

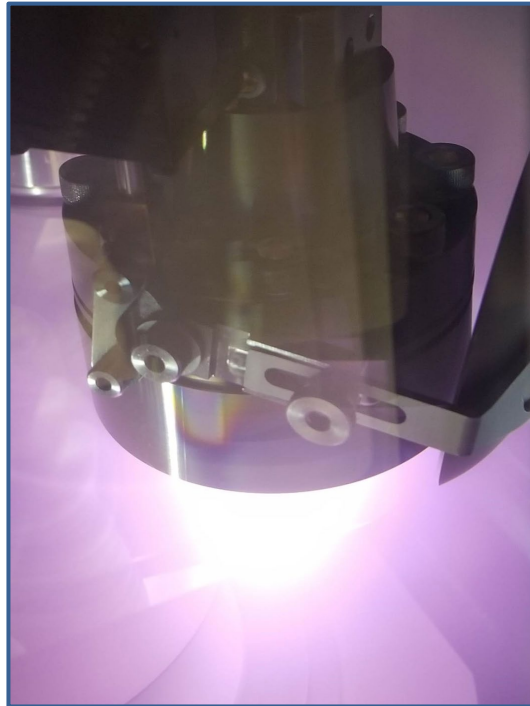
**Arizona State University NanoFab**

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# LESKER 5 SPUTTERER STANDARD OPERATION PROCEDURE

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Rev C



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## 1. Purpose / Scope

- 1.1 This document covers the procedure that should be followed for normal operation of the Lesker PVD75 PRO line Sputterer.

## 2. Reference Documents

- 2.1 Chemical Safety & Hazardous Waste Management Rules & Procedures Handbook
- 2.2 PVD Series Operation Manual
- 2.3 Kurt J Lesker Circular Sputtering Source Torus 3” HV operations manual

## 3. Equipment / Supplies / Material

- 3.1 Clean room vacuum.
- 3.2 Tweezers.

## 4. Safety

- 4.1 Follow all safety procedures outlined in the NanoFab Handbook
- 4.2 Follow safety procedures when working with DC voltage or RF energy.
- 4.3 Follow safety and handling procedures when working with vacuum systems and materials.
- 4.4 Do not attempt to repair the tool under any circumstances. Submit a service request and contact ASU NanoFab staff.
- 4.5 Red EMO Button can be pressed at any time an emergency situation arises. Contact NanoFab staff to follow up with any emergency condition.

## 5. Tool Reservation Policies

- 5.1 Only trained users will be allowed to use this equipment.
- 5.2 Our NanoFab 15-Minute rule.
  - 5.2.1 Please start within 15 minutes of your equipment scheduled time or the tool becomes available to anyone. Please place a ‘Tool in Use’ tag when you arrive to indicate use.
  - 5.2.2 Please have the equipment available for the next user within 15 minutes after your scheduled time.
- 5.3 Cancellations.
  - 5.3.1 If you cannot meet the equipment schedule, please cancel your iLabs schedule to allow other users to utilize the equipment.
  - 5.3.2 Scheduling on iLabs allows cancellation within 24 hours of your scheduled time. Please email staff if cancellation within 24 hours.
  - 5.3.3 We discourage last second cancellations.
  - 5.3.4 We discourage scheduled equipment no-shows.
- 5.4 Scheduling Overnight Pumpdown runs.
  - 5.4.1 Please load overnight runs at 5pm and completed by the following morning at 8am.

## 6. Materials List

### 6.1. Lesker 5 Sputterer available material list.

If the material is not listed, please check with ASU NanoFab staff for approval.

<i>Materials List</i>	
Aluminum	Permalloy (Co/B/Zr/Ta)
Bismuth Ferrite	Silicon
Chrome	Silicon carbide
Cobalt	Silicon dioxide
Hafnium	Tantalum
Iron	Titanium
Molybdenum Disilicide	Titanium dioxide
Nickel	Tungsten
Nickel chrome	Zirconium
Niobium	Germanium

## 7. Processing Update

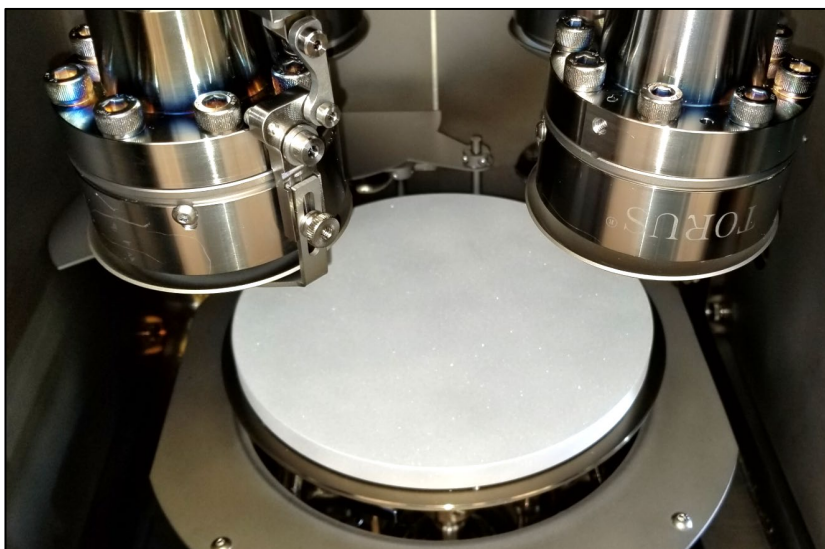
6.1 You will need to be present during all sputtering processing. Please ensure the tool dep rate and processing is stable before you walk away. \*Please do not leave the lab.

### 6.2 Targets

6.2.1 Targets are replaced by NanoFab staff. Please submit an iLabs service request for target change at least 24 hours ahead of your scheduled tool time. Target swaps to be performed by staff only.

### 6.3 Substrates

6.3.1 The 8" platen will allow various sizes of substrates.



- 6.4 Recipes
  - 6.4.1 If you do have any recipes modifications in mind for your processing, please give us a heads up to setup and test the recipe ahead of your scheduled run.
  - 6.4.2 The tool has the capability to run reactive recipes.
- 6.5 Magnetron guns.
  - 6.5.1 Sputterer uses only new TORUS magnetic guns with keeper targets.
  - 6.5.2 Source refers the four Magnetron guns in the chamber.
    - 6.5.2.1 Source 1- Uses RF power for Dielectric materials.
    - 6.5.2.2 Source 2- Uses DC power for Metallic materials.
    - 6.5.2.3 Source 3- Uses DC power for Metallic materials.
    - 6.5.2.4 Source 4- Uses DC power for Magnetic materials (Ni).
- 6.6 Processing.
  - 6.6.1 This tool will not be used for dirty materials that could contaminate Silicon such as Au, Ag, Pt, Cu, Zn, ZnO and ITO.
  - 6.6.2 Our DC recipes are set to run @120W. Power is adjustable during the process to increase the dep rate. The maximum power is 300W.
  - 6.6.3 Our RF recipes are limited to 0.5Å dep rate for these softer or ceramic materials that are typically bonded to backing plates.
  - 6.6.4 Film thickness maximum is 1µm per day. Cool down gun in between 5000A depositions.
  - 6.6.5 Please submit SR for any required removal of wafer shutter or the tilting of the magnetron gun. These tasks are to be performed by the staff. Modification of the tool will shut the tool down for other customers, so please reduce tool impact on others by performing consecutive runs in minimal time.
- 6.7 Pumpdown of chamber.
  - 6.7.1 You do not need to be present during chamber pumpdown.
  - 6.7.2 Recipes restricted to start at the minimal pressure of 5.0e-5Torr.
  - 6.7.3 Please utilize the tool to one run per 3-hour session.
  - 6.7.4 It is in your best interest to minimize your chamber vent time to minimize water absorption within the chamber. Please do not vent the tool until your samples are ready to load on platen.
- 6.8 Login of Sputterer software. See staff for log-in information to operator interface.
- 6.9 Please perform your NanoFab iPad sign-in log with your intended materials and thicknesses.

## 7. Vent and Pumpdown

- 7.1 Vent Chamber.
  - 7.1.1 Select Vacuum screen to view the current PC pressure.

- 7.1.2 Depress PC Vent button on right display margin. A Recipe Monitor PC Vent recipe window is displayed and wait till the recipe completes. PC Pressure will indicate atmosphere pressure.
- 7.2 Chamber and wafer loading.
  - 7.2.1 Open chamber door at atmosphere pressure by pulling black handle.
  - 7.2.2 Select the Deposition page to access chamber fixtures.
  - 7.2.3 Pull back window viewport shutter to determine Mylar liner needs to be replaced.
  - 7.2.4 Depress the substrate shutter button to Open. Shutter will open and the platen will be exposed.
  - 7.2.5 Load substrate(s) on platen. Your maximum load substrate size is one 8" wafer.
  - 7.2.6 Depress Substrate shutter button to Close. Shutter will close.
  - 7.2.7 Check Crystal life (Q%) Active Source/Thickness control on tab. before you close the chamber door.
    - 7.2.7.1 Select a Source 1-4 tab. Select thickness control tab. View Q% to see this value is >60%. Notify engineering if XTAL requires replacement.
  - 7.2.8 Use the Nilfisk vacuum to remove any loose particles from chamber if required.
  - 7.2.9 Close the chamber door.
- 7.3 Pump Chamber Down
  - 7.3.1 Depress the PC Pump button on right display margin. A Recipe Monitor PC Pump recipe window is displayed. The Pump PC recipe will complete with the minimal pressure of 5.0E-5 Torr. Lower pressures are recommended for your processing.

## 8.0 RF Backsputter Recipe

- 8.1 OPTIONAL- RF Backsputter process available for in-situ precleaning of your substrates.
  - 8.1.1 Depress Run Recipe button on right margin of Deposition display.
  - 8.1.2 Select RF Platen Bias recipe. Depress Run Recipe button.
  - 8.1.3 Insure PC Capman pressure setpoint of 4mTorr.
  - 8.1.4 Select or insure RF Bias output value of 100W.
  - 8.1.5 Depress Continue Load button to start.
  - 8.1.6 Monitor RF Bias on Deposition display page. Default settings: 100W for 2 minutes.
  - 8.1.7 Recipe Monitor window will complete when processing for film layer completion.

## 9.0 Sputtering Recipe Processing

9.1 Select and Load your intended deposition recipe.

9.1.1 Recipes range from default Src1-4, reactive, dedicated films or multi-layered.

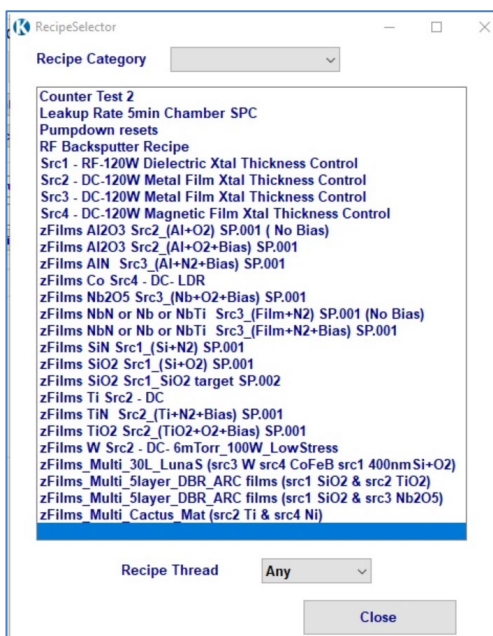


Fig 1- Recipe selection

9.1.2 Select Run Recipe button on the deposition screen.



Fig 2- Material type loaded in each source.

9.1.3 Choose desired Deposition recipe.

9.1.3.1 Select your intended Deposition recipe. Be sure to select the recipe based on the Source (Magnetron Gun 1-4).



Note: The target should be already in place in the gun based on your service request to NanoFab staff.

- 9.1.3.2 Depress the Run Recipe button.
- 9.1.3.3 Insure PC Capman Pressure setpoint- Process pressure of 4 mTorr.
- 9.1.3.4 Select PC Source Final Thickness Setpoint. Set thickness in Å units.
- 9.1.3.5 Depress Continue Load button to start source startup.

Recipe steps listed below require user values, enter these values into the "Value" column or accept the defaults already in place. Then click "Continue Load"

Recipe Name	Step	Equipment Type	Equipment Name	Equipment Operation	Notes	Minimum	Maximum	Value
Substrate Rotation Motor Start - User...	2	Motor	Substrate Rotation_Speed	Set Value = n.nn	Substrate Rotation 10 RPM			10
Ramp and Bum In - Pws2 120W - Use...	2	Power Supply	Power Supply 2 Output Setpoint	Set Value = n.nn	Target Bum-in Power (wat...	0	300	120
Ramp and Bum In - Pws2 120W - Use...	4	Recipe	Dwell	N Seconds	Bum-in time (seconds)			120
Deposit with xtal thicknes control - Src...	3	Source	PC Source 2 Tooling	Set Value = n.nn	THK Tooling Factor			243.0
Deposit with xtal thicknes control - Src...	5	MFC	PC Capman Pressure Setpoint	Set Value = n.nn	Process Pressure mTorr			6.0
Deposit with xtal thicknes control - Src...	6	Source	PC Source 2 Final Thickness Setpoint	Set Value = n.nn	Thickness in kÅ unit			1.0
Deposit with xtal thicknes control - Src...	7	Power Supply	Power Supply 2 Output Setpoint	Set Value = n.nn	Set Film PWR Level	0		100

Fig 2- Recipe inputs.

9.1.4 Select Reactive recipe variables that include O2/Ar or N2/Ar process gases.

Recipe User Set Values

Recipe steps listed below require user values, enter these values into the "Value" column or accept the defaults already in place. Then click "Continue Load"

Recipe Name	Step	Equipment Type	Equipment Name	Equipment Operation	Notes	Minimum	Maximum	Value
Substrate Rotation Motor Start - User...	2	Motor	Substrate Rotation_Speed	Set Value = n.nn	Rotation of Platen speed (...)			15
Ramp and Bum In - Pws2 Ti PWR & Ti...	2	Power Supply	Power Supply 2 Output Setpoint	Set Value = n.nn	Target (Ar) Bum-in Power ...	0	300	140
Ramp and Bum In - Pws2 Ti PWR & Ti...	4	Recipe	Dwell	N Seconds	Bum-in time (seconds)			180
Upstream N2 Pressure Control Reducti...	5	MFC	PC MFC 3 Ratio	Set Value = n.nn	N2/Ar %Ratio			4.0
RF Backsputter for in Recipe use RF ...	4	Power Supply	Power Supply 1 Output Setpoint	Set Value = n.nn	RF Bias PWR Level			25
Deposit with xtal thicknes control - Src...	3	Source	PC Source 3 Tooling	Set Value = n.nn	THK Tooling Factor			52
Deposit with xtal thicknes control - Src...	5	MFC	PC Capman Pressure Setpoint	Set Value = n.nn	Process Pressure mTorr			2.0
Deposit with xtal thicknes control - Src...	6	Source	PC Source 3 Final Thickness Setpoint	Set Value = n.nn	Thickness in kÅ unit			1.0
Deposit with xtal thicknes control - Src...	7	Power Supply	Power Supply 2 Output Setpoint	Set Value = n.nn	Set Film PWR Level	0		130

Fig 3- Reactive recipe inputs



- 9.1.5 Monitor using deposition page.
- 9.1.6 Recipe Monitor window appears to show automated recipe steps.
- 9.1.7 Active Source tab appears with a green Icon.
- 9.1.8 Monitor Power Supply Tab. Monitor active gun in chamber through viewport.
- 9.1.9 Ensure the correct pressure indicated on screen.
- 9.1.10 Ensure that the substrate rotation is operating.
- 9.1.11 When Ramp and Burn-in step is completed, enable recipe deposition popup appears to start processing. Ensure correct material selected.
- 9.1.12 Depress the Continue Recipe button
- 9.1.1 Processing starts. Recipes set to start with power levels of 1Å/sec dep rate.
  - 9.1.1.1 Insure substrate shutter opens on screen and through viewport.
  - 9.1.1.2 Insure power stability of gun on screen and through viewport.
  - 9.1.1.3 Increase power to increase dep rate, if required. Max power 300W.
  - 9.1.1.4 Enter the Power value on NanoFab run log towards end of the dep.
- 9.1.2 Monitoring run.
  - 9.1.2.1 You will be able to view your Power, Rate and Thickness for your active Source on the Rate Monitor display shown below. You also have the option to use the power supply and thickness control tabs under each Source tab.

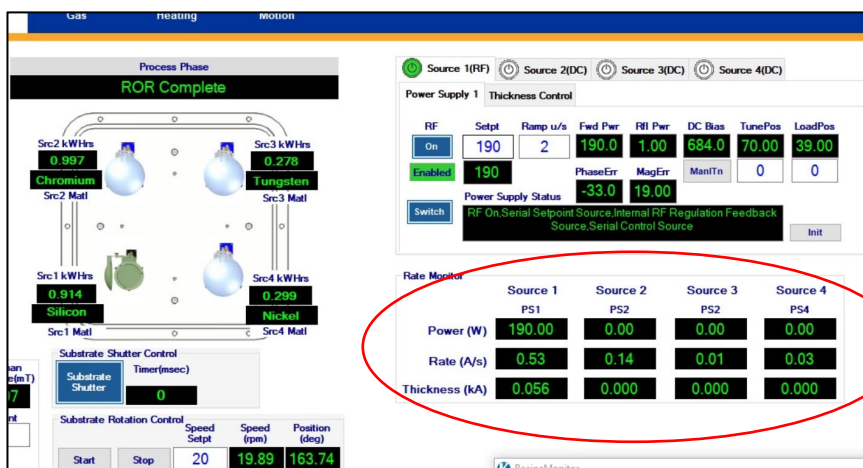


Fig 4- View Dep Rate

- 9.1.2.2 You could open Dashboard to view various output parameters of your choice during the ran as an option.
- 9.1.3 **\*\*Skip Step-** If processing has already started and you find yourself in a situation where you need to end the process and ramp down the power and end process, depress Skip step on the recipe monitor window.

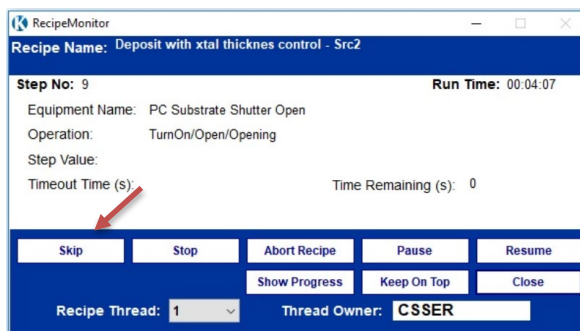


Fig 5- Recipe Monitor window.

- 9.1.4 Recipe Monitor window will complete when processing for film layer completion.
- 9.1.5 When recipe completed, Blue light turns off and “completed” message displays.
- 9.2 Post Deposition
  - 9.2.1 If you will be performing multiple layers, please go back to step 7.5.
  - 9.2.2 If you are completed with processing, proceed to step 7.7 Vent Chamber.
- 9.3 Vent Chamber
  - 9.3.1 Following processing, allow 5 minutes for guns to cool off.
  - 9.3.2 Select Vacuum screen to view the current PC pressure.
  - 9.3.3 Depress PC Vent button on right display margin. A Recipe Monitor PC Vent recipe window is displayed until and will display recipe completed when done. PC Pressure will indicate atmosphere pressure.
  - 9.3.4 Depress the PC Vent button.
  - 9.3.5 Open chamber when the Vent recipe is completed.
  - 9.3.6 Unload Substrates.
    - 9.3.6.1 On the Deposition screen, depress the Substrate Shutter button to Open.
    - 9.3.6.2 Remove your samples off the platen.
  - 9.3.7 If required, vacuum the inside of the chamber with the Nilfisk vacuum.
  - 9.3.8 Replace the view port Mylar liner if required.
  - 9.3.9 Close the chamber door.
  - 9.3.10 Depress the PC pump button to pump down the chamber.
  - 9.3.11 Change the tool status to Run Completed on the NanoFab run log.

## 10. Revision History

Effective Date	Originator	DESCRIPTION OF REVISION	Issue
07/23/19	Jaime Quintero	Initial Release	A
12/09/20	Jaime Quintero	Updated recipes	B