED light turns ON before opening the bell jar.

CAUTION: Do not completely rely on the green LED before opening the bell jar. Wait a minute or two after the system reaches atmosphere before opening it. Opening the bell jar before the system is completely vented can cause damage to the system.

3. Bring the bell jar up by holding the “bell jar” button up. Once the bell jar is at an appropriate height then you can take off the sample holder by unscrewing the three screws that hold it and twisting it. Load samples onto sample holder and place back.

CAUTION: Be careful not to drop the holder or knock anything in the chamber such as the deposition sensor or the shutter as it might break.

4. Place any deposition materials as needed for thermal sources “boats” or e-gun sources “crucible liner in the rotating carousel” (please provide your own crucible liner and material to avoid contamination) as follows:
   - Crucible index 1: Aluminum, other aggressive metals
   - Crucible index 2: Chromium, Titanium
   - Crucible index 3: Palladium, gold, or other inert metals
   - Crucible index 4: Silicon dioxide, or other oxides
   - Front thermal boat (B): Aluminum, other similar metals
   - Back thermal boat (A): Gold or other inert metals

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5. Verify that both shutters are closed and that the sensor is active on the deposition controller. Replace if sensor’s life is below 70%.

6. Place new glass slides on the side view-through glass windows.

**CAUTION:** Performing evaporation without glass slides can permanently coat the view-through glass windows, and avoid monitoring the e-beam as it sweeps in the material pocket. If e-beam sweeps outside the liner it will produce permanent damage to the system.

7. Lower the bell jar and make sure it is well secure with the feed through collar.

**CAUTION:** Make sure there is no debris or metal on the o-rings on the feed through collar. If so vacuum and wipe it away thoroughly. Bringing the bell jar down embeds the metal into the o-rings and ruins them.

8. Turn on the vacuum by switching on the “mechanical pump” switch. In about 45 minutes (this time varies) the system should be at an operating pressure < $5.0 \times 10^{-6}$ torr.

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**Electron Beam Operation:**

There are two operation modes: manual (MAN) and automatic (AUTO) for the e-beam evaporation process. In manual mode the deposition controller is bypassed and the user controls the emission current, hence the evaporation rate, using the manual knob. In automatic mode the system interlocks with the deposition controller in order to perform automatic evaporation. This operating mode (AUTO) is not recommended for inexperienced users and should be avoided at all times.

1. Open the N2 tank that drives the shutter.
2. Program the desired thickness in the deposition controller. [As a general use, process X uses film X recipe] For example, film 2 corresponds to chromium and process 2 uses film 2.
   a. Go to process X in the deposition controller menu.
   b. Select film X and click edit.
   c. Update the desired thickness set point.
3. Turn on the water chiller.
4. Turn on the interlocks key to manual (one click counterclockwise).
5. Turn on the X-Y sweep controller.
6. Turn on the high voltage mains breaker.
7. Turn on high voltage by pressing the white button. The display should read ~10 kV.
8. Turn on the emission.
9. Slowly increase the emission current until a glow is see inside the chamber. At this state check through the view-through glass window and confirm that e-beam is sweeping in the material.
10. Open the manual shutter and continue to increase the emission current. The emission knob is very sensitive so anytime operate with extreme care and keep monitoring the evaporation rate in the deposition controller.
   **CAUTION:** This step is very important. Failure to do this will avoid the deposition sensor read any evaporation rate. Hence, the user would naively increase further the emission current to the point of potentially damaging the system.
11. Once the evaporation is at the desired rate click on start layer, and then start film on the deposition controller. There should be a knock produced by the automatic shutter.
12. Monitor the evaporation rate and adjust the current as needed in order to keep your desired evaporation rate.
13. The system will close the shutter automatically once the thickness reaches the set point.
14. Decrease the emission current slowly.
15. Turn off the filament.
16. Turn off the high voltage by pressing the off button. Wait ~5 minutes to let the high voltage electronic system cool down, especially after long evaporations.
17. Turn off the high voltage main breaker.
18. Turn off the X-Y sweep controller.
19. Turn off the interlocks key (one click clockwise). Wait ~10 minutes to let the chamber cool down.
20. Turn off the water chiller.
21. Turn off the mechanical pump and wait for venting. Green LED lights up.
22. Open the bell jar by pressing the “bell jar” switch up until chamber opens. Follow same guidelines for opening the chamber as described in the “Preparing Chamber for Deposition” section.
23. Un-mount sample holder, remove samples and place it back to the chamber.
24. Vacuum the chamber thoroughly and wipe o-rings with isopropanol if metal debris is present.
25. Close the bell jar by pressing the “bell jar” switch down.
26. Turn on the mechanical pump. Do not leave the room until pressure is < 1.0 x 10^-2 torr (~3 minutes). If it does not reach that pressure notify the super user.

Remove all trash left behind and be courteous with other users by leaving a neat clean and organized common working area.

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Thermal Evaporation Operation: SOP in process