

# PVD 3 – Lesker PVD 75 Deposition System

## Standard Operating Procedure

---

4D LABS Confidential

---

*Revision: 1.5 — Last Updated: November 13/2014, Revised by Chris Balicki*

---

### Overview

This document will provide a detailed operation procedure of the PVD 3 System. Formal Training is required for all users prior to using the system.

### Revision History

#	Revised by:	Date	Modification
0	Chris Balicki	2009/12/09	Document Initial Release
1	Chris Balicki	2010/05/05	Added System Shutdown/Startup procedures
2	Chris Balicki	2010/07/15	Several edits to procedures
3	Chris Balicki	2010/11/05	Revised Startup/Shutdown procedures
4	Chris Balicki	2013/02/14	Minor changes
5	Chris Balicki	2014/11/13	Minor changes

Document No. 4DSOP000X

## Table of Contents

Overview.....	1
Revision History.....	1
Table of Contents.....	2
General Information .....	3
Operation .....	4
Restarting C-Ware.....	4
Vent Main Chamber .....	4
Sample Loading .....	4
Pump Main Chamber .....	5
Datalogging .....	5
System Shutdown.....	5
System Startup.....	6
Deposition .....	7
Thermal Evaporation via Manual Control (recommended).....	7
Electron Beam Evaporation via Manual Control (recommended) .....	8
Deposition via Recipe .....	9
References and Files.....	10
Contact Information .....	10

## General Information

The Lesker PVD 75 Deposition System (PVD 3) provides both thermal and electron beam deposition. A single thermal source and a 4 pocket e-beam source are housed in the process chamber. The system can process samples up to 6" in diameter. Materials approved include: Chromium, Titanium, Gold, Platinum, and Palladium. The system features upgraded vacuum pumps for decreased pump down time and recipe control for safe and efficient use. Other features include substrate cleaning via argon plasma and substrate heating up to 350°C.

## Operation

### Restarting C-Ware

*Note: User must be logged in to perform this procedure. Only perform this procedure if it is determined that the software is bugged and requires a restart.*

1. Confirm that Sigma SQS-242 and SQM-242 software are off. If either software is on, turn off the software accordingly.
2. Exit C-Ware and restart C-Ware.
3. Login.
4. Enter the 'Vacuum' screen.
5. Run the 'Start PC Pump' recipe to restore high vacuum <or> run the 'Start PC Vent' recipe to vent the chamber to atmosphere.

### Vent Main Chamber

1. Login.
2. Enter the 'Vacuum' screen.
3. Run the 'Start PC Vent' recipe.

*IMPORTANT: If you need to abort, click on the green portion of the 'Running Recipe' window and click abort.*

4. Verify that the turbo pump speed is decreasing at recipe step 29. If yes, proceed to step 5. If not, perform the Restart C-Ware procedure.
5. Wait for the recipe to finish. Close the recipe window by clicking 'OK'.
6. Open the chamber door.

### Sample Loading

1. Remove and set aside the platen shield. Use the dedicated needle nose pliers for platen insertion. Spot the platen from falling. Ensure that the platen is seated evenly. Replace the platen shield.
2. Check the chamber door viewport and ensure that there is a new piece of mylar film protecting the glass window.
3. Check the crystal sensor using the Sigma SQM-242 software. If sensor life is <55%, replace the crystal. Request assistance from the Nanofabrication Staff if necessary.
4. Check the sources. If material is low, request assistance from the Nanofabrication Staff.

*NOTE: Users are permitted to add Cr material to the thermal source if it looks insufficient. Users are NOT permitted to add material to the e-beam source.*

## Pump Main Chamber

1. Close main chamber door.
2. Run 'Start PC Pump' recipe.  
*IMPORTANT: If you need to abort, click on the green portion of the 'Running Recipe' window and click abort.*
3. At step 23 of the recipe, apply a slight pressure to the chamber door until the VAC switch turns green and the turbo pump turns on.
4. Wait for recipe to finish. Close the recipe window by clicking 'OK'.
5. Wait for the main chamber pressure to reach  $<2.00E-6$  before performing deposition.

## Data logging (optional)

*Note: This procedure is optional and only permitted by users who have previously consulted with the Nanofabrication Staff.*

1. Enter the 'System' screen.
2. Click the 'Suspend Screen Updates' button (the button will highlight green).
3. Select/de-select the signal names that you wish to data log.
4. Click the 'Suspend Screen Updates' button.
5. Click the 'Generate Data Log' button (this will start a new file for the data log).
6. Enter the 'Operation' screen.
7. To start data logging, click 'Recording Start'.
8. To stop data logging, click 'Recording Stop'.
9. To retrieve data, open MS Access.
10. Open the Datalog.mdb file in the 'Open Recent Database' screen.

*IMPORTANT: Do not attempt to open the Datalog.mdb directly from Windows Explorer. The file can only be opened through MS Access, as per the above procedure.*

11. Select you data log in the left hand column.

*Note: To save/process data, users must export data to excel and save the excel file to a flash drive. Please ensure that you format your flash drive prior to inserting it into the system computer. Do not store any sort of files on the computer. Data logs will be regularly deleted from the system.*

## System Shutdown (STAFF ONLY)

1. Perform the Vent Main Chamber procedure. Wait until the chamber is vented to atmosphere.
2. Exit C-Ware.

3. Turn off the computer by performing the Windows Shutdown procedure ('Start' → 'Turn Off Computer' → 'Turn Off').  
*(Behind Front Right Side Door)*
4. Turn off the individual power sources.
5. Turn off the main power switch.  
*(Behind Right Side Latch Panel)*
6. Turn off PS located beside RF matching (see figure 1).
7. Turn off UPS (see figure 2).  
*(Behind Back Left Side Door)*
8. Turn off breaker switches (see figure 3).
9. Turn off Piluzzi PS up top (see figure 4).

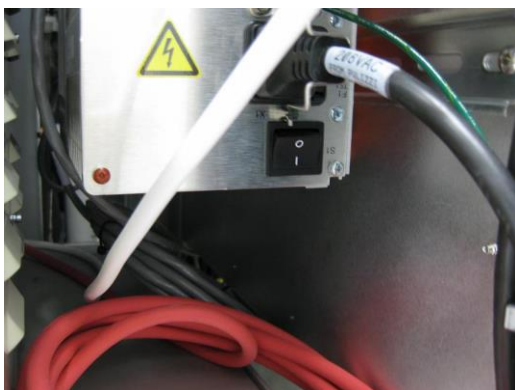


Figure 1: PS located beside RF matching box



Figure 2: UPS



Figure 3: Breaker switches



Figure 4: Piluzzi PS

### System Startup (STAFF ONLY)

- (Behind Back Left Side Door)*
1. Turn on Piluzzi PS up top (see figure 4).
  2. Turn on breaker switches (see figure 3).

*(Behind Right Side Latch Panel)*

3. Turn on UPS (see figure 2).
4. Turn on PS located beside RF matching box (see figure 1).

*(Behind Front Right Side Door)*

5. Turn on the main power switch.
6. Turn on the individual power sources.
7. Turn on the computer (power switch located behind flip down computer casing).
8. Start C-Ware.
9. Perform Pump Main Chamber procedure.

## Deposition

*Note: For up-to-date source status and operation parameters, please check the log book and the Materials Information sheet posted near the equipment. Deposition should take place at a pressure of  $<2.0E-6$ Torr.*

### THERMAL Evaporation via Manual Control (recommended)

1. Verify that Sigma SQS-242 and Sigma SQM-242 software is off. If both software are off, proceed to step 2. If not, proceed to step 1a.
  - a. If Sigma SQM-242 is on, turn it off.
  - b. If Sigma SQS-242 is on, turn it off and perform the Restart C-Ware procedure.
2. Enter the 'Platen Motion' screen.
3. Click the 'Fwd' button to initiate sample rotation.
4. Enter the 'Deposition' screen.
5. Open the Sigma SQM-242 software.  
*IMPORTANT: Sensor 1 is for the thermal source.*
6. Enter the desired material Density, Tooling Factor, and Z Factor in the 1<sup>st</sup> row (check Materials Information sheet).
7. Click 'Start'.
8. Open the Evap shutter.
9. Turn on 'Evap' power supply.
10. Click on Evap ramp rate and enter the value for the corresponding material ramp up (check Materials Information sheet).
11. Click on Evap set point and enter desired set point (check Materials Information sheet / log book).
12. Monitor your thickness and deposition rate in the Sigma Monitor software. Perform predeposition if desired. If rate adjustment is required, repeat steps 10-11, first entering the ramp rate followed by the new set point.
13. When desired deposition rate is reached, click 'Zero Sensor' and open the Substrate shutter.
14. Wait until desired thickness is deposited.
15. Close the Substrate shutter.

16. Close the Evap shutter.
17. Click on Evap ramp rate and enter the value for the corresponding material ramp down (check Materials Information sheet).
18. Click on Evap set point and enter 0.
19. Wait for set point to reach 0.
20. Turn off 'Evap' power supply.
21. Turn off the Sigma Monitor software.

### ELECTRON BEAM Evaporation via Manual Control (recommended)

1. Verify that Sigma SQS-242 and Sigma SQM-242 software is off. If both software are off, proceed to step 2. If not, proceed to step 1a.
  - a. If Sigma SQM-242 is on, turn it off.
  - b. If Sigma SQS-242 is on, turn it off and perform the Restart C-Ware procedure.
2. Enter the 'Platen Motion' screen and click the 'Fwd' button to initiate sample rotation.
3. Enter the 'Deposition' screen.
4. Verify that all materials in the Crucible Indexer section are off. Select the desired material by turning it on and wait for the 'In Posn' indicator to turn green.
5. Open the Sigma SQM-242 software.  
*IMPORTANT: Sensor 2 is for the electron beam source.*
6. Enter the desired material Density, Tooling Factor, and Z Factor in the 2<sup>nd</sup> row (check Materials Information sheet).
7. Click 'Start'.
8. Open the Ebeam shutter.
9. Turn off 'EB Off'.
10. Turn on 'EB On'. Verify that 'EB HV' indicator is green.
11. Click on EB ramp rate and enter the value for the corresponding material ramp up (check Materials Information sheet).
12. Click on EB set point and enter desired set point (check Materials Information sheet / log book).
13. Monitor your thickness and deposition rate in the Sigma SQM-242 software. Perform predeposition if desired. If rate adjustment is required, repeat steps 11-12, first entering the ramp rate followed by the new set point.
14. When desired deposition rate is reached, click 'Zero Sensor' and open the Substrate shutter.
15. Wait until desired thickness is deposited.
16. Close the Substrate shutter.
17. Close the Ebeam shutter.
18. Click on EB ramp rate and enter the value for the corresponding material ramp down (check Materials Information sheet).
19. Click on EB set point and enter 0.
20. Wait for set point to reach 0.
21. Turn off 'EB' power supply.



22. Turn off selected material in the Crucible Indexer.
23. Enter the 'Platen Motion' screen and click the 'Fwd' button to turn off sample rotation.
24. Turn off the Sigma SQM-242 software.

### Deposition via Recipe

*Note: Utilizing the deposition recipes are not intended to be a shortcut to understanding the system. In many ways, the software is more complicated and it is strongly recommended that users have expert knowledge of the system before running recipes. The deposition recipes have set deposition rates. Rates SHOULD NOT be altered! Thickness can be altered.*

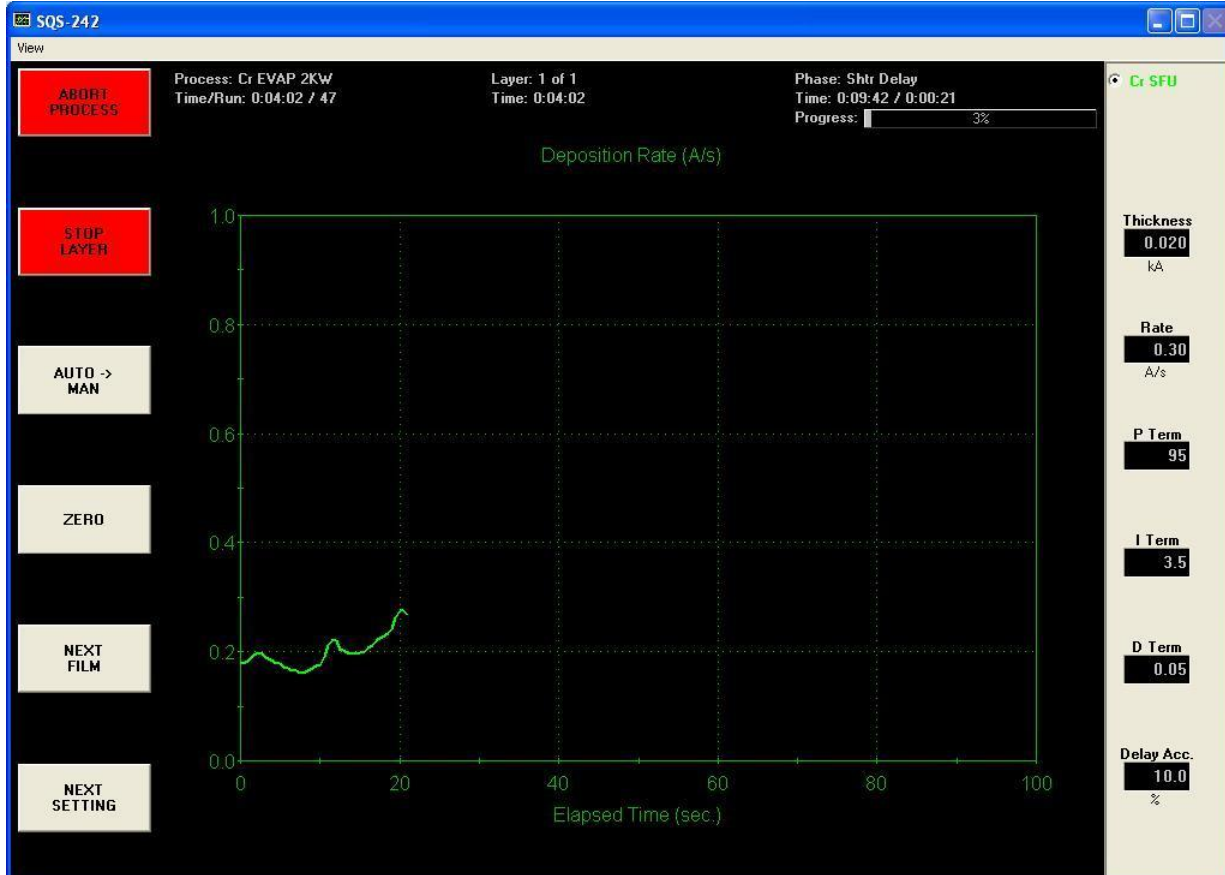
1. Ensure that Sigma SQM-242 software is off. If Sigma SQS-242 is on, proceed to step 2. If not, proceed to step 1a.
  - a. Enter the 'Sigma' screen.
  - b. Click the 'Sigma Launch 242' button in the top left of the screen.
  - c. When prompted with the username/password request, simply click 'OK'.
2. Return to C-Ware and enter the 'Deposition' screen.
3. Verify that all materials in the Crucible Indexer section are off. Select the desired material by turning it on and wait for the 'In Posn' indicator to turn green.
4. Enter the SQS-242 software and ensure that the desired process file is loaded.
5. Return to C-Ware and click 'Run Recipe'.
6. Select the desired deposition recipe and click on the green 'Run Recipe' confirmation.

*Note: The recipe is now running. Observe the steps to familiarize yourself with the system. IMPORTANT: If you need to abort, click on the green portion of the 'Running Recipe' window and click abort.*

7. Return to the Sigma SQS-242 window.

*Note: Observe the phase steps in the top right. These phases take the order of: Ramp1 Pwr, Ramp1 Time, Soak1 Time, Ramp2 Pwr, Ramp2 Time, Soak2 Time. THESE PARAMETERS SHOULD NOT BE CHANGED! Following Soak2 Time, the Shutter Delay phase takes place. During this phase, the power is automatically adjusted such that the deposition rate stabilizes. Once the rate stabilizes, the software opens the Substrate shutter and the deposition phase takes place.*

8. Wait for the Shtr Delay phase to take place.
9. Enter the deposition thickness desired in the right hand side of the screen. DO NOT CHANGE ANY OTHER PARAMETERS!



10. Wait for recipe to finish. Close the recipe window by clicking 'OK'.
11. If user is finished all depositions via Sigma SQS-242 CoDep software and/or intends to use the Sigma SQM-242 Monitor software, turn off Sigma CoDep and perform Restart C-Ware procedure.

## References and Files

PVD75 Ver 6.0 Operation Manual

## Contact Information

Questions or comments in regard to this document should be directed towards Chris Balicki (balicki@4dlabs.ca) in 4D LABS at Simon Fraser University, Burnaby, BC, Canada.