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1.0 Purpose/Scope

- 1.1 This document covers the procedure that should be followed for normal operation of the Edwards thermal evaporator for the purpose of depositing Chrome, Nickel, Gold, Germanium or Gold/Germanium substrate materials that might be used for research purposes. **It is suggested that you review this document thoroughly before proceeding with the operation of this tool.**

<p>If an error condition occurs at anytime during your process immediately shut off the power supplies if they are on & place the tool in a safe mode. Place the sign on the tool to down, contact CSSER staff & submit a service request.</p>

2.0 Reference Documents

- 2.1 Chemical Safety & Hazardous Waste Management Rules & Procedures Handbook

3.0 Equipment/Supplies/Material

- 3.1 Isopropyl Alcohol (IPA)
3.2 Clean Room Wipes
3.3 Nilfisk vacuum cleaner
3.4 Deposition Boats-provided by CSSER
3.5 Metal Sources-Chrome and Nickel provided by CSSER. Gold, Germanium, provided by user.

4.0 Safety

- 4.1 Follow all safety procedures outlined in the Rules and Procedures Handbook mentioned in 2.1. The handbook can be found <http://www.fulton.asu.edu/fulton/csser/safety.php>

5.0 Set Up Procedures

- 5.1 Log Book
- 5.1.1 Fill in date, name, and source metal(s).
 - 5.1.2 Check "Usage" on the rate monitor; if that value is above 900 then the crystal in the rate monitor needs to be changed. Contact CSSER
- 5.2 Cold Trap
- 5.2.1 Use the 10 liter Dewar to fill the cold trap with liquid nitrogen. The cold trap should be filled every time before the chamber is placed in to vacuum.
 - 5.2.2 If needed, the Dewar can be refilled from the fill station located inside of the clean room.
- 5.3 Vent
- 5.3.1 On the vacuum controller, the top line of the display will say "Sealed". Press the **VENT** button. The display will say "Chamber Vent". It will take two to three minutes for the chamber to reach atmosphere.
 - 5.3.2 When chamber is vented and lid releases, press the **Seal** button. Remove the locking pin, lift lid to the vertical position and replace locking pin. You must have either one hand on the lid or the locking pin in place, at all times. This is to avoid the lid falling and breaking the chamber.

5.3.3 Remove the sample holder and place it on a clean room wipe.

5.4 Pre-Clean Chamber

5.4.1 Use IPA and clean room wipe to clean the surface of sample holder. Also, use IPA and clean room wipe to clean the sealing surface on lid.

Note: Do not clean the black bell jar o-ring.

5.4.2 Use the Nilfisk vacuum cleaner to remove the particles from inside the chamber and any metal flakes from the chamber walls.

6.0 Procedures

6.1 Load Chamber

6.1.1 Load metal source(s) if needed.

6.1.2 Ensure that the source post is in touch with the contact.

6.1.3 Load samples onto sample holder. Load in the area next to the crystal cutout for best results.

NOTE: The shutter only covers a portion of the sample holder. If the sample size is bigger than a 4" wafer or multiple samples are loaded, than the shutter extension needs to be mounted. If assistance is needed than refer to CSSER staff.

6.1.4 Place the sample holder on the ring. Ensure that the cutout is in position so that the sample holder does not block the metal source from the crystal.

6.1.5 Ensure that the shutter is in closed position, labeled as C.

6.1.6 Remove the locking pin, lower lid to the horizontal position and replace locking pin. You must have either one hand on the lid or the locking pin in place, at all times. This is to avoid the lid falling and breaking the chamber.

6.2 Pump Chamber

6.2.1 On the vacuum controller, press the **Cycle** button. Check the vacuum controller display and ensure that the value is decreasing. If not, make sure that the lid is sealed against the chamber o-ring by pressing on the lid. The vacuum controller will display "roughing" then "pump down" and "fine pumping". Allow time for the vacuum system to pump the chamber to a base pressure of 3.0×10^{-6} . This will take about 10 minutes.

6.3 Rate Monitor

6.3.1 The **Run** button indicator must display "closed" for the **Data** button to work.

6.3.2 The led's, on the FTM7 film thickness monitor, identify the parameter that is displayed. Press the **Data** button to display each parameter.

6.3.3 Use the **Data** button to check parameters in rate monitor. Refer to table 7.1. Make any changes if needed.

6.4 Deposit

6.4.1 Ensure that the base pressure is at 3.0×10^{-6} or lower and enter that value into the log book.

- 6.4.2 Ensure that current control knob is at zero and the **LT Selector** is set on 10V and A
- 6.4.3 Ensure that the front and rear doors are closed and locked. Turn the current supply knob to **LT** from **O**. The green led will light up signify that the door interlocks are made.
- 6.4.4 Refer to previous entries on the log sheet to determine a current starting point for the desired metal.

NOTE: Excessive amounts of current will damage the source materials. To avoid damage, only make small adjustments with the current control knob.

- 6.4.5 Turn the current control knob slowly and watch the amp meter respond. If the amp meter does not respond then that would be an indication of poor contact on the metal source. Contact CSSER staff for help with poor contact issues. It would be suggested to check the all of the metal sources for good contact before any depositions are completed. That way the chamber can be vented and the poor contact issues corrected without damaging any samples that have been partially processed.
- 6.4.6 Slowly increase current control knob until the desired deposition rate is obtained. Refer to table 7.2 for deposition rate limitations and maximum deposit thicknesses.

NOTE: If the shutter extension is installed the crystal cannot display the deposition rate. Slowly increase current to the starting point determined in 6.4.4 and then open the shutter. Then, adjust the current control knob to get desired rate.

- 6.4.7 Once the desired rate is obtained, open the shutter while pushing the RUN button. The thickness display will reset to zero and then show the accumulate thickness deposited on the sample.
 - 6.4.8 Record the rate, current, and chamber pressure at the halfway point of the deposition.
 - 6.4.9 When the target thickness is reached, close the shutter.
 - 6.4.10 Slowly turn the current control knob down to zero.
 - 6.4.11 Turn the current power supply to **O** from **LT**. Write the thickness in the log book.
 - 6.4.12 If another layer is needed, turn the metal source rotation knob to the new position. And, on the rate monitor, change the layer to reflect the next deposition. Then, repeat steps 6.4.1 to 6.4.11.
- 6.5 Vent
- 6.5.1 Let the chamber cool from 5 to 10 minutes with the chamber still under vacuum.
 - 6.5.2 Press the **VENT** button. The display will say "Chamber Vent". It will take two to three minutes to reach atmosphere.
 - 6.5.3 When chamber is vented and lid releases, press the **Seal** button. Remove the locking pin, lift lid to the vertical position and replace locking pin. You must have either one hand on the lid or the locking pin in place, at all times. There is a potential of the lid falling and breaking the chamber.
 - 6.5.4 Remove the sample holder and place it on a clean room wipe. Remove samples.
 - 6.5.5 Remove metal source(s) from chamber.

6.6 Post-Clean Chamber

6.6.1 Use IPA and clean room wipe to clean the surface of sample holder. Also, use IPA and clean room wipe to clean the sealing surface on lid.

Note: Do not clean the black bell jar o-ring.

6.6.2 Use the Nilfisk vacuum cleaner to clean the particles from inside the chamber and any metal flakes off of the chamber walls.

6.7 Idle mode

6.7.1 Replace the sample holder on the ring. Ensure that the cutout is in position so that the sample holder does not block the metal source from the crystal.

6.7.2 Remove the locking pin, lower lid to the horizontal position and replace locking pin. You must have either one hand on the lid or the locking pin in place, at all times. This is to avoid the lid falling and breaking the chamber.

6.7.3 On the vacuum controller, press the **Cycle** button. Check the vacuum controller display and ensure that the number is decreasing. If not, make sure that the lid is sealed against the chamber o-ring by pressing on the lid. The vacuum controller will display “roughing” then “pump down” and “fine pumping”.

6.7.4 Press the **Seal** button on the vacuum controller. Verify that the high vacuum valve is closed and “sealed “is displayed on the vacuum controller. If this step is not done then oil from the diffusion pump will migrate and contaminate the chamber.

7.0 Tables

7.1 Rate Monitor Parameter Table

Layer	Material	Density	Z-Value	Tooling Factor
1	Chrome	7.2	28.9	1.85
2	Gold	19.22	23.2	1.85
3	Nickel	8.91	26.7	1.85
4	Germanium	5.32	17.1	1.85
5	Gold/Germanium	17.55	21	1.85

7.2 Rate Limit Table

Materials	Maximum Thickness	Maximum Rate	Typical Rate
	nanometers	nanometer/second	nanometer/second
Chrome	50	0.15	0.1 ± 0.02
Gold	250	0.25	0.2 ± 0.02
Nickel	100	0.15	0.1 ± 0.02
Germanium	200	0.15	0.1 ± 0.02
Gold/Germanium	250	0.25	0.2 ± 0.02

7.3 Log Sheet

Edwards #2 Log Sheet

Date	Name	Time Start	Metal	Density	z ratio	Tooling Factor	Base Press	Deposit Press	Current	Rate	Thickness

8.0 Figures

8.1 None

Effective Date	Originator	DESCRIPTION OF REVISION	Issue
1/08/10	Todd Eller	Update to new format	A
10/18/11	Todd Eller	Minor Changes	B
11/8/13	Todd Eller	Minor Changes	C