

Arizona State University NanoFab

LESKER #3 EVAPORATOR STANDARD OPERATING PROCEDURE

Rev M



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1) Purpose / Scope

- a) This document covers the procedure that should be followed for normal operation of the Lesker #3 Electron Beam Evaporator for the purpose of depositing materials on substrate materials that will be used for research purposes. It is suggested that you review this document thoroughly before proceeding with the operation of this tool.

2) Reference Documents

- a) Chemical Safety & Hazardous Waste Management Rules & Procedures Handbook
- b) PVD Series Operation Manual.

3) Equipment / Supplies / Material

- a) Nilfisk clean room vacuum
- b) Tweezers/Kapton tape.

4) Safety

- a) Follow all safety procedures outlined in the NanoFab Handbook
- b) Follow safety procedures for high voltage when working with high voltage or RF energy.
- c) Due to the unpredictability of high power eBeam on source materials, all deposition processing requires to be monitored at all times.
- d) Follow safety and handling procedures when working with vacuum systems and source materials.
- e) Do not attempt to repair the tool under any circumstances. Submit a service request and contact ASU NanoFab staff.
- f) 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

- a) Scheduling for Lesker3 evaporator occurs from 8am to 11am, from 11am to 2pm and from 2pm to 5pm during business hours.
- b) Scheduling can only take place two consecutive three-hour segments per person or the same group of persons operating the tool for fairness to the other users.
- c) Only trained users will be allowed to use this equipment.
- d) It is recommended to schedule your runs to secure you scheduling and to alert other potential users of the tool.
- e) Our NanoFab 15-Minute rule.
 - i) 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.
 - ii) Please have the equipment available for the next user within 15 minutes after your scheduled time.

- f) Cancellations.
 - i) If you cannot meet the equipment schedule, please cancel your iLabs schedule to allow other users to utilize the equipment.
 - ii) Scheduling on iLabs allows cancellation within 24 hours of your scheduled time. Please email staff if cancellation within 24 hours.
 - iii) We discourage last second cancellations. We discourage schedule no-shows.
- g) Scheduling Overnight runs.
 - i) Please complete overnight runs by the following morning by 8am.

6) Materials and information

- a) Tool restrictions. The maximum deposit rate is to 3Å/sec and maximum thickness per pocket is 3kÅ. Surface roughness will play a role with higher deposition rates.
- b) Maximum power% of eBeam for this tool is 30%.
- c) NanoFab only provides Nickle and Aluminum materials which are always kept in tool pockets.
- d) Au material.
 - i) We will loan our Au crucible for short term lend while you acquire your Au material. Lending only during business hours. **We charge \$100/gram of Gold (Au)** and you are responsible for the Au material. Please submit iLabs Service Request.
 - ii) For use of your own Au material and crucible, we have a **minimum Au + crucible weight of 30 grams combined.**
- e) Due to the small size of the 7cc crucibles, we have a restriction to keep thicknesses per pocket to 3000Å. Use a second pocket or vent and refill if you need to coat thicker coatings.
- f) The crucible purchased from www.Lesker.com site.
 - i) **FabMate Graphite crucible is EVCFABEB-4.**
- g) The 12" Platen to Source material distance is 14".

7) Vent

Note. Recommended to minimize the time the chamber is exposed to atmosphere.

- a) Vent Chamber
 - i) Select the Vacuum display screen.
 - ii) Select the Start PC Vent button.
 - (1) When Vent complete, the popup indicates Recipe Completed. The chamber pressure 7.6e+2 Torr displayed.
 - (2) Depress OK. Open the chamber door.
- b) Preparing the chamber.
 - i) Use the vacuum to remove any loose particles from inside the chamber.

- ii) Please ensure that the viewport Mirror Array glass is not over peeling. Replace as required. Ensure that both glass mirrors are properly in place against braces.
- iii) Select Deposition button to switch to the deposition screen.
- iv) Select the Ebeam Shutter button to open the shutter to access source material pockets.
- v) Ensure your intended materials have adequate materials.
- vi) Please label your materials on the crucible indexer as you add them.
- vii) Do not fill any crucible above the top lip of the liner or the turret will jam.
- viii) Select the "Cru Pos #" buttons to rotate the source pocket positions.
- ix) From the Windows Start Menu, open the SQM 242 Rate Monitor Program.
 - (1) Depress Start program and note the Life (%) of the crystal monitor is over 60%.
 - (a) Contact Nanofab staff to replace crystal if required,
- c) Load Substrates
 - i) Remove the platen and place on table to load your samples. The platen should already be homed following the Vent recipe completion.
 - ii) Load your substrates into the centermost of platen using the clips or Kapton tape.
 - iii) Carefully reinsert platen into the chamber.

8) Pumpdown and setup

- a) Pumpdown the chamber.
 - iv) Select the Vacuum display screen.
 - v) Ensure the Source Shutter is closed.
 - vi) Close the door.
 - vii) Select the Start PC pump button and hold the door until the rough pumpdown starts.
 - viii) Pumpdown recipe completed when pressure meets 5.0E-5Torr. Lower pressures encouraged.
- b) Setup of Run.
 - ix) Start Run record on the NanoFab iPad run log.
 - x) Insuring proper cooling water supply on tool. Check to see that a green background is displayed on the Src1 Flow Switch and Water Not over Temp indicators on the Cooling display page.
 - xi) Startup of SQM 242 Rate Monitor program.
 - (a) Launch program from the Windows Start Menu,

- (b) Select File then select Open. Select the desired source material and click Open.
- (c) Verify that the density and Z-ratio and tooling factor on SQM 242 Rate Monitor are correct & tooling factor is 154.
- (d) Select Start on the SQM program. When starting additional layers, you MUST select Stop and then Start again to ensure proper parameters are entered.

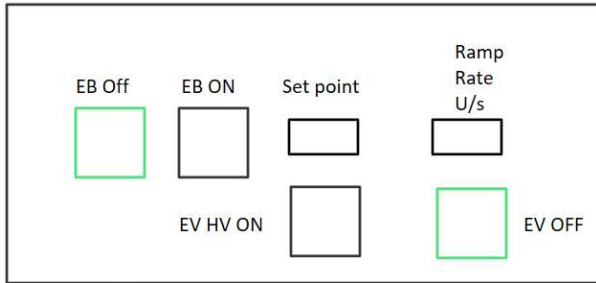
9) eBeam Source startup

- d) Processing may begin after the minimal 5.0e-5Torr pressure.
 - (1) Popup indicates PC Pump recipe is completed.
 - (2) Depress OK. Pumpdown will continue to lower pressures if you wish.
- e) Select the Platen Motion screen.
 - i) Depress the FWD button to rotate the platen.
- f) Open the right cabinet door and depress the RESET button on the High Voltage Controller. Verify that seven interlock LED's are ON/Green. This will enable the eBeam.
- g) Select the Deposition screen.
 - i) Insure the eBeam Shutter is closed before you start source eBeam startup.
 - ii) Select your Crucible (1 – 4) and that indicator is Active for your desired material.
- h) Note the percent Power Level by the previous user needed for that particular material in the NanoFab run log.
- i) Depress the EB ON and then the EB HV ON buttons to energize 8kv voltage. Open Right Cabinet door to verify you have 8.0 kV showing on the High Voltage meter.

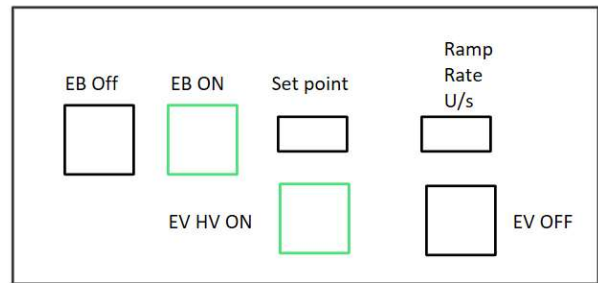
WARNING: Please do not leave the tool unattended while the eBeam power is ON.

TOOL NOTE:

- (1) If you lose dep rate during run, insure you have your 8.0kV voltage at the meter display.
- (2) A NO voltage and a HIGH current situation could mean the Source Filament might be SHORTED.
- (3) Another possibility to the loss of dep rate is a tripped High Voltage circuit breaker.
 - (a) Please turn OFF eBeam power and notify NanoFab staff when these situations occur to avoid possible damage to power supply.
- (4) If the tool goes DOWN, Please place the tool status Placard Sign to DOWN. Please submit an iLabs Service/maintenance request signifying an tool issue. Please document issue on the iPad Run Log.



eBeam power OFF



eBeam power ON

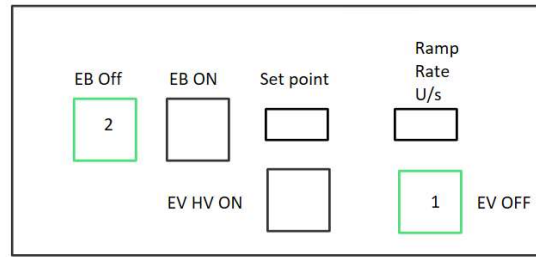
- j) eBeam Ramp Up.
 - i) Enter **Ramp Rate of 0.05 U/sec (%Power)** when ramping power up.
 - ii) Enter the **Setpoint% (%Power) value. Use up to 2% increments** unless you are near your Maximum power level.
 - iii) Materials such as Cr and SiO₂ max use only <3% power level.
 - iv) Observe the beam and the dep rate during the critical power ramp-up and periodically during the deposition if it is possible.
 - v) Ramp Up and stabilize the Dep Rate.

10) Deposition

- a) Start of deposition.
 - vi) **OPEN eBeam Shutter** button to open the shutter and start deposition on substrates.
 - vii) **Depress “Zero Sensor”** on the SQM Rate monitor window to zero the total thickness.
- k) Continue to make fine adjustments to power level to maintain your desired dep rate.
- l) Continue to view the beam through the viewport.
- m) Halfway through the deposition, record the deposition pressure, deposition rate, emission set point and record these values on NanoFab the run log.

11) eBeam Shutdown

- b) Deposition completion and shutdown of eBeam.
 - i) When the target deposition thickness is completed, **CLOSE the eBeam Shutter.**
 - ii) Enter **Ramp Rate of 0.1 U/sec (%Power)** to ramp down power.
 - iii) Enter the **Setpoint% (%Power) value of Zero.** Wait until the current drops to zero.
 - iv) Depress both the EB HV OFF button and then the EB OFF buttons.
 - v) Allow gun filament 5 minutes to cool down before venting.
 - (1) Ensure your material is cooled down before venting.



eBeam power OFF sequence

12) Option: Start of multi-layer process

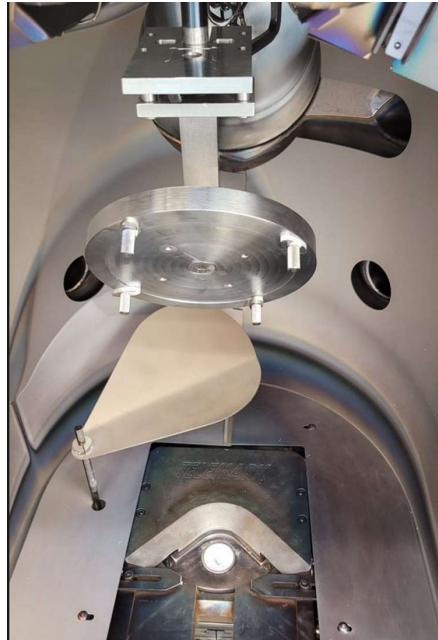
- n) Update the SQM 242 rate monitor with next material.
 - i) From the Windows Start Menu, launch the SQM 242 Rate Monitor Program.
 - (1) Select File then select Open. Select the desired source material and click Open.
 - (2) Select Start on the SQM program. When starting additional layers, you MUST select Stop and then Start again to ensure proper parameters are entered.
 - ii) Please go back to section 9.G to restart the eBeam for your additional material layers.
 - (1) No need to prestart platen rotation (FWD).
 - (2) No need to Depress RESET on the High Voltage Controller.

13) Vent and Pumpdown and Completion

- o) Vent of the Chamber.
 - i) Depress the Start PC Vent recipe button and wait for the recipe complete message and then select the OK button.
- p) Open chamber door and carefully remove the platen.
- q) Remove your samples from the platen and replace the platen in the chamber.
- r) Clean the inside of the chamber with the Nilfisk vacuum. Do not use the vacuum on the filament or source metals as it may contaminate them.
- s) Close the chamber door.
- t) Pumpdown of Chamber.
 - i) Select the Start PC pump button and hold the door until the rough pumpdown starts.
- u) On the iPad record Run Completed as Yes on the Tool In-Use page.
 - i) Please note any issues or anomalies occurred during run to NanoFab run notes.
- v) Use the vacuum to remove any loose particles from inside the chamber.
- w) Please ensure that the viewport Mirror Array glass is not over peeling. Replace as required. Ensure that both glass mirrors are properly in place against braces.

14) Evaporator Tilt Angled Fixture available.

- a) Availability of an 4" wafer Tilt Angle Fixture to allow to allow Glancing Angle Depositions (GLAD).
- b) The fixture will allow to decrease the incidence angle between the substrate and the source material.



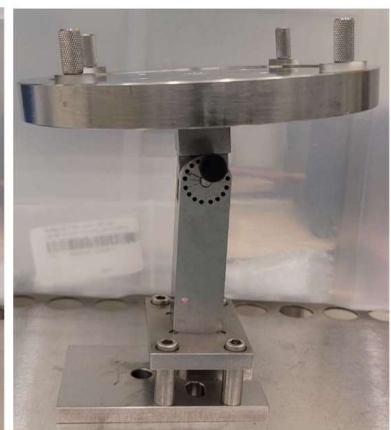
• 5° deg



• 25° deg



• 45° deg



• 85° deg

- 65° deg also available.

15) Lesker3 Material Approved List

- a) Lesker3 evaporator Approved Material List.
- b) If the material is not listed, check with ASU NanoFab staff for approval.

Allowed

Aluminum
Aluminum Oxide
Chromium
Copper
Germanium
Gold
Molybdenum
Molybdenum Oxide
Nickel
Nichrome
Palladium
Platinum
Silicon
Silicon Dioxide
Silver
Titanium
Titanium Oxide
Tungsten
Tungsten Trioxide
Vanadium

Not Allowed

Magnesium Fluoride
Scandium
Zinc

16) Revision History

Effective Date	Originator	DESCRIPTION OF REVISION	Issue
5/5/09	Paul Boland	Initial Release	A
6/8/09	Paul Boland	Updates and Clarifications, Added uniformity	B
9/22/09	Todd Eller	Update	C
1/20/10	Todd Eller	Update	D
3/18/10	Todd Eller	Update	E
1/30/12	Todd Eller	Update	F
2/20/13	Todd Eller	Update	G
4/10/15	Todd Eller	Update	H
3/17/17	Kevin Hilgers	Update	I
10/20/18	Jaime Quintero	Checklist version of operating procedures	J
8/28/19	Jaime Quintero	Updates and Tool Reservation Policies	K
04/01/20	Jaime Quintero	Update Operation	L
09/12/22	Jaime Quintero	Update eBeam operation	M