

## 1.0 Denton Thermal Evaporator

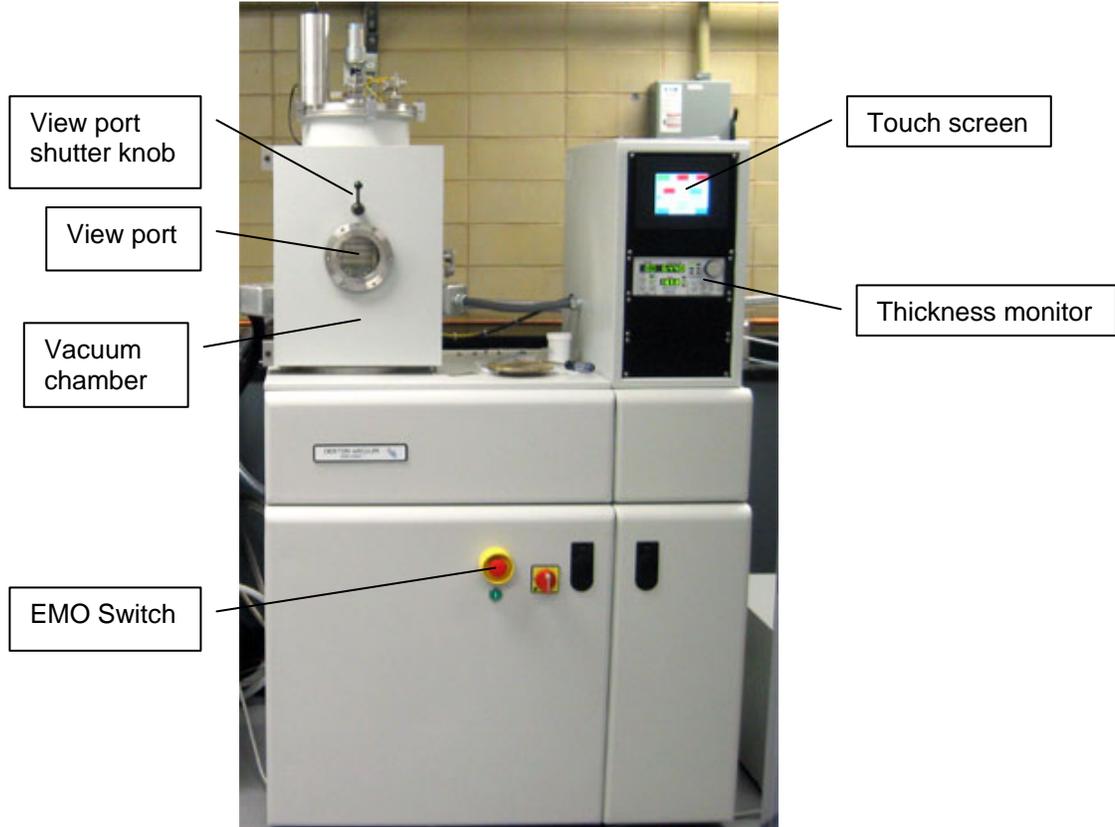


Figure 1: Denton Thermal Evaporator.

### 1.1 Introduction

Denton Thermal Evaporator is for metal deposition on silicon wafers or other compatible substrates. Some metals are provided for evaporation. Management approval is needed if user wants to provide own materials.

Only trained and approved (qualified) users may use this tool.

### 1.2 Features and Specifications:

- a) Touch screen interface
- b) Semi automatic operation: Auto pump and auto vent
- c) Quartz crystal thickness monitor
- d) Designed to accommodate wafers up to 6" in diameter.
- e) Substrate heating to 200° C.
- f) Substrate rotation.
- g) Three evaporation sources
- h) One 2kVA power supply
- i) Source and substrate shutters
- j) Cryo pump and dry roughing pump
- k) Base vacuum  $5 \times 10^{-7}$  Torr or better.

### 1.3 Applicable Documents

Denton Thermal Evaporator installation, operation, and maintenance manuals are available on the clean room computer.

### 1.4 Safety

- a) High electrical power sources are present. Do not open any panels or defeat interlocks.
- b) The power sources don't turn on if there is no vacuum in the chamber.
- c) If substrate heater is being used, there is burn hazard. Do not touch the hot surfaces.
- d) Pay attention to safety symbols on the equipment.
- e) Press EMO button if there is an immediate danger to personnel or the equipment and inform the staff.

### 1.5 Precautions

- a) Do not scratch or put any metallic objects on the vacuum seal surfaces.
- b) Before venting the chamber, ensure that substrate heater is off and substrate temperature is below 70° C. Ensure substrate holder is not too hot before touching it.

### 1.6 Operating Procedure

Activate the equipment in FOM.

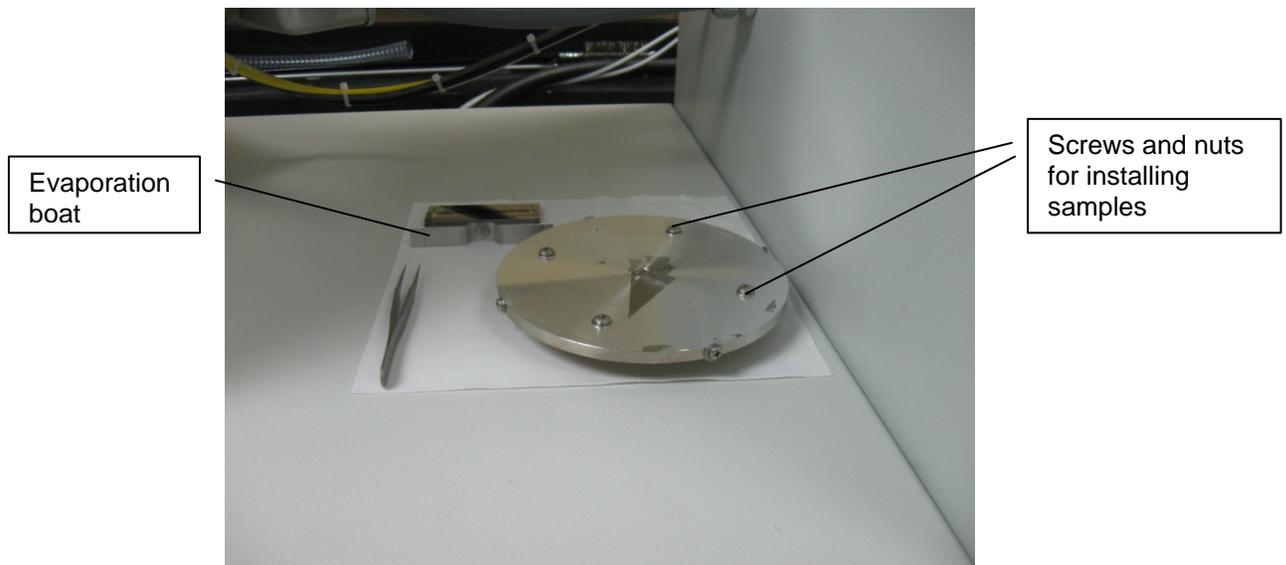


Figure 2: 6" substrate holder

#### 1.6.1 Mounting the Substrate

- a) Ensure your gloves are clean.
- b) Mount the substrates using screws and clips as shown in Figure 2. To avoid contamination, do not touch the substrates with hands, handle with tweezers.

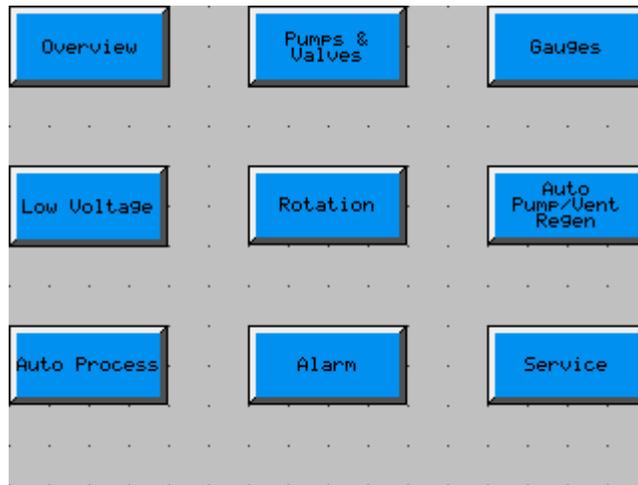


Figure 3: This screen provides access to all other screens.

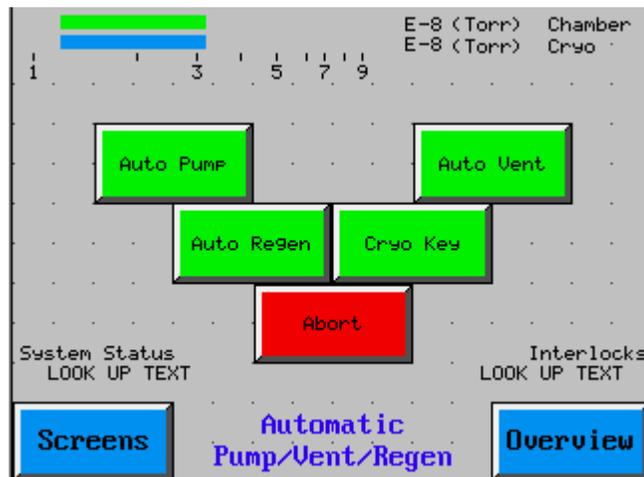


Figure 4: Auto pump/vent/regen screen.

### 1.6.2 Venting the Chamber

Always use automatic procedure for venting as described below. Do not use manual vent.

- a) Ensure the low voltage power for boats, substrate heater, and substrate rotation is off. Wait about ten minutes if you just finished evaporation for boat to cool down. Wait until substrate temperature is below 70° C if you heated substrate above this temperature.
- b) Select the Auto pump/vent/regen screen by touching that button as shown in Figure 3.
- c) Touch the Auto Vent button as shown in Figure 4. The automatic venting process will start.
- d) After a few minutes when the hissing sound of leaking nitrogen comes from the chamber door, it can be opened. Opening the door will shut the nitrogen down.
- e) The chamber looks like as shown in Figure 5. Do not scratch any vacuum seal surface. Inside of the chamber needs to be handled very carefully with clean gloves. Also use face mask to avoid contamination.
- f) Do not leave the chamber open. Load materials and substrate (as described in following sections), close the chamber door and start pumping right away.

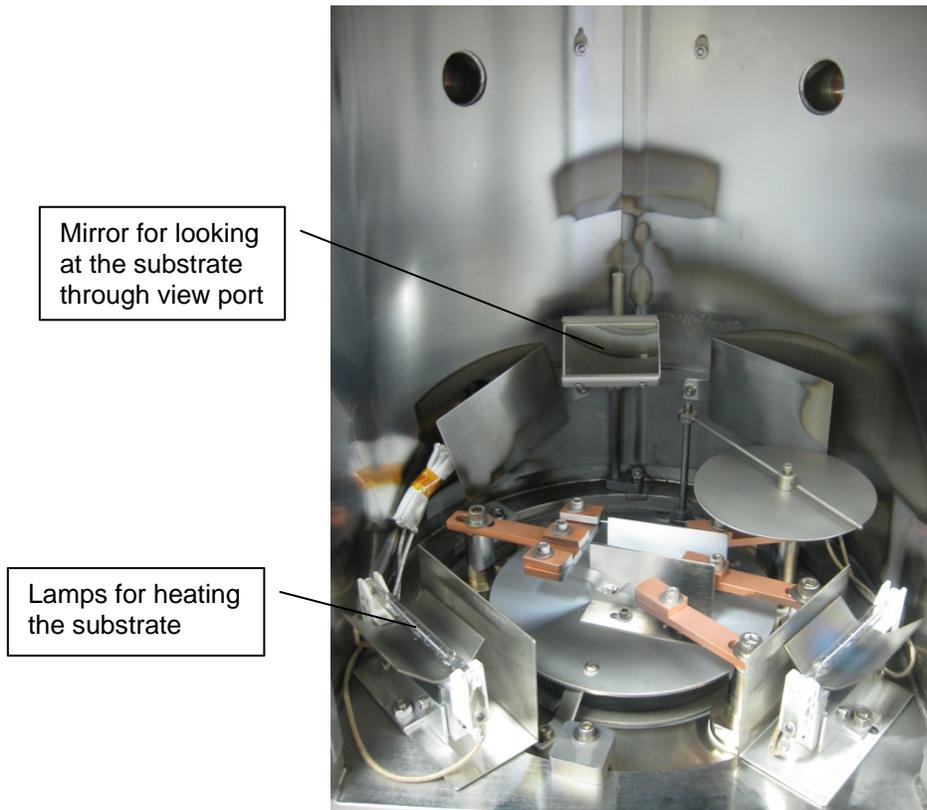


Figure 5: Chamber with door open.

### 1.6.3 Transferring the Substrate to Chamber

This procedure is best learned by practice with a staff member.

- a) Hold the substrate holder plate from the edges with your right hand. The substrate should be facing your palm but not touching.
- b) Turn the plate over with substrate facing down now and transfer through the door under the mounting structure (Figure 6).
- c) Raise it and ensure the vertical pins on the mounting fixture go through the slots on the substrate holder. You can do this only with substrate shutter in open position. You might need to rotate the mounting fixture to do this.
- d) Ensure the substrate plate is held securely before removing your hand.

### 1.6.4 Installing Boat and Adding Material

This needs to be done with source shutter open.

- a) If boat looks fine, add the materials using tweezers making sure the material is same as was used in that boat before.
- b) To change the boat two screws need to be loosened (not removed) as shown in Figure 7 using a hex wrench.
- c) Slide the boat out and install the new boat.
- d) Tighten the two screws. Ensure the boats or the copper electrodes do not touch the source shields.
- e) Add the proper amount of material using tweezers.

- f) Ensure you change the glass slides in the viewport (Figure 8) before closing the chamber door if needed. Glass slides get coated during evaporation but do not need to be changed every time as long as you can see through those.

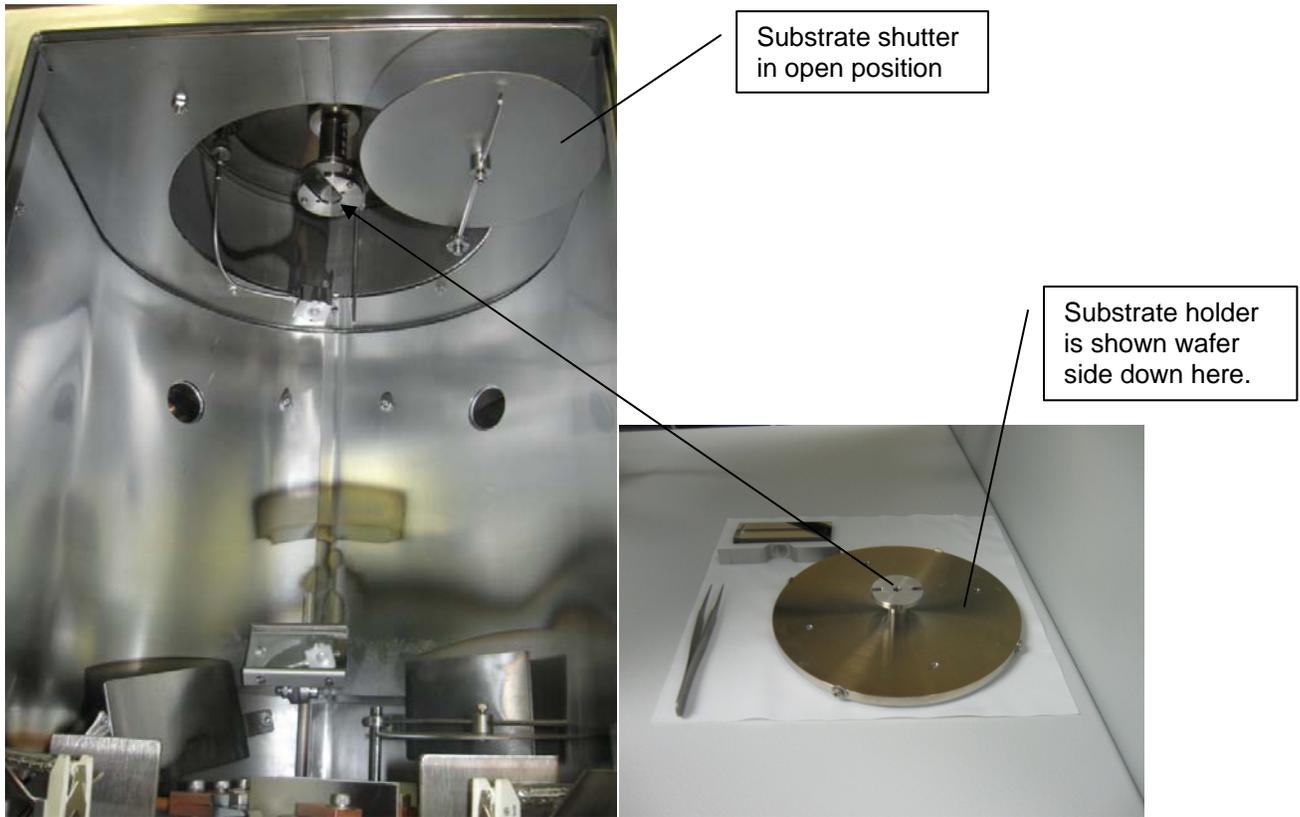


Figure 6: Installing the substrate holder.

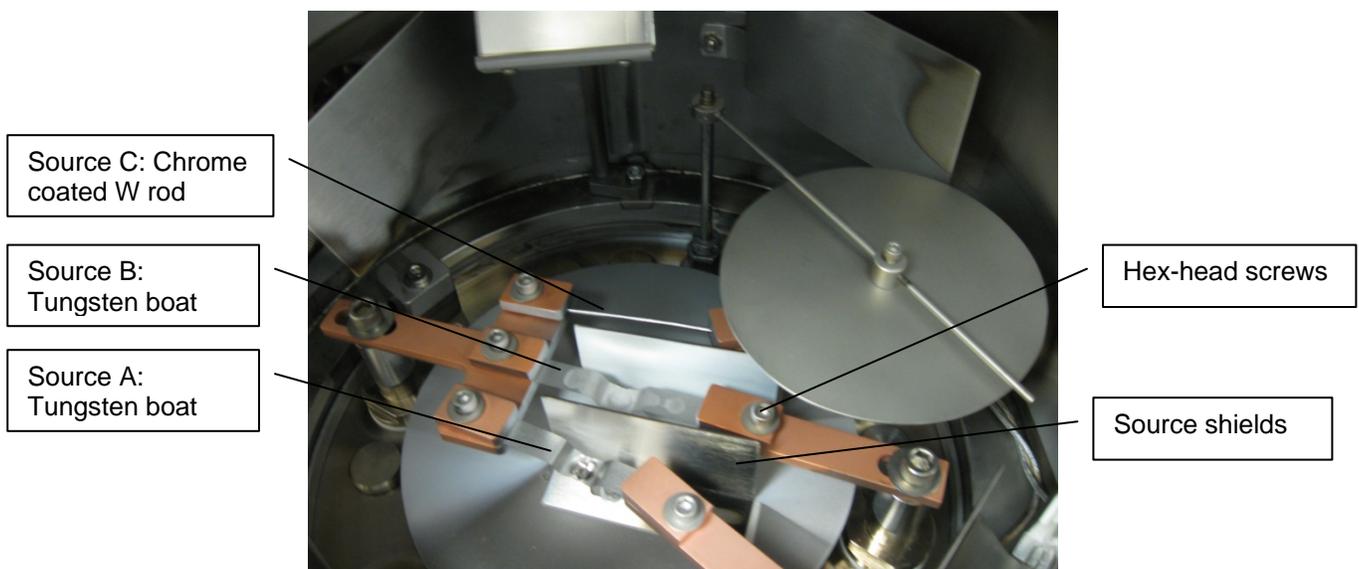


Figure 7: Close-up of evaporation sources.



Figure 8: Change glass slides in the viewport as needed.

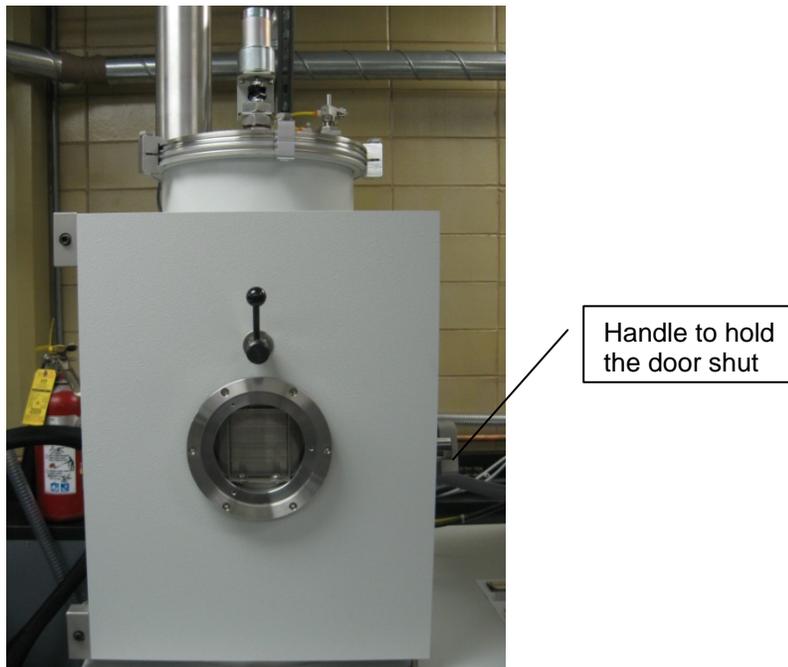


Figure 9: Chamber close-up.

### 1.6.5 Pump Down

- a) Close the door and swing the handle up gently to just hold the door shut (Figure 9). Do not swing too hard, it does not click!
- b) Touch Auto Pump button (Figure 4). As the pumping starts, the door will be held with vacuum and the handle will swing down. Always use automatic pump down as described, not manual.

- c) The chamber will pump down to  $10^{-6}$  Torr range in 5-10 minutes. You can do the evaporation at this vacuum. If you need higher vacuum you will need to wait longer.
- d) You can observe the pump down mechanism if you like. Select OVERVIEW button from the main screen (Figure 3) or from lower right-hand corner of any screen. It is shown in Figure 10.

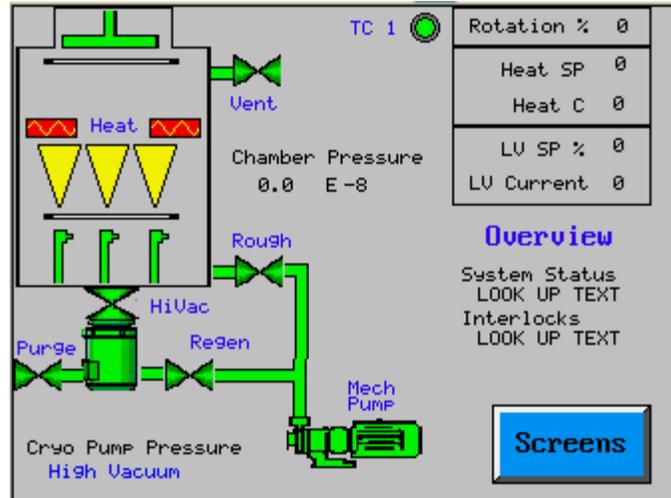


Figure 10: The Overview Screen.

This screen is used to display current system status and the state of vacuum chamber and pumping system. Access is provided to the screens display.

Graphics change color to indicate current state: **GREEN** = ON/OPEN, **RED** = OFF/CLOSED. Valves, pumps, rotation motor, and interlocks change color to indicate current state (**GREEN** = ON/OPEN; **RED** = OFF/CLOSED). Graphic indicators are displayed on the vacuum system graphic when evaporation sources are active.

### 1.6.6 Rotation and Substrate Heat

Consult staff before using rotation or heat.

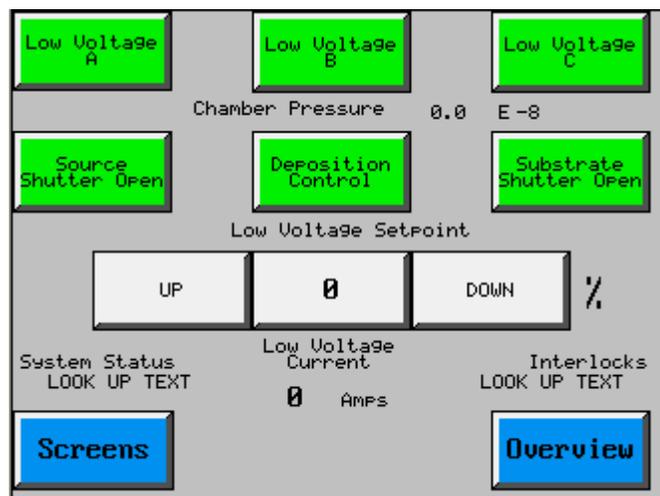


Figure 11: Low Voltage screen for evaporation.

### 1.6.7 Deposition

- a) Program the thickness monitor for the material you are using by using the program button and the rotating knob on the controller. You will need density and z-ratio of the material.
- b) Select the Low Voltage screen as shown in Figure 11 from the main screen shown in Figure 3.
- c) Ensure the substrate and source shutters are closed. They can be operated from this screen.
- d) Turn on the source that you want to use, the front one is called source A (Figure 7) by touching the appropriate button.
- e) Open the source shutter.
- f) Increase the current by touching the UP button briefly. You want to increase the current no more than 5 Amps at a time. The current needed for evaporation depends on material and the boat used. Some guidance can be obtained from staff.
- g) As soon as you see deposition rate on the thickness monitor, stop increasing the current. Then fine tune the current to get stable evaporation rate of 1-2 Å/sec. For some materials the rate will fluctuate which is normal.
- h) When you are satisfied with the evaporation rate, zero the thickness monitor and open the substrate shutter simultaneously.
- i) Keep on reading the thickness on the monitor. As it reaches the thickness you desire, close the substrate shutter.
- j) Slowly reduce the current using the Down button.
- k) Turn off the low voltage when current reached zero.
- l) Use procedure described in Sec 1.6.2 to vent the chamber.
- m) Use reverse procedure as described in Sec. 1.6.3 to remove your wafer.
- n) Pump down the chamber as described in Sec. 1.6.5.
- o) Remove your substrate from the holder and leave the holder on a clean wipe.
- p) Enter the required information in FOM and deactivate the equipment.