

# Denton Sputter SOP



## 1. Scope

1.1 This document provides operating procedures for the Denton sputter system.

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### 3. Reference Documents

#### 3.1 Referenced within this Document

3.1.1 None

#### 3.2 External Documents

3.2.1 None

### 4. Equipment and/or Materials

4.1 Denton Sputter System

4.2 Wafer/Sample

4.3 Target

4.4 Allen Wrench

4.5 Liquid Nitrogen Dewar

### 5. Safety

5.1 Follow all Nanofab safety procedures.

### 6. Setup Procedures

#### 6.1 Reserve Equipment

6.1.1 Reserve and enable Denton Discovery 18 Sputter system in Coral.

#### 6.2 Vent Main Chamber

6.2.1 Put on a brand new pair of clean gloves. Do not touch the inside of the chamber or the targets or the samples with bare hands or dirty gloves.

6.2.2 Press the green System Start button on the touchscreen.

6.2.3 Make sure sputter power supplies are off and none of the sputter heads are selected (all 3 green).

6.2.4 Make sure AUTO ENABLE button is flashing on the control panel. If not, press it. See *Figure 3, Touchscreen Control Panel Buttons*.

6.2.5 Press CHAMBER AUTOVENT button. See *Figure 3*.

6.2.6 The lid will automatically rise when it is vented, carefully hold lid so it does not rise too fast.

#### 6.3 Remove Old Target

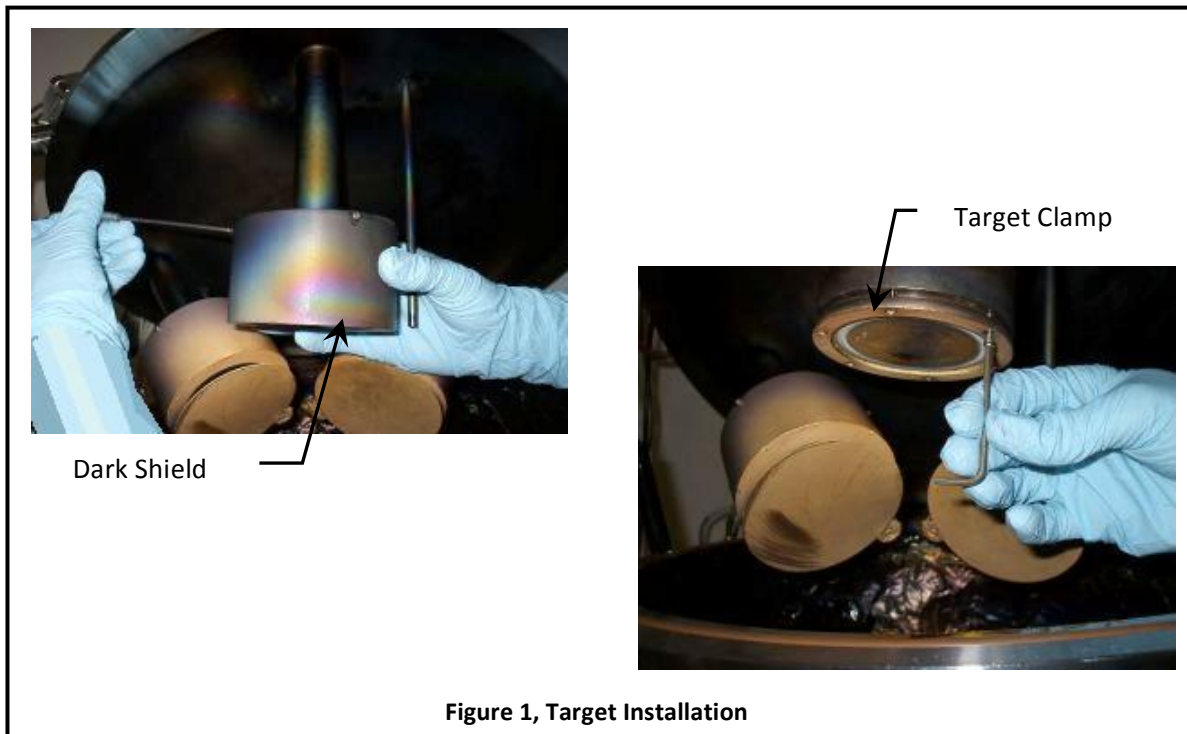
6.3.1 Insert the tray into the chamber over the chuck to help catch anything that is dropped.

6.3.2 Use an Allen wrench to remove the shutter from the sputter head.

6.3.3 Place the shutter and all vacuum components on a clean sheet of Al foil.

- 6.3.4 Loosen the wing nut on the clamp around the dark shield. See *Figure 1, Target Installation*.
- 6.3.5 Gently rock the dark shield while pulling down to remove the dark shield.
- 6.3.6 Use an Allen wrench to remove the screws from the target clamp. See *Figure 1*.
- 6.3.7 Remove the old target.
- 6.3.8 Place the old target in its corresponding bag and put it on the metal shelf.

#### 6.4 Install New Target



- 6.4.1 Put the target clamp over the new target in the sputter head and start all the screws.
- 6.4.2 Thread in the screws until the target is uniformly seated against the cathode face and tighten using the Allen (ball driver) wrench. Make sure the smooth, flat side of the target is facing in toward the sputter head so good heat conduction occurs. The eroded circular pattern should be facing out.
- 6.4.3 Put the new target's bag in the corresponding pouch on the side of the rack. The sputter head's number is located outside the chamber where the water and electrical contacts are made.
- 6.4.4 Replace the dark shield so the gap to the clamp ring is  $\sim 1/8''$  and tighten the wing nut.

## 6.5 Test Target Installation



Figure 2, Target Testing

6.5.1 Replace the shutter and open and close it a few times (SHUTTER button on the control panel) to assure it completely covers the target when the shutter is closed.

6.5.1.1 To test the shutter, make sure the AUTO ENABLE light is not blinking. Press it if it is. See *Figure 3*.

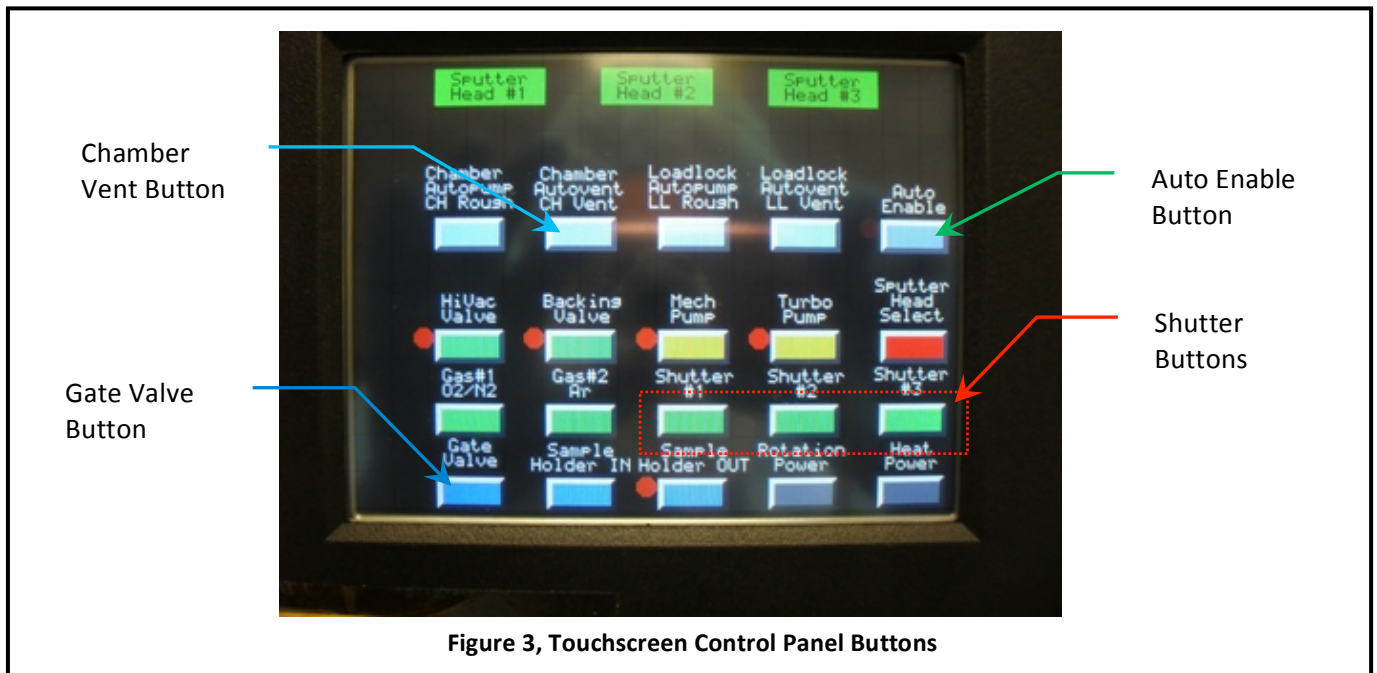


Figure 3, Touchscreen Control Panel Buttons

6.5.1.2 Press the SHUTTER button corresponding to the cathode number to open/close it.

6.5.2 Open the shutter.

6.5.3 Do a resistance test by placing one of the leads on the dark shield and placing the other lead on the target clamp ring. The resistance should read around 1 MegaOhm. If it is less than 100 kOhm, the target and the dark shield may be shorted. You should remove and then reinstall the dark shield with a larger gap between it and the target until the resistance is around 1 MegaOhm. See *Figure 2, Target Testing*.

- 6.5.4 Close the shutter.
- 6.5.5 Repeat the steps for any other new targets you want to install.
- 6.5.6 Remove the tray.
- 6.5.7 If the inside of the machine is dirty, vacuum it.
- 6.5.8 Clean around the machine to remove dust that could harm your work.

## 6.6 Load Samples

- 6.6.1 Place the 6" sample holder in the round groove in the center of the main chamber.
- 6.6.2 Place your clean, dry samples on the 6" sample holder.
- 6.6.3 Test the sample rotation by pressing the ROTATION POWER button (AUTO ENABLE light must be off).
- 6.6.4 Turn off the ROTATION POWER after testing it.

## 6.7 Pump Down Main Chamber

- 6.7.1 Check the Cryopump monitor. See *Figure 4*.
  - 6.7.1.1 If it is greater than 20 degrees Kelvin do not continue, contact staff



Figure 4, Cryopump Monitor

- 6.7.2 Close the lid to the main chamber and latch it in place. See *Figure 5*.
- 6.7.3 Make sure the AUTO ENABLE light is blinking. If not, press the AUTO ENABLE button.

- 6.7.4 Press the CHAMBER AUTOPUMP button. The system will automatically rough down the chamber and open the Hi Vac valve and Gate Valve
- 6.7.5 The ion gauge will come on automatically .



## 7. DC Sputter Procedures

NOTE: For best results wait until the base pressure (ion gauge green pressure readout) reads at less than  $2 \times 10^{-6}$  Torr before sputtering. Higher pressures may oxidize metallic films.

NOTE: Note the base pressure and the pump down time to be recorded in Coral at disable.

NOTE: The red pressure readout meter should be zeroed once the process pressure is reached. To zero the readout hold the 'zero' button down for 3 seconds.

### 7.1 Start Argon Flow

7.1.1 Turn off the AUTO ENABLE button so it is not blinking.

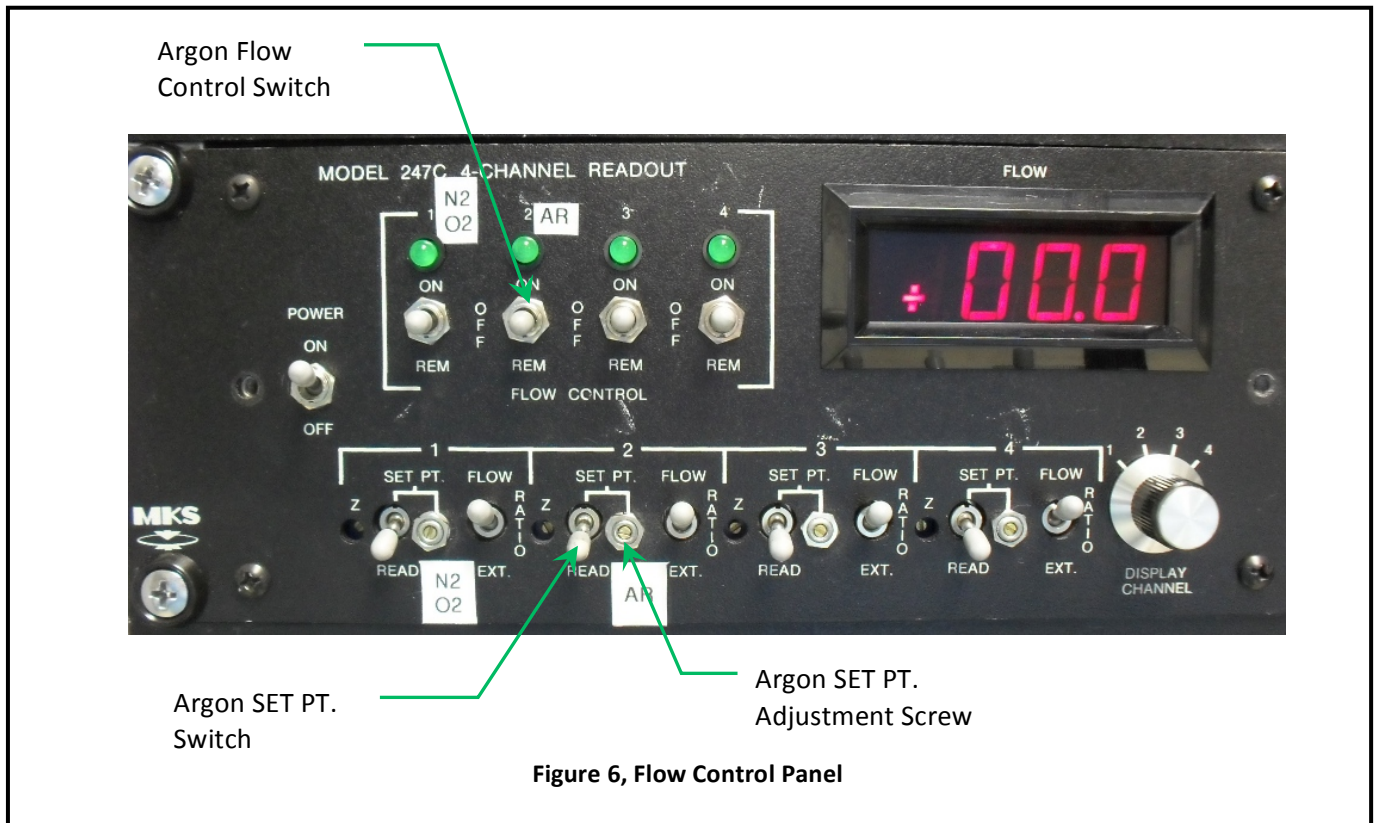
7.1.2 Set argon gas flow rate to 40% by holding the Ar toggle switch in the SET PT. position and turning the adjustment screw to the right of the toggle switch. See *Figure 6, Flow Control Panel*.

NOTE: The MFC is rated at 200 SCCM so a set point of 40% would be a flow rate of 80 SCCM.

7.1.3 Turn on the Argon FLOW CONTROL toggle switch on the flow control panel.

7.1.4 Press the GAS 2 button on the touchscreen to start the argon flow.

NOTE: The pressure readout on the red pressure readout meter and the green ion gauge should go up.



## 7.2 Set up DC Sputter Parameters

- 7.2.1 Select desired sputter target material by pressing the SPUTTER HEAD SELECT button to toggle through the three different heads.
- 7.2.2 Turn on the MDX 1.5 K power supply. See *Figure 7*.
- 7.2.3 Press the SET PT button and rotate the LEVEL knob to select the desired sputter power.
- 7.2.4 Turn on the ROTATION POWER button to start the samples rotating for more uniform sputter thickness.

## 7.3 Pre-sputter

- 7.3.1 Ignite the plasma by pressing the OUTPUT ON button. See *Figure 7*.
- 7.3.2 Press the RIGHT DISPLAY ACTUAL button a few times to toggle through the power, voltage, and current, to make sure you are sputtering with the right power settings.
  - 7.3.2.1 **If the voltage is high** (approx 1200 V), this means that the plasma did not ignite. Do the following:
    - 7.3.2.2 Open the appropriate shutter then quickly close the shutter.
    - 7.3.2.3 If the voltage drops, the plasma ignited, continue pre-sputter, if not press OUTPUT OFF and contact lab staff.
- 7.3.3 Allow the target to sputter with the shutter closed for about a minute to clean any oxides or absorbed contaminants off the surface of the target.



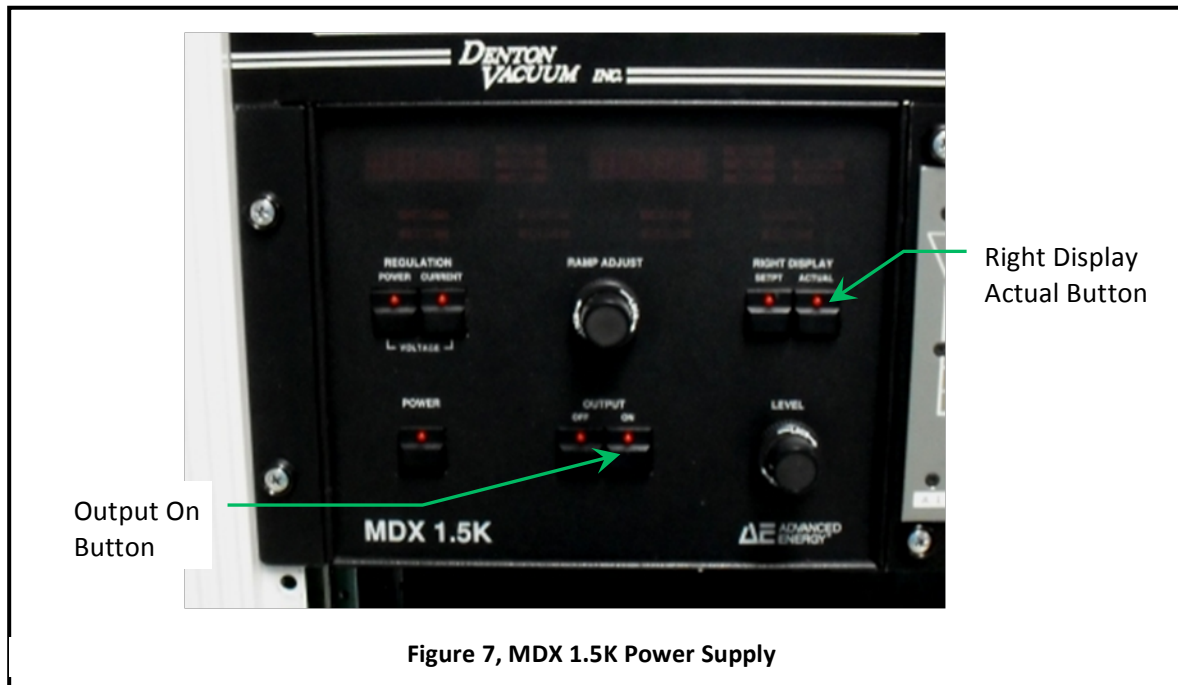


Figure 7, MDX 1.5K Power Supply

## 7.4 DC Sputter

- 7.4.1 Open the shutter by pressing the SHUTTER # button that corresponds to the target you are sputtering from.
- 7.4.2 Note the deposition pressure, time, power, and other parameters in the log book. After deposition, please note the measured thickness and sheet resistance of the material.
- 7.4.3 Let the system run for the desired sputter deposition time. There is no automatic timer to shut off the system.
- 7.4.4 Press the OUTPUT OFF button on the MDX power supply when the deposition time is reached.
- 7.4.5 Close the shutter by pressing the SHUTTER number button that corresponds to the target you have been sputtering.
- 7.4.6 If another material is to be deposited on top of the current sample, return to section 7.2.

## 7.5 Shutdown

- 7.5.1 Turn off power supplies.
  - 7.5.1.1 Turn off the MDX 1.5 K power supply.
  - 7.5.1.2 Turn off Rotation Power.
- 7.5.2 Turn off Argon flow.
  - 7.5.2.1 Turn off switch 2 on the flow control panel.
  - 7.5.2.2 Turn off Gas 2.
- 7.5.3 Toggle through Sputter Head Select until none of them are selected.

## 8. RF Sputter Procedures

NOTE: The two RF power supplies are connected only to cathode 1 and cathode 2. Make sure your target is in one of those cathodes.

NOTE: For best results wait until the base pressure reads less than  $2 \times 10^{-6}$  Torr before sputtering.

### 8.1 Start Argon Flow

- 8.1.1 Switch the Gate valve and Hi-vac valve control switch on the left side panel under the Cryo pump to Manual. (see staff if questions on this switch location)
- 8.1.2 Turn off the AUTO ENABLE button so it is not blinking.
- 8.1.3 Close the Gate Valve on the touch screen.
- 8.1.4 Set argon gas flow rate to ~ 80% by holding the Ar toggle switch in the SET POINT position and turning the screw adjustment adjacent to the toggle switch. See *Figure 6, Flow Control Panel*.
- 8.1.5 Turn on Argon Flow Control switch on the flow control panel.
- 8.1.6 Press the GAS 2 button on the touchscreen to start the argon flow.
- 8.1.7 Verify the capacitance manometer pressure is  $> 90$  mT.

### 8.2 Set up RF Sputter Parameters

- 8.2.1 Turn on the RF power supply and tuning power supply that corresponds to the target you are going to sputter from (either target 1 or target 2).
- 8.2.2 Press the SET PT button and rotate the LEVEL knob to select the desired sputter power.
- 8.2.3 Turn on the ROTATION POWER button to start the samples rotating for more uniform sputter thickness.
- 8.2.4 Open the shutter for the cathode to be powered up.

### 8.3 Pre-sputter

- 8.3.1 Ignite the plasma by pressing the RF ON button on the RF power supply. The tuning power supply will show if the plasma has ignited, but verify by looking into the viewport
- 8.3.2 Close the shutter and verify plasma is still ignited.
- 8.3.3 Allow the target to sputter with the shutter closed for about 1-2 minutes to clean any absorbed contaminants off the surface of the target.

### 8.4 RF Sputter

- 8.4.1 Begin sputtering on your samples by opening the shutter by pressing the SHUTTER # button that corresponds to the target you are sputtering from. Make sure the light turns on.
- 8.4.2 Open the gate valve.
- 8.4.3 Adjust the gas flow rate down to desired flow % and pressure. Verify plasma stays ignited.
- 8.4.4 Switch the toggle switch on the left side panel under the Cryo pump to up – auto position.

- 8.4.5 Note the deposition pressure, time, power, and other parameters for the CORAL data log. After deposition, please note the measured thickness and sheet resistance of the material you sputtered.
- 8.4.6 Let the system run for the desired sputter deposition time. There is no automatic timer to shut off the system.
- 8.4.7 Press the RF OFF button on the RF power supply when the deposition time is reached.
- 8.4.8 Close the shutter by pressing the SHUTTER # button that corresponds to the target you have been sputtering.
- 8.4.9 If another material is to be deposited on top of the current samples, return to section 8.2.

## 8.5 Shutdown

- 8.5.1 Turn off power supplies.
  - 8.5.1.1 Turn off the RF power supply and the tuning power supply.
  - 8.5.1.2 Turn off Rotation Power.
- 8.5.2 Turn off Argon flow.
  - 8.5.2.1 Turn off switch 2 on the flow control panel.
  - 8.5.2.2 Turn off Gas 2.

## 9. Unload Samples

### 9.1 Vent Main Chamber

- 9.1.1 See section 6.2

### 9.2 Disable Coral

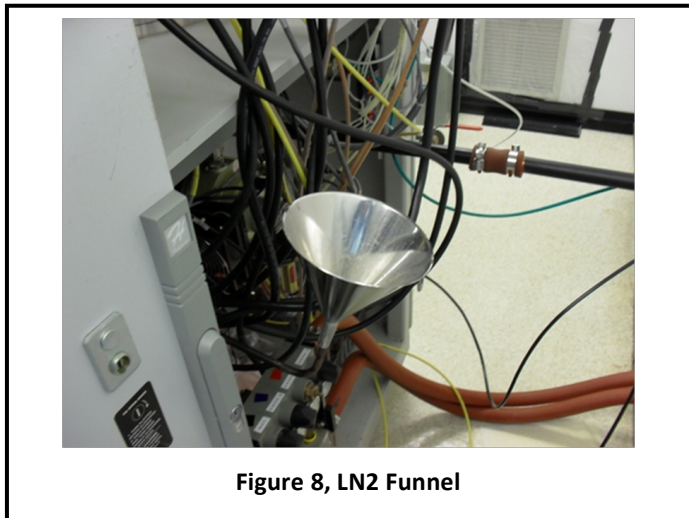
- 9.2.1 Enter your run data and disable the Denton Discovery 18 Sputter system in Coral.

## 10. Appendix

### 10.1 Typical Film Characteristics

### 10.2 Add Liquid Nitrogen

- 10.2.1 Fill dewar with LN2 from the tank by the Oxford 100.
- 10.2.2 Carry dewar back to clean room and slowly pour LN2 into metal funnel until 1/3 full. Funnel is on the back of the Denton sputter machine. See *Figure 8, LN2 Funnel*.
- 10.2.3 Continue to add LN2 as needed.



### 11. Revision History

Rev	Date	Originator	Description of Changes
1	19 Jan 2010	Sam Bell	
2	15 Apr 2011	Sam Bell	Deleted load lock instructions
3	12 Jul 2011	Sam Bell	Added instructions for cryopump and new touchscreen
4	04 Aug 2011	Kevin Hensley	Changed gate valve instructions
5	29 Nov 2011	Kevin Hensley	Ion gauge procedure, mfc change, and pressure readout
6	27 Sept 2018	S Pritchett	Update RF procedure, dark shield clamp and tray use.