

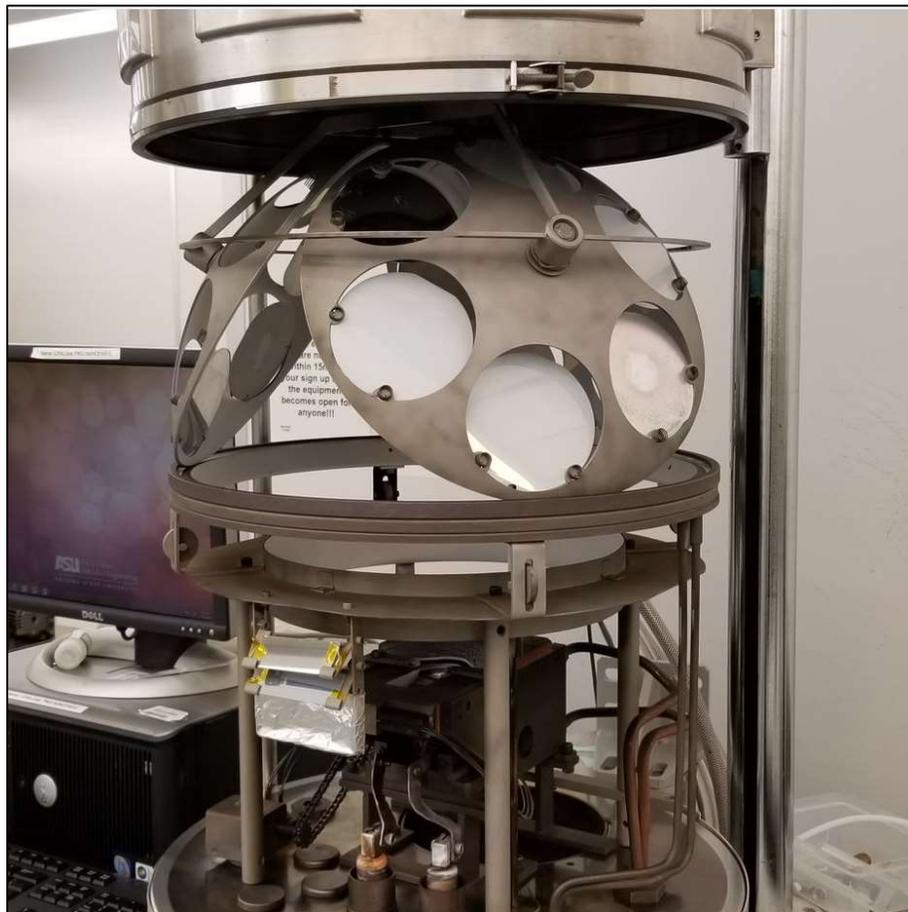
Arizona State University NanoFab

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# CHA EVAPORATOR STANDARD OPERATING PROCEDURE

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Rev J



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## 1) Purpose / Scope

- a) This document covers the procedure that should be followed for normal operation of the CHA 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.
- b) The CHA evaporator utilizes three rotating planetary fixtures for improved step coverage. Not recommended for liftoff processes. The fixture can hold up to Eighteen 4" wafers and can also be used to also mount Three 4" or 6" wafers with a dome orientation to the source.

## 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) Follow safety and handling procedures when working with vacuum systems and source materials.
- d) Do not attempt to repair the tool under any circumstances. Submit a service request and contact ASU NanoFab staff.
- e) Red EMO Button can be pressed at any time an emergency situation arises. Contact NanoFab staff to follow up with any emergency condition.

## 5) Use of the Tool

- a) Ensure the tool status placard is UP before use.
- b) The tool will be pumped down to High Vacuum when not in use.
- c) The Cryo pump will be regenerated as needed, every week or two.

## 6) Materials

- a) The allowable materials in this evaporator is Aluminum/Silicon 99% (AlSi) or Aluminum (Al).
- b) Due to the small size of the 7cc crucibles, we recommend keeping thicknesses per pocket to 3000Å. We recommend not overfilling the crucibles that can lead to overspilling on the edges.
- c) The crucible purchased from [www.Lesker.com](http://www.Lesker.com) site. The part number for this FabMate Graphite crucible is ECVFABEB-4.

## 7) Venting procedure

- a) Please fill out machine logbook with name, date, time, and material you intend to deposit.
- b) Please place a Tool in Use tag.
- c) Turn OFF gauge switch on the Ion Gauge controller. This will turn off the Ion gauge filament.



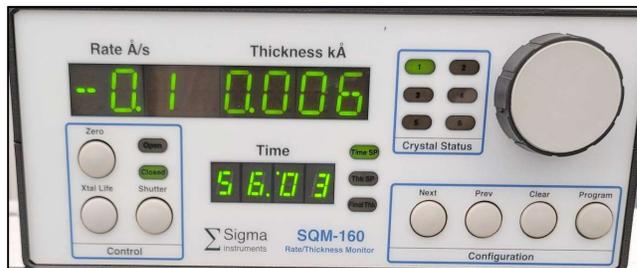
- d) Vacuum Controller front panel. The upper knob selector always remains in Automatic.
  - i) Select the Auto Control switch from Start to STANDBY. This will close the high-vac switch.
  - ii) Select VENT on the Auto Control switch. Vent light on controller will come On.
- e) Switch Hoist toggle switch.
  - i) Hoist will not operate until the chamber pressure switch senses the chamber has reached atmosphere.
  - ii) After 2 minutes, momentarily cycle Switch Hoist toggle switch to RAISE to check for Vent.
  - iii) Complete raising chamber top-hat to top position. Place switch back to mid position.
- f) Vacuum Controller front panel.
  - i) When the chamber is vented, select Auto Control switch to STANDBY.



- g) Chamber prep at atmosphere.
  - i) Remove the planetary carousel from track and place upside down to load samples. Mount your samples into empty slots.
    - (1) Ensure the carousel will be loaded with dummy wafers in every unused slot.



- ii) Select Shutter switch to OPEN.
- iii) Use the crucible indexer knob on the left side front of the tank cover, rotate to desired pocket.
- iv) Load your crucible. Inspect crucible external walls for over spilling or severe cracking.
- v) Select Shutter switch to CLOSE.
- vi) Please ensure that the viewport Mirror Array glass not over peeling. Ensure both glass slides are properly in place against braces.
  - (1) Replace glass when peeling. Replacements for 3x1" glass with Al are available.
- vii) If needed, use the vacuum to remove any loose particles from inside the chamber.



- h) SQM-160 Rate Thickness controller.
  - (1) Depress the XTAL LIFE button and note the Life (%) of the crystal is over 60%.
    - (a) Please alert NanoFab staff if XTAL requires replacement.
  - (2) Verify that the density and Z-ratio and tooling factor on SQM 160 Rate Monitor corresponds to material. The tooling factor for this setup is set to 260.
  - (3) Depress PROGRAM and then depress NEXT to cycle to scroll through Density, Tooling Factor and Z-Factor values. Use knob to enter proper values. Depress PROGRAM to exit.

## 8) Pumpdown procedure

- a) Vacuum Controller front panel.

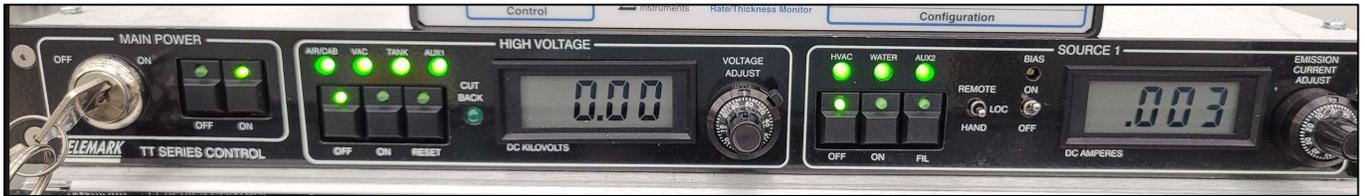


- i) Select the Auto Control switch from Vent to START. This pumpdown sequence will start the pump rough sequence and will cycle to high-vac pressure.
  - (1) When the chamber is roughing, the controller will display the Roughing light.
  - (2) When pressure reaches High-Vac, the Roughness light turns Off.
- ii) Turn ON gauge switch on the Ion Gauge controller to turn on the Ion gauge filament.
- iii) Processing may begin after the minimal  $5.0 \times 10^{-5}$  Torr pressure.

## 9) Startup of eBeam Source

- a) It is the recommendation of the NanoFab staff to remain in front of the tool during the duration of the evaporator when the eBeam is On.
- b) Motor Control switch.
  - i) Place the Motor Control switch knob to the LOW setting. Visually check motor drive chain is rotating on the barrel.
- c) Power Supply Sweep Controller.
  - i) Turn Controller to ON. Sweep controller using Sweep select no. 1 setting.





- d) Telemark Power Supply Controller Main Power.
  - i) Turn the Main Power key to ON.
  - ii) Press the Main Power ON button.
- e) Telemark Power Supply Controller High Power.
  - i) Press the RESET button. Verify all 7 interlock lights are ON. This will ensure that vacuum as well as cooling and cabinet interlocks are met. Please notify NanoFab staff if this is not met.
  - ii) Press the High Voltage ON button. Ensure that the display reads -10.00 kV.
- f) Telemark Power Supply Controller Source 1.
  - i) Verify that the emission current control knob is initially set to zero.
- g) Adjusting eBeam power.
  - i) Slowly raise the emission current by no more than 10ma per 10 seconds to the desired current. Wait 1-2 minutes for metal to melt. While metal is heating, ensure that the beam is not hitting the hearth. Also ensure that the metal is not overheating and splattering out of the pocket.
  - ii) Keep a visual of the source material during the ramp up steps and during the deposition.
    - (1) It is recommended to stay at the tool during the deposition.

## 10) Deposition procedure

- a) Increase and then manage the Emission Current to meet your deposition rate.



- b) Start of deposition.
  - i) Depress the Zero button on the Rate thickness controller.
  - ii) Select the Shutter button to OPEN.

- c) Managing the Deposition.
  - i) During the deposition, watch the beam position through the sight glass to ensure that the spot is not hitting the crucible or anywhere on the gun.
  - ii) Verify that planetary drive is rotating during your run.
  - iii) Continue to manage the Emission Current to meet your deposition rate.
  - iv) Halfway thru to the desired thickness, please record the emission current, deposition rate, and chamber pressure during evaporation in the logbook.
  
- d) End of the Deposition.
  - i) CLOSE the shutter when the desired thickness is reached.
  - ii) Telemark Power Supply Controller Source 1.
    - (1) Slowly LOWER the Emission Current knob back to 0.
    - (2) Press the Source1 On button to OFF.
  - iii) Telemark Power Supply Controller High Power.
    - (1) Press OFF on the High Voltage button.
  - iv) Telemark Power Supply Controller Main Power.
    - (1) Press Power Supply Main button to OFF
    - (2) Turn the Power Supply Key switch to OFF.
  - v) Power Supply Sweep Controller
    - (1) Turn sweep control switch to OFF.
  - vi) Motor Control switch.
    - (1) Slide Motor Control switch to OFF.
  - vii) Wait 5 minutes for the crucible to cool before venting the chamber.

## 11) Vent and Unloading procedure

- a) Turn OFF gauge switch on the Ion Gauge controller. This will turn off the Ion gauge filament.
- b) Vacuum Controller front panel. The upper knob selector always remains in Automatic.
  - i) Select the Auto Control switch from Start to STANDBY. This will close the high-vac switch.
  - ii) Select VENT on the Auto Control switch.
- c) Switch Hoist toggle switch.
  - i) Hoist will not operate until the chamber pressure switch senses the chamber has reached atmosphere.
  - ii) After 2 minutes, momentarily cycle Switch Hoist toggle switch to RAISE to check for Vent.
  - iii) Complete raising chamber top-hat to top position. Place switch back to mid position.
- d) Vacuum Controller front panel.
  - i) When the chamber is vented, select Auto Control switch to STANDBY to close vent valve.
- e) Remove carousel and unload your substrates.
- f) Remove any source materials you may have installed and vacuum out any particles from the chamber.
- g) Wipe down any chamber assembly.
- h) Replace carousel and switch Hoist rocker switch to Lower.
  - i) Be watchful as the barrel is being lowered to the close position.

## 12) Pumping and Completion.

- a) Please leave the CHA chamber under vacuum when completing processing.
- b) Select the Auto Control switch from Vent to START. This pumpdown sequence will start the pump rough sequence and will cycle to high-vac pressure.
  - i) When the chamber is roughing, the controller will display the Roughing light.
  - ii) When pressure reaches High-Vac, you may turn ON gauge filament switch.
- c) You may complete the record sheet.
- d) You may remove the Tool in Use tag from the tool.

### 13. Revision History

Effective Date	Originator	DESCRIPTION OF REVISION	Issue
11/17/08	Paul Boland	Change process to reflect manual operation of new power supply and supporting hardware controls.	C
7/22/09	Jon Martin	Update Format	D
1/14/11	Jon Martin	Change to section 6.2.9 for sweep control to use all materials in same position	E
7/31/12	Paul Boland	Include Q-pod rate monitor instructions.	F
8/20/12	Jerry Eller	Minor procedure and fix typo's	G
11/8/13	Jerry Eller	Add instructions for new cryo-pump	H
09/14/22	Jaime Quintero	Major Revision. Using SQM-160 Controller.	J