

# **THERMAL EVAPORATION UNIT (for Al evaporation)**

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**System Operator:**

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## **Checklist before turning ON the system:**

- ✓ Make sure the chiller is ON and the chilled water is circulating on the system, if not, turn it ON and OPEN the inlet and outlet valves for Al-evaporator (If the chiller is not ON, switch it ON going through the instructions next to the chiller)
- ✓ Make sure the availability of Liquid Nitrogen (LN2), if it is not available in the containers, get it from LN2 plant (If LN2 is not available in the lab, DO NOT plan any process)
- ✓ Make sure the availability of required apparatus and chemicals; such as, tweezers, Al target, lint-free cloth, IPA, etc.
- ✓ Make sure about the planned electrical shut-down if it is within 2hrs don't plan your process (If there is any, DO NOT plan any process)
- ✓ Wear Hairnet, Facemask and Gloves before operating the system

## **Instructions for Operating the System:**

1. Switch ON the main switch on the right side of the system
2. Switch ON the rotary vacuum pump by pressing the green rotary vacuum pump starter button on the front panel
3. Switch ON the pirani gauge
4. Check the rotary pump by means of Gauge Head-1 for its satisfactory operation every day
5. Open the combination valve to backing position. Wait till the pressure falls below 0.05 mbar in order to switch on the diffusion pump
6. Switch ON the diffusion pump by selecting the diffusion pump rotary switch to DP position on the front panel. The diffusion pump will take about 30 minutes to reach the operating temperature (mean while clean the chamber and load your sample)
7. Vent the chamber by opening the air admittance valve
8. Open the chamber when the pressure inside is equal to the atmospheric pressure. A subtle sound from the interlock confirms that the chamber is ready to be opened. Open the chamber and slide it on a side.
9. Check the condition of the filament, if found in a very bad condition – needs to be replaced, ask system owner and/or the operator in the working hours. Do not plan any processes till then and MAKE AN ENTRY FOR THE SAME IN LOGBOOK. Go to SHUT DOWN procedure for the system (Point No. 23 onwards)
10. Load the filaments or boats with the Al rod and fix the substrates on the work holder
11. Close the chamber door by aligning it to the base. Slowly pull down and push from the shaft and chamber top. Close the air admittance valve
12. Close the backing valve and open roughing valve by turning the handle of the combination valve towards the top position
13. Select Gauge head 2 in pirani gauge
14. When gauge head 2 show 0.05 mbar pressure close roughing valve, open backing valve
15. If by this time DP is warmed up (30 minutes) then go to point 15 else wait for the warming up of DP (30 minutes to complete)

16. Liquid Nitrogen (LN2) needs to be poured in to the LN2 trap before the HIVAC valve is opened. This ensures that DP oil vapors will condense without entering in to the chamber.
17. When gauge head 2 shows  $1 \times 10^{-3}$  mbar, switch OFF pirani gauge and switch ON the penning gauge. Do not keep the penning gauge on for longer time. Intermediate checking would be preferable. Wait till the penning gauge indicates vacuum less than  $2 \times 10^{-6}$

**18. Steps for performing thermal evaporation is as follows:-**

- A. Switch on the mains for LT (1/2)
  - B. Verify that the current adjustment knob is in its minimum position
  - C. Switch ON the LT (1/2) circuit breaker
  - F. Looking through the view port of the chamber, very slowly increase the LT current knob
  - G. As the current is increased, with the clockwise turning of the LT knob, the material in the boat starts heating up
  - H. Check the pressure in the chamber on the penning gauge. If the pressure is increasing too much (i.e. Crossing  $1 \times 10^{-4}$  mbar) reduce the current by turning the LT knob anticlockwise and keep at a lower value (not zero) till the degassing is complete
  - I. After degassing is complete and when the pressure reaches the minimum value increase the emission current
  - J. When the material in the boat starts melting, open the shutter
  - K. When the required thickness is reached close the shutter, bring the LT knob to minimum position to make the current zero, switch off the LT circuit breaker  
When the evaporation is complete switch OFF the LT(1/2)
19. Switch OFF the Penning gauge. Wait for 15 minutes and then, close the HIVAC valve
  20. Vent the chamber by opening the air admittance valve
  21. When the chamber pressure reaches the atmospheric value, open the chamber and take out the coated substrate. Handle the fresh films with care
  22. Reload the work holder and filaments when necessary and proceed as before for the next cycle of evaporation.

**Procedure for shutting down the system:**

If there is no other sample for deposition after step 20 above, close the chamber, close the air admittance valve and follow the procedure for shutting down the system

23. Switch OFF the diffusion pump
24. Pump the chamber down to  $(10^{-4})$  mbar or better

25. Continue to run the rotary pump for a period of at least 30 minutes, keeping the combination valve on the backing position, and keeping water supply to DP till the diffusion pump cools down to a safe level
26. Close the backing valve
27. Switch OFF the rotary pump and close the water supply to DP
28. Switch off mains by using both the mains isolator on the unit and at the power supply point
29. Switch OFF the pump and the chiller (if no other systems working on the chiller)

### **Precautions:**

1. Always clean the load chamber, glass slides and glass window with IPA before and after every deposition
2. Before starting the deposition always makes sure that the LT knobs are at the minimum positions
3. Before opening the high vacuum valve always ensure that the chamber pressure is  $< 0.05$  mbar and the combination valve is at the backing position
4. Pour LN<sub>2</sub> in its trap before opening the high vacuum valve
5. Before switching off the DP, ensure that the high vacuum valve is in closed position
6. After switching OFF the DP wait at least for 30 mins. and then switch off the rotary pump and cooling water supply
7. Do not keep any of the gauges running for long duration. This is more critical for penning gauge
8. Venting the chamber should be done slowly by slightly opening the air admittance valve
9. Always keeps the system in vacuum condition when not in use

### **Emergency shut-down of the system/Electricity failure:**

1. Close the HIVAC valve immediately
2. Move the combination valve to CLOSE position
3. Turn OFF the DP switch
4. Turn OFF the RP switch
5. Turn OFF main switch of the system

### **Violation Policy:**

1. If due to failure of following any of the steps in SOP there is a damage caused in the system's normal operation.
  - a. The user's authorization for the system is suspended for atleast 2 weeks and the user is liable to get the system to its working condition as soon as possible (theoretically in no time)
  - b. The user has to go through the qualification test and a written test again after 2 weeks.
  - c. After being authorized user of the system, The User has to train next 2 requests for getting authorization on the system.

**Training and Authorization Policy:**

1. One Overview Run (Second Optional)
2. Two Supervised Runs (Third Optional)
3. One Test Run