

## **Physical Vapor Deposition (PVD) System Operation**

There are two sputter guns: Gun 1 is the RF sputter

Gun 2 is the DC sputter

One E-beam (contains four source holders) and one DC glow discharge.

### **Operating Procedures for PVD System**

1. Before entering cleanroom, go to the gas room (next to the cleanroom entrance).
  - a. Make sure the Nitrogen gas tank is turned on and has sufficient pressure\*.
  - b. If doing sputtering, also make sure the Argon gas tank is turned on and has sufficient pressure\*.
2. Sign in on the sign-in list before using any of the equipment.
  - a. Verify that the power switch is on.
3. Load the substrate to the system and close the chamber door.
4. Adjust the substrate holder to desired position.
5. A mirror is attached behind the substrate holder. Use to view the e-beam source.
6. Next, turn on the main power switch on the front lower left side of the system.
7. Switch to “Start” on the main power (the switch will return to “ON” when released)
8. Open the “Roughing” valve.
9. Turn on the SRS ion gauge controller.
10. *Optional*: heating the substrate
  - a. Turn on the “Temperature Control” power.
  - b. Turn on the substrate heater “OUTPUT”
  - c. Adjust current level to increase temperature.
11. Press “Start” on the BOC EDWARDS vacuum pumping system.
12. After rough pump runs for a some time, the turbo pump will automatically turn ON (Observe the pumping speed LED’s, red for rough pump and green for turbo)
13. Close the “HIGH-VAC Throttle” valve, if not already closed.
14. Open the “HI-VAC” valve.
15. Monitor vacuum pressure gauges on the monitor
  - a. Turn ON auto ion gauge button to observe high vacuum pressures
  - b. Verify the pump speed indicator, red will light for rough pumping, and green will light for turbo pumping speeds.
16. Turn on the chiller unit: set temperature to 20°C, verify pressure is at 65-70psi
  - a. Note: If chiller doesn’t power ON, a large main circuit breaker controlling this unit is located in the clean room, next to the emergency exit doors.
17. From the rear of the PVD system, in the lower cabinets:
  - a. Verify the water pressure gauge reads 45-55 psi, located near the water flow indicators.
18. Verify all 4 red LED’s are on for the water flow indicators (below system in cabinet)
19. Verify the interlock lights are on (all five green display LED’s on the TT-3/6 control)

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\* IF THE TANK IS EMPTY OR TOO LOW IN PRESSURE, REPLACE IT WITH A NEW TANK.

## E-Beam

20. Monitor the SRS Pressure gauge display for vacuum level. It is recommended a vacuum level of  $< 5 \times 10^{-6}$  Torr and it usually takes about 2.5 hours.
21. When the desired vacuum level is reached, align the mirror behind the substrate holder. A flashlight can be used for better vision.
22. Verify e-beam shutter switches open and close, and set to "open". Check the recent e-beam source positions (*see appendix A*).
23. Turn on power supply for e-beam controller
24. Ensure Sweep controller is in "manual" mode
25. Using the joystick, manually center the e-beam until the lateral/longitudinal LED bar codes are in the middle ( $\uparrow\downarrow$  for longitudinal,  $\leftarrow\rightarrow$  for lateral), (*See appendix C*).
26. Turn on the "voltage emission", notice HV red LED on bottom left
27. If in manual mode, adjust e-beam current emission (near 30 mA) as to center the emitted current on the middle of crucible
28. Turn down emission current to zero
29. Verify sweep select is in "control" (i.e. NOT "Sweep Select")
30. Select sweeping pattern desired (e.g. spiral, triangle, manual)
31. After target is melted:
  - a. Close e-beam shutter
  - b. Rotate sample into position, note markings on sample/mirror stage knob
  - c. "Zero" the INFICON deposition monitor
  - d. Open e-beam shutter
  - e. Adjust emission current while observing deposition rate, and adjust until desired rate achieved. (*See Appendix B for rates of deposition*).
32. When finished:
  - a. Close e-beam shutter
  - b. Adjust emission current to zero
  - c. Turn off voltage emission source
  - d. Turn off power supply controller
  - e. Turn off deposition monitor
  - f. Allow substrate temp to cool by maintaining vacuum and water flow for 30 min. prior to venting.
  - g. Vent the system, see venting procedure in this manual.

## Sputtering

33. Close the "HI-VAC" valve
34. Open the "HI-VAC Throttle" valve.
35. Open "Process gas".
36. Open "Process gas #1", DO NOT USE "Process gas #2" since it is not connected.
37. Read the vacuum level, CM1 display on SRS should read about 50 mTorr.
38. Adjust to desire flow rate by tuning the "flow cont." knob.

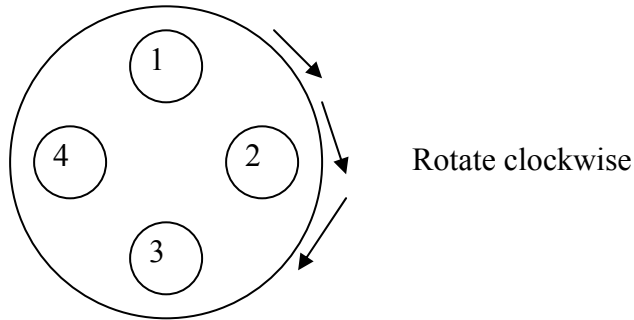
## Venting

**\*\*\*Never vent the system if above 80°C\*\*\***

39. After every deposition, leave vacuum and chiller running for 30 min. before venting, or use the substrate temperature controller to monitor the approximate temperature.
40. Turn off the IG Auto & IG1 button on the SRS monitor.
41. Press the "Start" button in BOC EDWARDS to release it
42. Wait for the speed to reduce until speed indicator green lights turn OFF, then open "Vent" valve
43. Release chamber handle, but do NOT open the chamber door
44. Close "Vent" valve
45. If used, turn OFF power on substrate heater, adjust to zero, and turn OFF the Power Switch in the temperature control.
46. Turn OFF power in SRS
47. Turn OFF main power control
48. Turn OFF power in lower left corner
49. Turn Substrate holder to its original position or else it will hit the shuttle.
50. Take out the sample.
51. Turn OFF chiller
52. Turn OFF nitrogen gas, and any other gases used

## Appendix A

As of 6/23/03, the positions are as shown below:



- 1 = empty
- 2 = gold
- 3 = chromium
- 4 = titanium

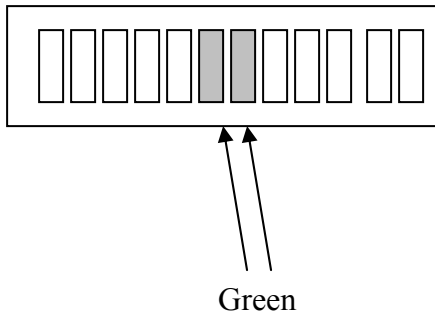
Rotating the e-beam target crucible knob clockwise yields a clockwise rotation of the crucible holder itself when viewing with the mirror below the substrate holder stage.

## Appendix B

The deposition of titanium onto a glass substrate was utilized and the following was observed.

- Emission current (amps, "a") → Deposition rate (Angstroms/second)
- 100ma → 0.2-0.3 A/s
  - 170ma → 0.6 A/s, yielded a deposition of 1kÅ = 1000Å° in 30min.

## Appendix C



LED's light while adjusting  
e-beam joystick