



## Modulab – Evaporation System

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### Safety

- Wear safety glasses.
- Wear vinyl gloves on top of nitrile gloves to prevent contamination in the PVD.
- The inside of the tool and the fixtures can get very hot. Use caution.

### Allowed Materials and Processes

- This tool is only used to deposit aluminum.

### Restricted Materials and Processes

Do not use any other material besides aluminum inside MODULAB Evaporation System.

### Operating Procedures

1. Check tool status and configuration
  - a. Visit <http://www.mmf.montana.edu/equipment-status.html>.
  - b. Request different targets, shields, or gases as far in advance as possible, preferably at least two weeks, by emailing the lab manager and [mmfstaff@montana.edu](mailto:mmfstaff@montana.edu).
2. Check tool reservations for conflicts and reserve the tool
3. Check lab status
  - a. Check the house N<sub>2</sub> bottle pressure. If it is below 300 PSI, report to staff.
  - b. Check process gas bottle pressures (Ar, Ar/O<sub>2</sub>, O<sub>2</sub>, N<sub>2</sub>, etc.). If any are below 300 PSI, report the shortage to staff.
  - c. Turn on N<sub>2</sub> for the lab.
    - i. This switch is located in between gowning room and entrance to the lab.
4. Log into SUMS
5. Turn on Power Strip located to the rear of the Modulab Evaporator
6. Equipment checks
  - a. Ensure that Compressor, Valve Control Power, and Chamber Pressure switches are ON
  - b. Check that all other switches are off
7. Open Foreline Valve
  - a. Upon opening, the Turbo Foreline Pressure gauge should indicate a dropping pressure
  - b. Wait until pressure gauge reads <50 mTorr before moving on to the next step
8. Start Turbo Pump Control
  - a. Press START on the Turbo Pump Control panel
  - b. The Turbo Pump will take several minutes to get up to its operating speed of ~27000 RPM
    - i. The display will indicate when the Turbo Pump has reached its operating speed
9. Prepare evaporation sample
  - a. Using a pair of scissors and a ruler, measure and cut the evaporation sample into a rectangle of the desired size.
    - i. Make sure your size is less than 60cm<sup>2</sup>, as the PVD can be overloaded



- b. Fold the evaporation sample into a small enough piece so that it can easily fit into the Filament.
        - i. Make sure the folded sample length does not exceed the Filament length
10. Open Vent Valve to open Chamber door
  - a. An audible hissing sound can be heard as the vacuum is released
  - b. It takes a minute or two for the door to open
11. Unload Chamber
  - a. Remove Mirror Assembly
    - i. Mirror Assembly rests at the mouth of the chamber
    - ii. When removed, place Mirror Assembly mirror side down for better stabilization
  - b. Remove Wafer Holder
    - i. When removed, place the support screw of the Wafer Holder into one of the holes in the Mirror Assembly, or place it upside down on top of a tape roll
  - c. Remove Filament Shield
    - i. Filament Shield fits snugly onto the base and may require two hands to remove
  - d. Remove Filament
    - ii. Unscrew each clamp counter-clockwise
    - iii. Careful when handling filament as it will become very brittle after repeated evaporations
12. Load Chamber
  - a. Place evaporation sample into middle of Filament
    - i. Make sure evaporation sample is secure inside Filament
  - b. Place wafers into Wafer Holder
    - i. One to four wafers can be loaded into the Wafer Holder
      1. If loading two wafers, place them opposite each other to keep things balanced
    - ii. Lock wafers into place by pressing the spring clips and sliding wafer beneath
  - c. Replace Filament into Clamps
    - i. Filament should be resting in the ridges of the screw clamps before tightening
  - d. Replace Filament Shield
  - e. Replace loaded Wafer Holder
  - f. Replace Mirror Assembly
13. Close Foreline Valve
14. Close Vent Valve
15. Open Rough Valve while holding chamber door shut
  - a. Door should become sealed to vacuum chamber and Chamber Pressure (Pirani) gauge should indicate a dropping chamber pressure
  - b. All other valves should be CLOSED
16. Wait for Chamber Pressure (Cold Cathode) to be  $\leq 200$  mTorr
17. When Set Point Light comes on, CLOSE Rough Valve
  - a. Set Point light is an LED located on the right



18. Open Foreline Valve
19. Open HiVac Valve
20. Wait 15-20 minutes
21. Check that the Chamber Pressure (Cold Cathode) has reached  $\sim 10^{-5}$  mTorr
22. Ensure that Deposition Power Control (DPC) is set to ZERO
23. Turn Deposition Enable switch to ON
24. Slowly increase Deposition Power Control (DPC) to +60%
  - a. Increase at a rate of 1% per second
  - b. Ensure that the Chamber Pressure (cold cathode) does not rise above  $10^{-4}$  mTorr as you increase the DPC
25. Hold for 1-2 minutes to completely evaporate the sample
  - a. As Filament begins to glow, evaporation sample should melt and wick onto Filament
  - b. Sample is fully evaporated when individual coils on Filament are visible
26. Slowly turn Deposition Power Control (DPC) to ZERO
27. Turn Deposition enable switch to OFF
28. Let PVD cool for five minutes
29. Close HiVac Valve
30. Open Vent Valve to Open Chamber Door
  - a. It takes a minute or two for the door to open
  - b. Door should not be forced open, only a small force is necessary to open the chamber.
31. Unload Chamber
  - a. Careful when handling objects inside the Chamber, as they are still hot
  - b. Remove Mirror Assembly using hot pad
    - i. Mirror Assembly rests at the mouth of the chamber
    - ii. When removed, place Mirror Assembly mirror side down for better stabilization.
  - c. Remove Wafer Holder
    - i. When removed, place the support screw of the Wafer Holder into one of the holes in the Mirror Assembly, or place it upside down on top of a tape roll.
  - d. Remove Filament Shield using hot pad
    - i. Filament Shield fits snugly onto the base and may require two hands to remove
  - e. Remove Filament
    - i. Unscrew each clamp counter-clockwise
    - ii. Careful when handling filament as it will become very brittle after repeated evaporations
32. Unload wafers from Wafer Holder
33. If done with evaporating, continue to step 34. If doing another deposition, go back to step 12
34. Putting away the Filament
  - a. If Filament is not very brittle and could be used for another deposition, place it back in the drawer with the other Filaments



- b. If Filament is too brittle and cannot be used for another deposition, place it in the recycled metal bin
35. Reload Chamber
  - a. Replace Filament Shield
  - b. Replace Wafer Holder
  - c. Replace Mirror Assembly
36. Close Vent Valve
37. Close Foreline Valve
38. Open Rough Valve while holding chamber door shut
39. Wait for the Chamber Pressure (Pirani) gauge to pump down to <50 mTorr
  - a. This will take several minutes
40. Close Rough valve
41. Ensure that all valves are CLOSED
42. Stop Turbo Pump Control
43. Turn off Power Strip

## Troubleshooting

- Modulab Evaporator is plugged in but will not turn on.
  - Check that someone is logged into SUMS
  - If no one is logged into SUMS contact MMF Staff

## Version History

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- 2020.1 – Original document written by Geneva Feist, Andrew Lingley, and Daniel Hurford.