

# Angstrom NexDep RF/DC Magnetron Sputter Tool

## Standard Operating Procedure

Faculty Supervisor: Prof. Robert White, Mechanical Engineering (x72210)

Safety Office: Peter Nowak x73246 (Just dial this directly on any campus phone.)

(617)627-3246 (From off-campus or from a cell phone)

Tufts Emergency Medical Services are at x66911.

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**Background:** Sputtering is a type of physical vapor deposition process that involves deposition of atoms (usually from a target) onto a substrate through bombardment of excited ions. This tool is specifically a magnetron sputter in which sources (in this case RF or DC) are employed to create magnetic fields that are used to contain plasma near sputter targets. In this tool the inert gas, Argon, is ionized to spark this plasma, while Nitrogen and Oxygen are used as reactive components during deposition to make oxide and nitride films. Typically, sputtered atoms are neutral and therefore are not affected by the magnetic fields. For conducting targets (e.g. metals), any charge building up on the target will conduct away to ground. However, on insulating targets, charge build up will occur at DC. For this reason, an RF sputtering technique is employed that reduces charge build up at the target, and thus enables the sputtering of insulating films such as silicon dioxide. Overall, the sputtering process involves many different parameters that can affect the end result of the microstructure and quality of a film (target power, substrate temperature, substrate quality/cleanliness, chamber quality/cleanliness, chamber gas ambient pressure). This can make some aspects of the process hard to control - particularly sensitive parameters such as film stress. However, the technique has broad appeal as it allows low temperature deposition of metallic and insulating thin films over a variety of surfaces.

## References:

[1] Safi, *Recent aspects concerning DC reactive magnetron sputtering of thin films: a review*, Surface and Coatings Technology, Volume 127, Issues 2–3, 22 May 2000, Pages 203-218, ISSN 0257-8972.

[2] W. A. Pliskin, *J. Vac. Sci. Technol.* 1977, 14, 1064.

## Warnings:

The tool uses high power and low vacuum during deposition. Do not attempt to open the chamber until the deposition cycle is complete.

## Required Checkout:

You must be formally tested by laboratory staff before you may use this tool unsupervised. When you are first learning procedures, work with experienced lab users (students, post docs, faculty or staff) to become familiar with the tool before requesting a formal checkout procedure.

## **1.0 Material Requirements:**

- 1.1 Equipment: substrate, wafer tweezers, metal targets
- 1.2 Personal Protective Equipment: nitrile gloves, safety glasses
- 1.3 Chemicals: none

## **2.0 Procedure:**

*The main power to the tool should always be on and the chamber should be under vacuum. If you arrive at the tool and the tool is off or vented to atmosphere let the lab staff know.*

*Typically, if a user is preparing for a deposition a sign will be left on the tool to notify other users.*

*If the tool is already on and under vacuum (and no one else is using the tool), first follow the “Vent the Tool” procedure, and then move on to the “Load Samples and Targets” and “Pump Down” procedure.*

### Getting Started:

1. On the Desktop open up the SCADA Software. This is the main control software that controls the vacuum system and most aspects of the tool operation (except the deposition process itself). The icon looks like the one below:



2. On the main menu of the SCADA Software log in at the top right corner of the screen (View Appendix A.1) using your own username and password.

### Vent the tool (if you arrive and the tool is under vacuum):

1. Check the current state of the tool on the main menu of SCADA by viewing the chamber pressure located on the top right.
2. Most of the time (when the tool is idle) all four gas cylinders will be closed to save gas. \*Before venting make sure that only the Vent Gas HP N<sub>2</sub> cylinder (front left cylinder) valve is open (do not adjust the regulators).\* This is necessary for bleeding the chamber to atmosphere.
3. Check the output pressure of the Vent Gas HP N<sub>2</sub> - it should read 15 psi.
4. Check the pressure in the tank. If it is below 300 psi notify the lab staff.
5. Select “Chamber Vent Sequence” on the right side of the main menu in SCADA. A yellow window will appear to remind the user that after venting some surfaces in the tool may be hot due to the deposition process. Click OK to continue.
6. A new window for the venting process should appear (View Appendix A.4).
7. Click “Enable/Disable Active Cooling” to prevent the tool from actively cooling the substrate platen. Values for that box will grey out. If this is not disabled It will cycle through pumping down and venting a few times, making the vent process take much longer! Active cooling is only used if the substrate was purposely heated during deposition.
8. Click OK to begin venting.
9. The pressure should start to change and the turbo pump should slow down. Check this by viewing the turbo pump speed indicator located on the main menu (View Appendix A.10).
10. When the chamber is done venting (about 5 minutes), a blue notification will appear on the main menu as shown:

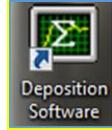


Click it to make it go away.

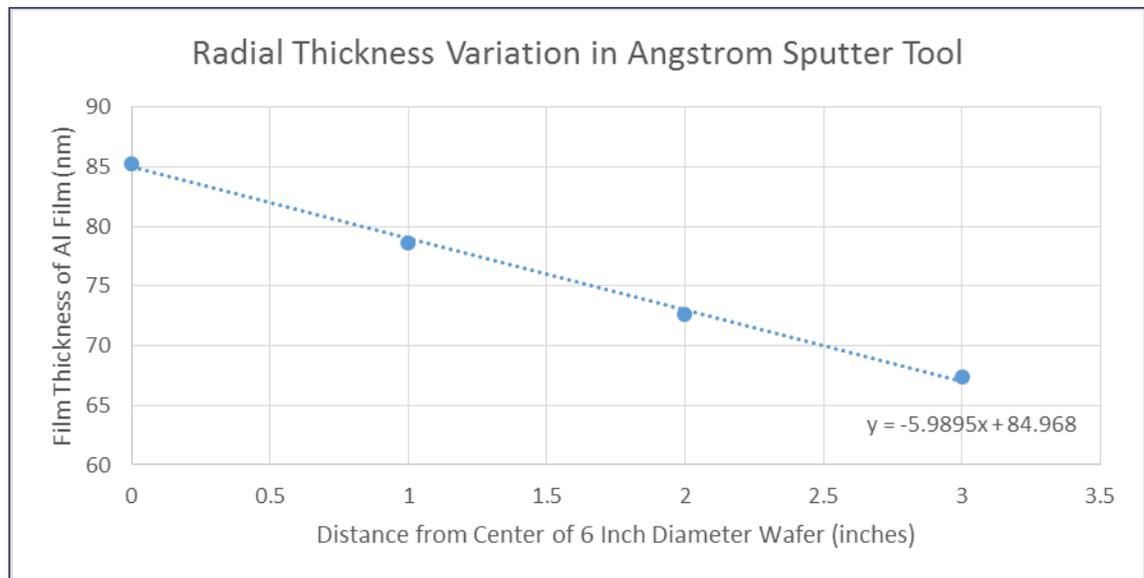
11. Under “System Interlocks” the indicator next to “Chamber above Atmospheric Pressure Setpoint” should now be green, and the chamber pressure reading on the top right corner should read “off scale”.

### Load samples and targets:

1. Once the tool is completely vented close all cylinder valves.
2. Open the chamber door using the two latches on the right side of the tool. Once the top latch is released all power supply to the shutters and guns are automatically turned off for safety. You will hear a click when opening one of the latches.
3. To see what targets are currently in which gun go to the systems tab in SCADA and under baseplate there should be a visual representation of which targets are in which gun.
4. If you wish to change targets contact lab staff to change targets or ask an experienced user.
5. Check the crystal life on the thickness monitor by going to the desktop and clicking the “Deposition Software” (Inficon) icon.



6. A menu will pop up asking to sign in. Click “ok” since there is currently no password.
7. Under view → “Sensor Readings” there will be a menu that pops up with information about the crystal including its current life (See Appendix G). If the crystal life is below 50% the crystal needs to be replaced (see section on crystal replacement below).
8. Locate the platen that is near the top of the chamber. This is a sputter up tool; you will notice that the guns point upward (See Appendix B.1, B.2, and B.4).
9. Twist the platen so that the thermocouple faces you. It is located in a rectangular shaped shield attached to the platen (See Appendix B.3). Twist until you hear a click. The click insures the platen is locked into place.
10. If it clicks and the thermocouple is not facing you, seal the chamber door, go to the Systems tab in SCADA, click baseplate on the top left corner, and then click “start” located on the substrate rotation box (See Appendix D.6). This will get the substrate platen to unlock. Turn off substrate rotation and proceed with the previous steps to get the thermocouple to face you. Remember to twist until you hear a click.
- 11. Remove the thermocouple shield. *Leave the shield inside the chamber to keep it clean.***
12. Carefully unplug the thermocouple (See Appendix B.3).
13. Once the thermocouple is unplugged push the substrate shutter away from you to expose the substrate platen (See Appendix B).
14. Twist the platen clockwise so that the screws that hold the platen up move towards the larger holes. It helps to push up lightly while twisting. Place the platen with the screws facing up on the platen stand provided that is located on top of the tool.
  
15. On the surface of the platen there are screws with triangle holders (See Appendix B.4) to help keep the substrate from falling. Locate the screwdriver with the red handle to proceed (located behind the tool).
16. Unscrew/screw in different bolts with triangle holders to adjust how you wish to load your substrate. After loading the substrate in the desired position, swing the triangle holders so that they are on top of the substrate and screw to hold it into place. ***Do not tighten too hard*** since too much force can cause the substrate to crack.
17. ***Make sure to cover all screw holes before deposition (so, either there is a screw in them, or the substrate is covering them). Failure to do so can cause particles to go through and hit surfaces above the substrate platen. It is okay if your substrate covers any holes without screws. Just don't leave any holes exposed.***
18. Include some method of measuring film thickness – often we use a glass microscope slide with a thick line drawn on it with a Sharpie marker. The marker can be dissolved after deposition with acetone, leaving a step on the slide surface which can be measured with the DekTak.
19. Radial thickness variation occurs along the platen. The following data was used with a 6 inch wafer with sharpie markings separated by 1 inch from the center. The sputtered material was Aluminum with a target thickness of 100 nm. The data is fit with a linear trend. The equation for this fit is listed on the plot.



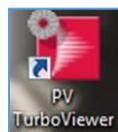
20. If there are any unused screws or triangles put them away in the bag/petri dish near the tool.
21. Pick up the platen and flip it so that the substrate faces down. Loading the platen requires the opposite steps as when unloading (load unto screws and twist counter clockwise to get it to stay in place with the smaller holes).
22. Connect the thermocouple back up (+ goes with +, - goes with -).
23. Place the shield to cover the thermocouple.
24. It is not necessary to move the substrate shutter back into its original position since once the chamber door is properly fastened it automatically closes all shutters, however, it is okay to do so before proceeding.
25. Once the samples and targets are loaded, inspect the edges on the door and chamber. Clean surfaces with a fab wipe/isopropanol if there are any unwanted particles
26. Close the chamber door, and fasten both latches.

#### Replacing the crystal (only do this if crystal life is below 50%):

1. The crystal is located in the back of the chamber in between both guns; it is a small circular sensor.
2. Pull the circular top off the crystal straight up, it will pull out.
3. Push the thin crystal disc out of the holder with your finger and throw it away.
4. Get a new crystal from the box, and put it carefully into the holder. The electrode pattern goes towards the back of the holder (the part that will connect to the electrical connectors in the sensor base).
5. When placing the crystal in the holder, try to avoid touching the front surface of the crystal.
6. Press the holder firmly back into the sensor base inside the chamber.

#### Pump Down

1. Once everything is loaded, make sure all gas cylinders are closed for a quicker pump down, and open the PV TurboViewer Software located on the Desktop. This software will communicate with the turbo pump so that it is possible to check the speed and power of the turbo while pumping down.



2. On the top left of the PV TurboViewer software select connection wizard.
3. Under "find single device" click the following icon:

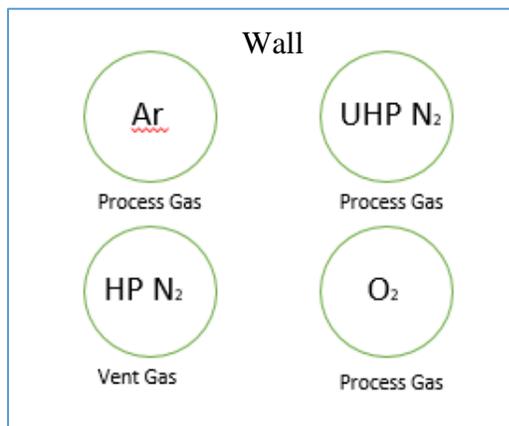


4. The software should now have connected to the turbo (See Appendix E). Keep this window open or minimized for quick access.
5. Go back to the SCADA software, go on the main menu, and select “Chamber Pump Down Sequence” (See Appendix A.3).
6. Once you’re ready select “Start Selected Sequence” (See Appendix A.5).
7. During pump down you will observe that the roughing pump turns on. Since the roughing pump is connected to the turbo you will notice in the PV Turbo Viewer that the turbo picks up some speed without actually using power.
8. There is a delay of about one minute before the Turbo turns on and starts using power to drive the chamber pressure even lower. After about a minute you should observe the power and speed increase in PV Turbo Viewer. You can also view the turbo speed bar increase on the main menu in SCADA(See Appendix A.10).
9. At full speed the PV TurboViewer will read 60,000 RPM and power values from 18-30W.
10. The longer the pump down the better quality films will have. This tool can achieve values in the low  $10^{-7}$  Torr range.
11. Record your final base pressure in the log book.

*Note : If you plan to leave the lab for a few hours while the tool pumps down, that’s fine. It might be a good idea to leave a note with your name and phone/email telling people that you are pumping down and when you expect to finish your deposition, in case someone comes while you are not there and vents the tool! **If you are leaving the tool pumped down make sure the chiller is off since it is only needed for cooling during deposition. Remember to turn it on before deposition.***

### Set up Deposition and Process Gases

1. Turn on the CFT33 recirculating chiller to the right of the tool by flicking the switch up to “on”.
2. Wait for the chiller temperature to reach 20°C as indicated on the front display on the chiller. A green LED should light up to the left of the display for “cool”. It may flicker back and forth between “cool” and “idle” since the chiller is aiming for a set point temperature.
3. Give it some time to reach the desired temperature. If needed adjust the temperature with the knob to the left of the power switch.
4. To check if everything is ready for deposition on the main menu click on “System Interlocks” and check if everything under “Required for Deposition” is highlighted green (See Appendix A.7). Deposition will not run if anything on that list is red.
5. Open the cylinders that will be used. All four cylinder tanks should have output readings of 15 psi on their respective regulators. The cylinders will be labeled and the schematic of their placement is as follows:



6. If your process requires your substrate to be heated go to the front of the tool and adjust the setpoint temperature (in green) using the up and down arrows on the temperature control (See Appendix D.5).

## Run Deposition

1. Go to the desktop and open up the “Deposition Software” (Inficon). Click Ok when the log in window appears. There is currently no log in required.
2. **In the deposition software go to database and choose “Angstrom User”.**
3. Go to file → process, and choose the deposition process you wish to run. For example: Sc1-DC-Al will refer to gun 1, DC, Aluminum deposition. Some processes will have specific deposition rates, or will involve sequential depositions, or co-depositions.
4. After selecting a process go to edit, then click process, to change settings for thickness. On the “layer” tab there should be an option for “final thickness”. Edit that number to the target thickness you wish to deposit (See Appendix G). **Do not change any other parameters** since these processes have already been set. If you want to create a new recipe please contact lab staff.
5. Once your process is set up click the “x” on the top right corner to close the menu.
6. On the deposition software main menu click “start process”. This will begin deposition of **all** layers you set up previously. The process has various numbers of pre-condition steps prior to deposition as well as other setpoints during and after deposition. You will notice all these numbers on the right side of the graph. **Do not adjust these numbers as they will change the process parameters.**
7. There is also an option to click “start layer”. This will only deposit the first layer if the process is a multilayer process.
8. “Next Film” will automatically set up parameters for the next layer in a multilayer process which you can then press “start layer” to begin deposition.
9. There are a couple of things to be aware of during deposition. The first thing to notice is that on the top of the screen there will be indicators for the current process that is running, time for that process to run, number of layers, time for deposition of that layer, an indicator for which step in deposition the tool is undergoing (labeled “phase”), time that the step takes to complete, as well as a process bar for that step (See Appendix G).
10. On the bottom of the screen there will be indicators for the current film process name, deposition rate, deviation from the target deposition rate, thickness, and power.
11. The default graph in this software is deposition rate. Go to View → Power Graph to view a live viewing of the power over time of the deposition process.
12. During deposition there are a few things you will notice. Firstly there is a ramp up of power that the tool undergoes to spark plasma. In the SCADA software you will notice that the chamber pressure will increase past the process pressure to insure the plasma is sparked.
13. After the first precondition step the pressure will go back down to the target process pressure, and the tool will enter its second pre condition that involves changing power values to get closer to the target deposition rate. You will notice deposition rate increases from zero because **deposition is occurring in this step**, however, the **substrate shutter is closed** to protect the substrate.
14. Once the tool achieves the proper target values for deposition rate it will go into the shutter delay step. Here the tool begins making adjustments to stabilize to the target dep rate. **Deposition is occurring with the substrate shutter still closed.**
15. After shutter delay any thickness readings from the crystal is zeroed, the substrate shutter is opened, and **deposition occurs**. Record the power (a percentage of 800W), and deposition rate during this step and add it to the log book.
16. Also record the power coming from the tool. On the front of the tool there should be a reading for current in mA and a reading for voltage in kV. Multiplying both numbers will give the current power in the tool. Compare this with the reading from the deposition software described in the previous step.
17. Record the film thickness right at the end of the deposition step and add it to the log book. When the deposition step is over the **substrate shutter is closed** to prevent any more particles from

depositing on the substrate, however, the crystal will still record further sputtering as power ramps down.

18. After deposition there is a feed step which safely ramps down power and closes the substrate shutter to prevent any more deposition from occurring. You should be able to see a decrease in power, and deposition rate.
19. If you wish to stop deposition for any reason throughout this process click “abort process”. This will bring the chamber to its post deposition sequence. “Abort layer” does something similar except that if you have another layer afterwards it will start that layer after undergoing post deposition parameters for the layer that was stopped.

### **Vent and Remove Samples**

1. Once all depositions are complete close any process gas cylinders and open the Vent Gas HP N<sub>2</sub> cylinder.
2. Bring the temperature set point back to zero if temperature was changed for deposition.
3. Go back to the SCADA Software and click chamber vent sequence. Click OK to make the warning window about heated surfaces go away.
4. Disable active cooling if no heating was done for your process and press OK.
5. Once the blue notification appears to show that venting is complete click on it to make it go away.
6. Close all gas cylinders.
7. Open the chamber, and remove your sample.
8. Close the chamber door.

### **Shutdown**

1. *Close all cylinder valves (do not adjust the regulators).*
2. Make sure the chiller is off
3. Start a new pump down sequence and make sure the tool pumps back down to vacuum and the turbo ramps up correctly.
4. Leave the computer and the SCADA software running and walk away.

### **Emergency Shutdown**

If you need to shut down in the middle of a run for any reason, the “abort” button on the SCADA main menu should be used for pumping down or venting issues. The “abort process” in the deposition software should be used during deposition issues. These abort buttons have automatic sequences that slowly ramp down power to protect the turbo pump.

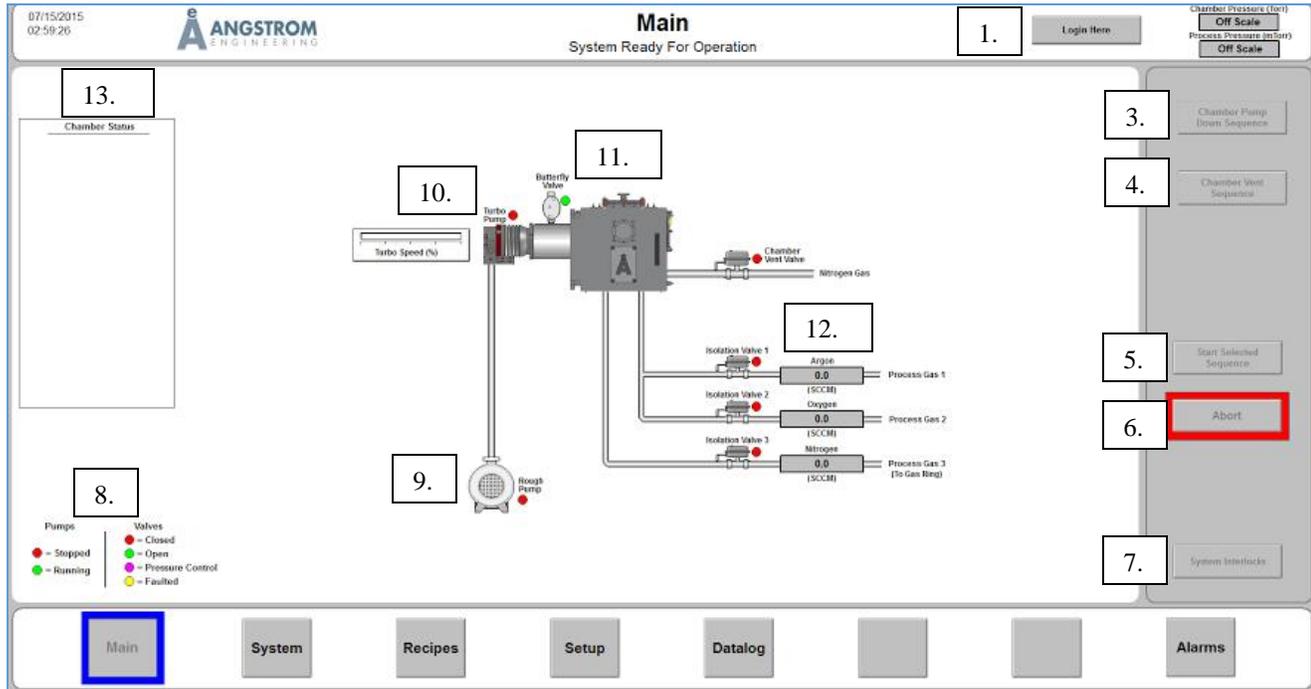
If something is really bad, hit the big red emergency stop button on the front of the tool to shut down **all power** to the tool immediately. Note that if you shut down all power to the tool the pumps will turn off, which will put significant wear on the turbo pump.

If at any time you feel unsure about how to use the tool, please stop work and contact a qualified user, laboratory staff and the faculty advisor. Please don't forge ahead when you are unsure, you may end up damaging the tool!

**Report all accidents or tool issues to Prof. White at x72210, r.white@tufts.edu.**

## Appendix

### A. Main Menu (SCADA)



1. **Log in Here:** Opens up the log in menu as shown

Login

Name:

Password:

OK

Cancel

Keyboard...

2. **Chamber Pressure (mTorr) & Process Pressure (mTorr):** Chamber pressure reads the current pressure in the chamber. Process pressure is a more accurate reading of the chamber pressure (has a more precise gauge) during deposition. If both ever read "Off Scale" it is because the chamber has reached high pressures (usually around atmospheric).
3. **Chamber Pump Down Sequence:** Begins the pump down process of the chamber. The user must select 5 to begin the process.
4. **Chamber Vent Sequence:** Begins venting sequence of the chamber. The menu for venting is as shown:

**Enable/Disable Active Cooling:** Should be clicked to disable (will then have parameters greyed out) if the user's substrate was never heated during deposition.

**Vent up Pressure:** Chamber pressure will increase by this amount at the beginning of the cycle.

**Pump Down Pressure:** Chamber pressure will decrease by this amount as the second step in the cycle.

**Pump & Purge Cycles:** The number of times you wish for the vent up and pump down cycles to occur. This cycle is useful for removing harmful gases.

**Chamber Vent Time Duration Setpoint:** How long the vent valve stays open.

**Chamber Vent Start Delay Time Setpoint:** Add a delay before introducing HP N<sub>2</sub>.

*\*The above values in the screen shot are the default values for the vent menu.*

5. **Start Selected Sequence:** Pump down will not begin unless this is selected.
6. **Abort:** Can be used to stop pump down or venting. Typically, the user may have to check the "alarms" tab to view the status of any faults or errors. Abort will not cut off power supply immediately on the turbo during a pump down abort. It is advised to let the turbo slow down a few minutes before restarting pump down.
7. **System Interlocks:** Gives the user an overview of what is needed to start a deposition. An example of a chamber being ready for deposition is as shown:

**Pressure OK to Start Deposition:** Chamber has reached base pressure.

**Pneumatic Gas Pressure OK:** Pressure to move shutters for the guns and substrates is sufficient.

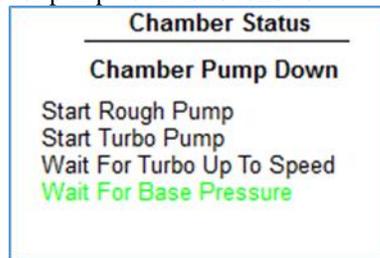
**Source 1&2 Water Flow Ok:** The chamber is running water properly to both guns to keep things cool during deposition.

**Chamber above Atmosphere Pressure Setpoint:** Chamber is vented to atmosphere.

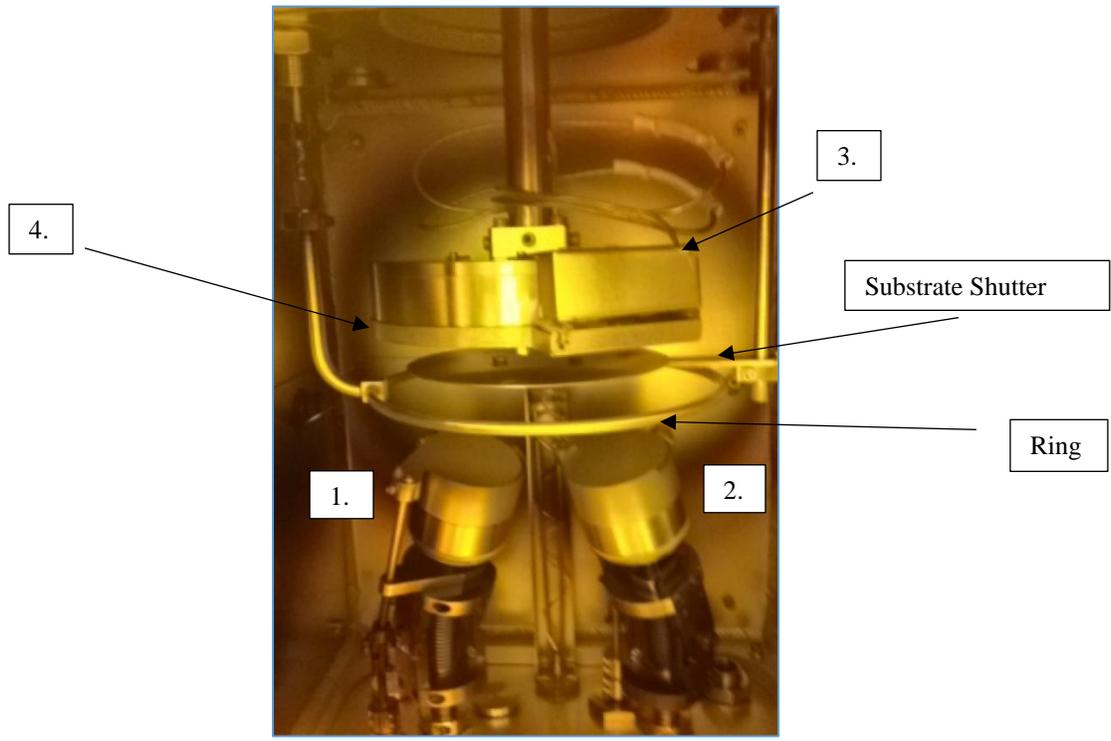
**Chamber Safety Pressure Has Been Attained:** Pressure setpoint to protect the turbo pump from working too hard is reached.

**Turbo Up To Speed has Been Attained:** Turbo has reached full speed (60,000 RPM) and Full Power (18-30 W) to get the chamber to a reasonable base pressure.

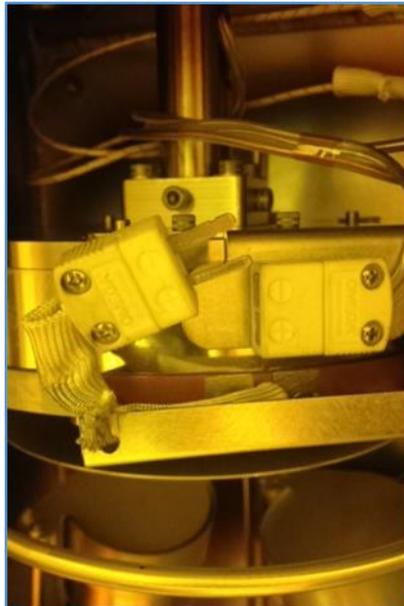
8. A key for the current status of the tool's pumps and valves.
9. **Rough Pump:** Refers to the pump that sits on the ground on the right of the sputter tool. This is used to bring the tool to a lower pressure than atmosphere.
10. **Turbo Pump:** Refers to the pump that sticks out of the tool on the right of the chamber. This pump is used to bring the tool to even lower pressures that the rough pump would not be able to do on its own. The rough pump is always started before the Turbo pump. When venting back up to a higher pressure the turbo pump will slow down before the rough pump. The indicator next to the turbo pump on the schematic tells the user the current status of the turbo pump. A full bar is needed to achieve base pressure.
11. **Butterfly Valve:** Determines the base pressure. This is automatic and can be changed manually under the systems tab (See Appendix C.6).
12. Shows the current status of the vent gas used for bleeding to atmosphere (HP N<sub>2</sub>) and the three Process Gases (Argon, UHP N<sub>2</sub>, O<sub>2</sub>). Also shows the flow rates in sccm for the three process gases.
13. **Chamber Status:** Usually has useful information on the current processes that are occurring in the chamber. The process for pump down is as follows:



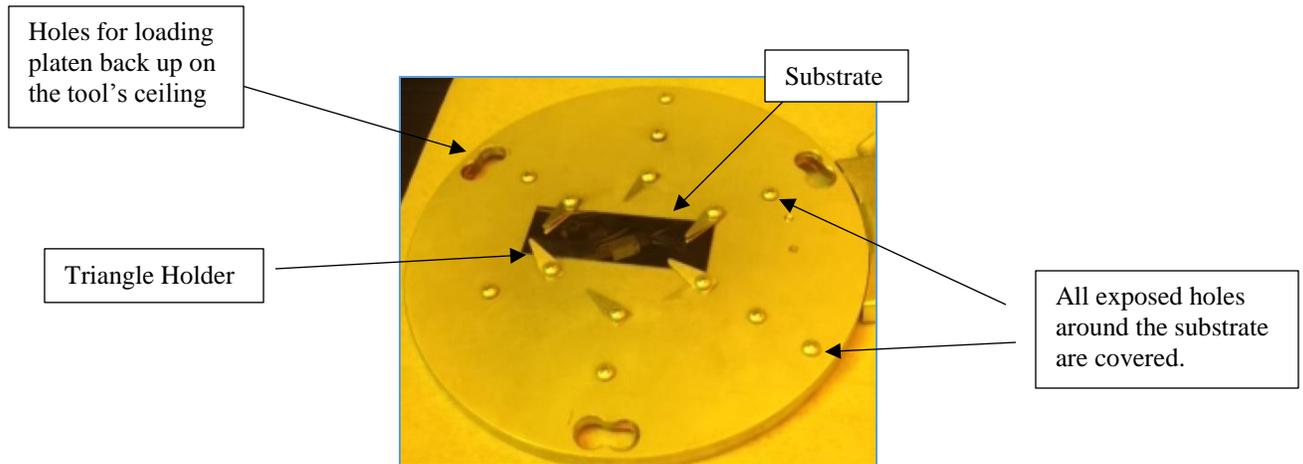
## B. Inside the Chamber



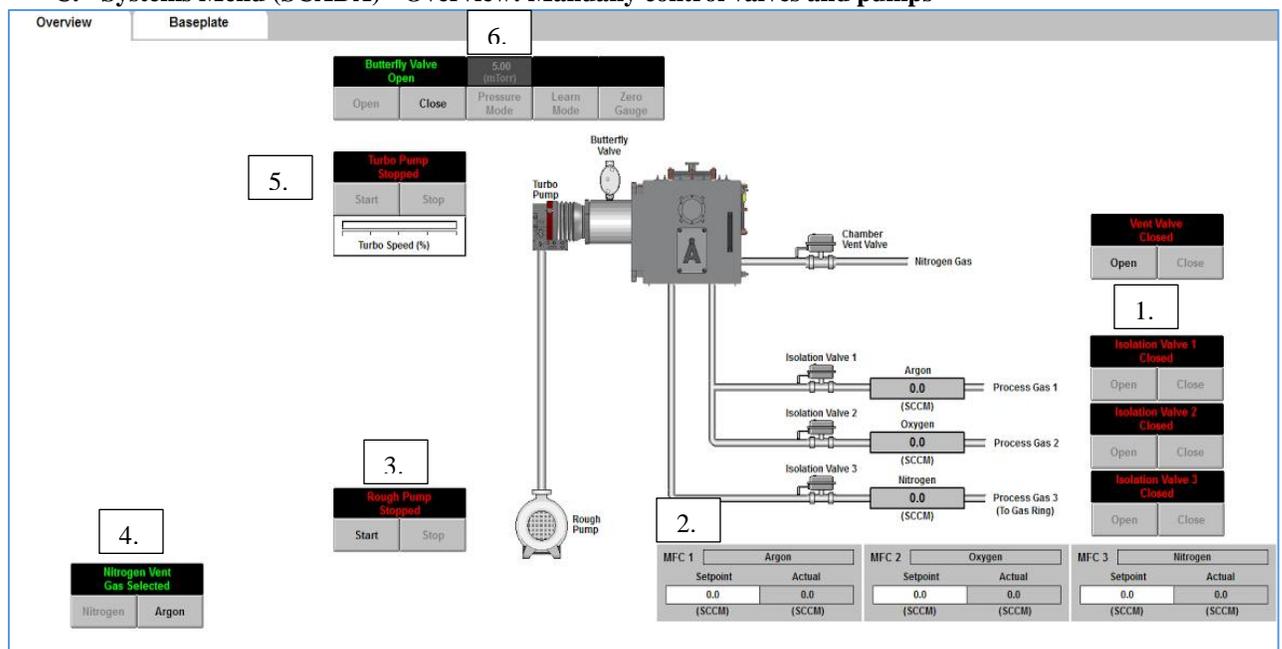
1. **RF/DC Gun 1:** This gun has been set up to do both RF and DC sputtering.
2. **DC Gun 2:** This gun can only do DC sputtering.
3. **Thermocouple Shield:** Once the shield is removed the thermocouple can be unplugged as shown:



4. **Substrate Platen:** Once the platen is removed different configurations of screws and triangle holders can be used to keep a substrate in place during deposition:



### C. Systems Menu (SCADA) - Overview: Manually control valves and pumps

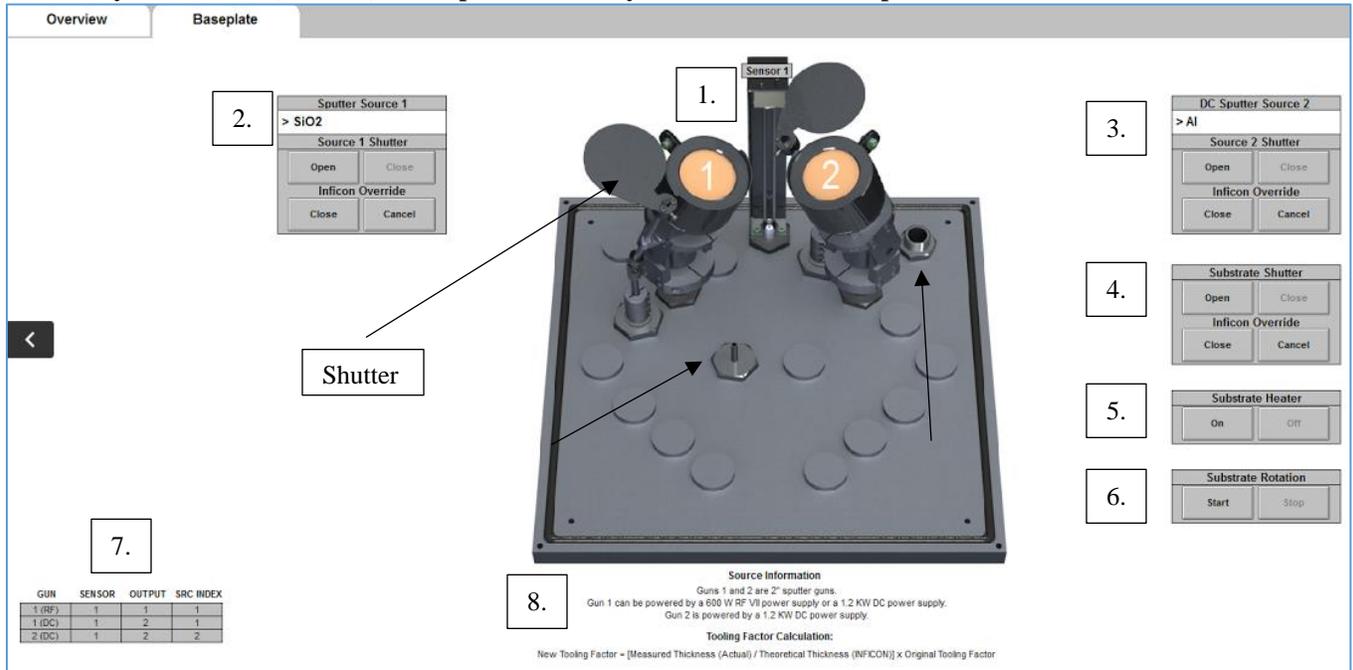


1. Open and close valves to vent gas and process gases
2. Choose the flow rates for the three process gases. Set point refers to a target pressure while actual will tell the user what the current flow rate is.
3. Start or stop the rough pump.
4. Choose which vent gas to use. HP N<sub>2</sub> is the current cylinder hooked up to vent.
5. Control turbo pump.
6. Controls pressure coming from turbo using the butterfly valve. The process pressure can be changed manually here. Useful for creating recipes.

**Zero Gauge:** is used if the chamber pressure is below 2.0 e-6 Torr and if no process gases are entering the chamber. It will zero the process pressure gauge to give an accurate reading in the main menu.

**Learn Mode:** Should not be used unless advised by Angstrom Engineers. While a process gas is entering a chamber (usually 40 sccm) learn mode can be used so that the butterfly valve can relearn all the necessary control parameters. This has already been serviced.

### D. Systems Menu (SCADA) – Baseplate: Manually control shutters and platen rotation



- 1. Guns 1 & 2 Sensor 1:** Shows the user where the guns and crystal are located.
- 2. Sputter Source 1 (RF/DC):** After changing a target the user can write down what target is currently in gun 1. The shutter can be opened and closed here for gun 1, and an override can be used while making recipes in the deposition software (Inficon) to keep the shutter closed during the deposition step while PID controls are being set up.
- 3. Sputter Source 2 (DC):** Similar to 2.
- 4. Substrate Shutter:** Open and close the substrate shutter or override the Inficon software to handle PID controls to avoid getting any deposition on the substrate.
- 5. Substrate Heater:** Turn on heating for the substrate platen. Control the temperature on the following device:



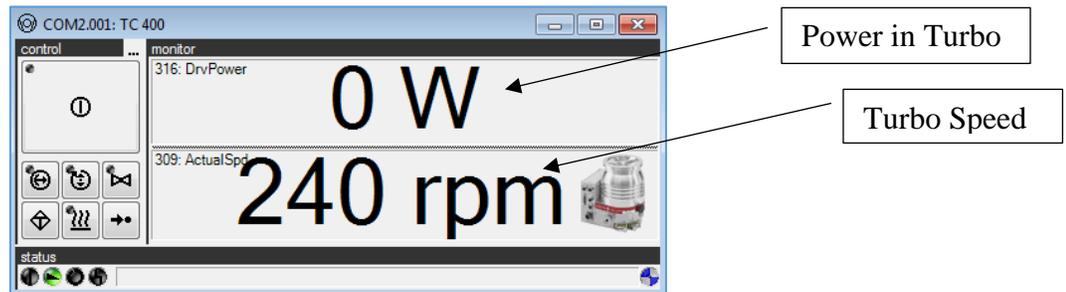
Remember to use active cooling during the vent process if the platen is heated.

- 6. Substrate Rotation:** Turn on substrate rotation to get the platen to spin. Control speed using the following knob:

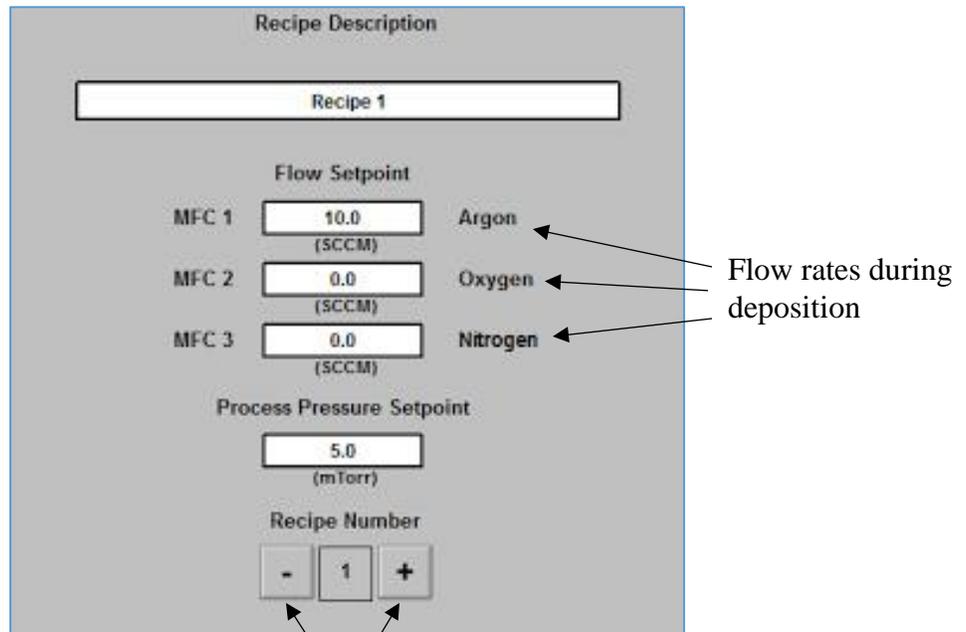


7. **Reference Matrix:** Has a list of values to be used for setting up recipes and processes in the Inficon deposition software. “Gun” shows visually which gun can use RF or DC or both, “Sensor” will always be 1 since there is currently only one crystal, “Output” refers to power supply (RF = 1, DC = 2), “Source Index” is used to refer to the needed gun during deposition (similar to “Gun”).
8. **Source Information/Tooling Factor:** Has more information regarding power supply of both guns as well as an equation for updating tooling factors of materials.

**E. PV TurboViewer**



**F. Recipe Menu**



Navigate through 15 different recipes

## G. Inficon Deposition Software

The screenshot shows the Inficon Deposition Software interface. On the left, there is a vertical menu with buttons: **START PROCESS**, **START LAYER**, **AUTO -> MAN**, **ZERO**, **NEXT FILM**, and **NEXT SETTING**. Callouts on the left describe these buttons: 'Begin full process' for START PROCESS, 'Start current layer' for START LAYER, 'Switch to manual control (for adjusting process parameters)' for AUTO -> MAN, 'Zero thickness (for manual mode)' for ZERO, and 'Switch to next film' for NEXT FILM. The main area features a graph with 'Deposition Rate (A/s)' on the y-axis (0.0 to 1.0) and 'Elapsed Time (sec)' on the x-axis (0 to 50). At the top, status information includes 'Process: Src1-RF-S102', 'Time/Run: 0:00:00 / 69', 'Layer: 1 of 1', 'Time: 0:00:00', and 'Phase: Stopped', 'Time: 0:00:00 / 0:00:00', 'Progress: 0%'. At the bottom, a data bar shows: 'Film: Src1-RF-S102', 'Rate(A/s): 0.00', 'Dev [%]: 0.0', 'Thick(A): -0.0003', and 'Power[W]: 0.0'. Callouts at the bottom identify these as 'Current layer', 'Deviation from Target Deposition Rate', 'Current Thickness', and 'Current Power'. A callout at the top right points to the progress bar, stating 'Current step in deposition process, time for that step to run vs. total process time, and progress bar for that step'. Another callout at the top center points to the layer information, stating 'Current layer and time to deposit layer'.

### Sensor Readings Menu

The 'Sensor Readings Menu' displays a table with the following data:

	Rate (A/s)	Thick (kA)	Freq. (Hz)	Life (%)	Source
Sensor 1	.00	0.0455	5852525.58	85.3	Output 2
Sensor 2	Not	Used	Fail	0	None
Sensor 3	Not	Used	Fail	0	None
Sensor 4	Not	Used	Fail	0	None

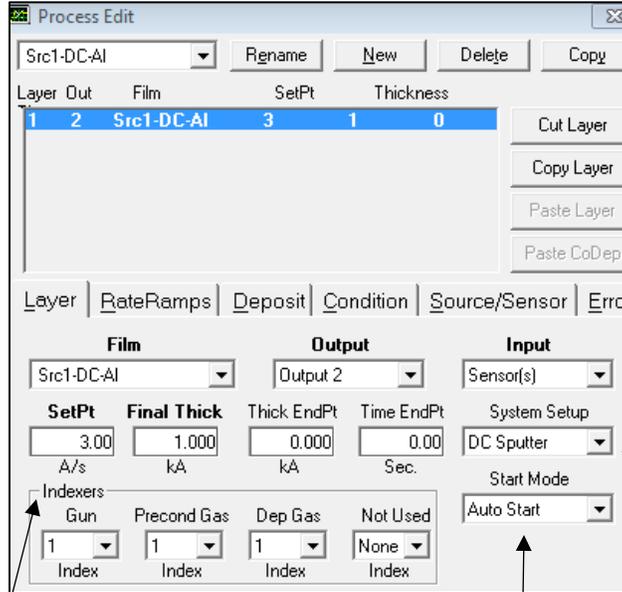
Callouts include: 'The tool currently only has one sensor' pointing to the first row of the table; 'Current Deposition rate, thickness, crystal frequency, life, and source that is being read (DC or RF)' pointing to the columns of the table.

**Process Edit (very similar parameters in film edit except film edit does not have the option to do multi layers):**

**Layers Tab:**

Layer = for layer order  
Out = source (DC = 2, RF = 1)  
Film = film name (edit in "Film")  
SetPt = target deposition rate  
Thickness = first number indicates the target thickness, the second number indicates a thickness end point

**Select a layer in this menu to edit parameters**



Change the name of a process, create an entirely new process, delete an existing process, or copy a process

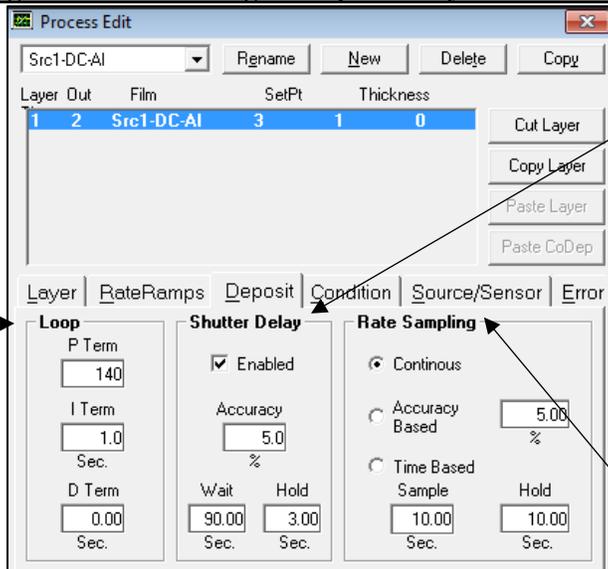
Cut and copy layers within the layer menu to change the order of multi depositions

References parameters under file → system. These have already been set up for each type of power supply

Automatically start Layer. Important for multi-layer processes

Use SCADA as a reference for which gun is which as well as to set up the gas index using the recipe tab

**Deposit Tab (Set starting values when making a new process layer and edit after manual runs):**

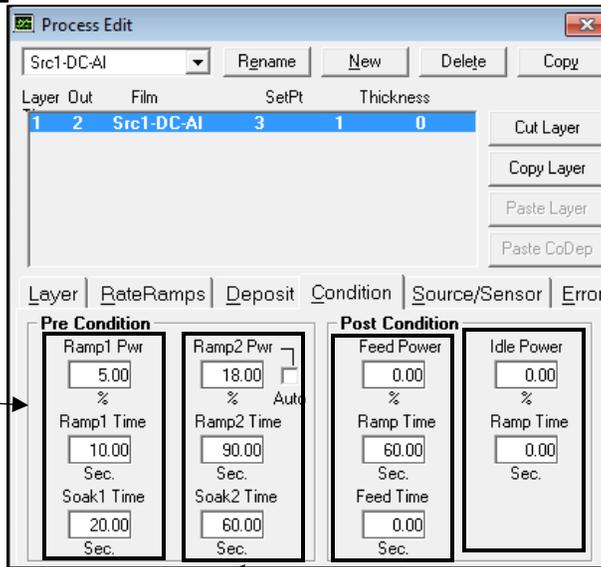


PID Parameters

Accuracy: Deviation from target dep rate that is used before opening substrate shutter  
Wait: Waits a specified time to achieve accuracy or else process needs to be adjusted  
Hold: If accuracy is reached in the right time it will hold those values a few seconds before opening the shutter

How data is being read to implement controls

**Condition Tab (Set starting values for ramps and holds/soaks when making a new process layer and edit after manual runs):**



For Sparking Plasma:  
Ramp1 Pwr: Target percentage of total power (800W) used to spark plasma  
Ramp1 Time: Time of ramp  
Soak1 Time: Time that Ramp1 Pwr is held for

For Reaching Target Dep Rate (using PID):  
Ramp2 Pwr: Target percentage of total power used to reach dep rate  
Ramp2 Time: Time of ramp  
Soak2 Time: Time that Ramp2 Pwr is held for

After Deposition Ramp Down for Protecting Pump:  
Feed Pwr: Target percentage of total power used to end deposition (usually 0 power)  
Ramp Time: Time of ramp  
Soak2 Time: Time that Feed Pwr is held for

If feed power is not made zero idle power and ramp time can be used to add an additional ramp down

**Source/Sensor Tab:**

Layer	Out	Film	SetPt	Thickness	
1	2	Src1-DC-Al	3	1	0

**Source**

Material: Aluminum

Max. Power: 50.00 %

Slew Rate: 3.0 %

**Sensor Tooling (%)**

Sensor 1: 60.0

Max power allowed for ramps

Rate of transitions between phases

Tooling Factor (Adjust after making DekTak measurements. Reference Equation in SCADA)

References "Materials" under edits for parameters (Density, and Z Factor) that are used for the crystal