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Purpose/Scope

- 1.1 This document covers the procedure that should be followed for normal operation of the CHA E-beam evaporator for the purpose of depositing ferrous, non-ferrous & dielectrics on 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 & always check with staff when using a new target material, to verify if special precautions need to be taken to reduce cross contamination.**

If an error condition occurs at any time 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.

2.0 Reference Documents

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

3.0 Equipment/Supplies/Material

- 3.1 Isopropyl Alcohol
- 3.2 Nilfisk clean room vacuum
- 3.3 Cleanroom wipes
- 3.4 Source Material
- 3.5 Graphite Crucible Liner

4.0 Safety

- 4.1 Follow all safety procedures outlined in the CSSER Handbook mentioned in section 2.1
- 4.2 Follow safety procedures for high voltage when working with high voltage or RF energy.
- 4.3 Follow safety and handling procedures when working with high pressures, pyroforic, or toxic gases.

5.0 Set Up Procedures

- 5.1 PC Logon and Chamber/Source Preparation
 - 5.1.1 Log into the PC, using your **ASURITE/ASUAD ID**,
 - 5.1.2 Ensure that the Q-pod software is running. There is a Q-pod shortcut on the desktop. Select the **DataLog Off** option on the Q-pod display. Also, if **XTAL FAIL** is displayed the crystal will have to be replaced before any further processing.
 - 5.1.3 Refer to the ON-BOARD display; ensure the MONITOR button is lit. The display should read "CRYO ON 12K". The 12K indicates the cryp pump temperature. It has an operating range of 12 to 17 degrees. If the temperature is above 19°K, then submit a service request and contact CSSER staff.
 - 5.1.4 Fill out machine logbook with name, date, time, and material you intend to deposit.
 - 5.1.5 Ensure that **FILAMENT** is off on the ION GAUGE CONTROLLER.
 - 5.1.6 On the VACUUM CONTROLLER, select **STANDBY** with the Auto Control switch. Wait until all of the valves are closed. Then select **VENT** with the Auto Control switch. This will bring the chamber to atmospheric pressure. It will take approximately 2 to 3 minutes. When the chamber is vented, select **STANDBY** to close the nitrogen vent valve.
 - 5.1.7 Switch Hoist toggle switch to **RAISE** to lift the bell jar. (Rocker switch will only switch one position at a time. Place at center position, and then switch to desired function. Hoist will not

- operate until the chamber pressure switch senses the chamber has reached atmosphere.) Hoist will stop automatically.
- 5.1.8 Remove carousel from track and place upside down to load samples. The carousel will be loaded with dummy wafers. The dummy wafers can be removed and placed in a wafer box that is provided.
 - 5.1.9 Open the shutter and place material into a source pocket. Aluminum is provided by CSSER, typically in position 2. If other than Aluminum, use the crucible indexer knob on the left side front of the tools tank cover, rotate to desired pocket 2, 3, or 4. Use tweezers to place and fill each crucible liner. (Source material must be filled to where beam is visible in window, 50% minimum, covering the bottom of the Crucible liner.)
 - 5.1.10 Close the shutter and replace carousel with samples onto the track.
 - 5.1.11 Wipe down bell jar O-ring and associated chamber base plate with isopropyl alcohol only! Ensure there is no particulate generated from handling chamber hardware. (If so, vacuum out before starting pump down.) Chamber O-ring and base plate should be cleaned every time chamber is opened.
 - 5.1.12 Switch Hoist toggle switch to **LOWER** position, keeping hands away from bell jar as it lowers to chamber base plate.
 - 5.1.13 Enter the Density and Z-ratio for your material and the tooling factor in their respective fields. Note: There is an extensive material data table in the help section of the Q-pod software. Not all of these materials are allowed in the tool. Please verify with CSSER staff before running any new material.
 - 5.1.14 Ensure that the tooling factor is equal to 120%

6.0 Procedure

- 6.1 Chamber pump down
 - 6.1.1 On the Q-pod display, select the **START** button to start the Run Time. The Run Time can be used to monitor the time it takes to evacuate the chamber.
 - 6.1.2 On the VACUUM CONTROLLER, select **START** with the Auto-Control switch. This will begin the process of evacuating the chamber.
 - 6.1.3 After the controller switches to high vacuum (indicated by light on display), ensure that power to the ION GAUGE CONTROLLER is **ON**.
 - 6.1.4 On the ION GAUGE CONTROLLER, turn rate switch to the **4** position. Press the **FILAMENT** switch. Refer to the IONIZATION GAUGE, when the value drops below 1 than the range switch can be increased to a higher range position.
 - 6.1.5 At 5×10^{-5} Torr, press DeGas switch to turn **ON**, you may leave it on as long as 30 minutes but it is recommended at least 2 minutes. Press switch to turn **OFF**. (IONIZATION GAUGE may swing to full scale position and shut off the filament. This is normal, simply turn the range switch to a lower setting, (i.e. if in 5 then switch to 4), and switch **FILAMENT** on again to monitor chamber pressure.
 - 6.1.6 Allow time for the vacuum system to pump the chamber down to 3×10^{-6} Torr. Enter the chamber pressure into the log sheet.
 - 6.1.7 Place the Motor Control switch to the **10** setting. The speed is preset for optimum deposition so you should not have to adjust. (Carousel rotates samples around to obtain a more uniform film; the speed may be monitored by watching motor/chain drive at top of chamber.)

- 6.2 TELEMARK POWER SUPPLY CONTROLLER
 - 6.2.1 Turn the Main Power Key to **ON**.
 - 6.2.2 Press the Main Power **ON** button. (located under Main Power on the controller).
 - 6.2.3 Wait a few moments for the cooling fans and power supply to warm up.
 - 6.2.4 Press the **RESET** button (located under High Voltage on the controller).
 - 6.2.5 Verify all interlock LED's are on (located under HIGH VOLTAGE).
 - 6.2.6 Press the **ON** button (located under High Voltage on the controller).
 - 6.2.7 Ensure that the HIGH VOLTAGE display reads -10.00 ± 0.07 kV.
 - 6.2.8 Verify that the emission current control knob is at zero (located under Source1 on the controller).
 - 6.2.9 Turn sweep control switch **ON** (located next to the writing that says Power Supply Controller).
 - 6.2.10 Press the Source1 **ON** button. (it is located under Source1 on the High Voltage controller)
 - 6.2.11 **SLOWLY** raise the emission current by no more than 10 ma 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
- 6.3 Deposition and shut down
 - 6.3.1 Reset Q-pod to zero thickness value and open the shutter. Ensure MOTOR CONTROL switch is set at **lo**
 - 6.3.2 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. If there is a problem with the beam position or oscillation, quickly reduce the beam current and contact CSSER staff.
 - 6.3.3 Halfway thru to the desired thickness, record the emission current, deposition rate, and chamber pressure during evaporation in the logbook.
 - 6.3.4 Close the shutter when the desired thickness is reached.
 - 6.3.5 **SLOWLY** lower the emission current back to 0.
 - 6.3.6 Press Source1 **OFF** button.
 - 6.3.7 Press High Voltage **OFF** button.
 - 6.3.8 Turn sweep control switch to **OFF**.
 - 6.3.9 Press Power Supply **MAIN OFF** button and turn Key switch to **OFF**.
 - 6.3.10 If another metal layer is needed before venting chamber, you may switch locations at this time by rotating the crucibles to the next source location (i.e. 1 – 4) that you have inserted a material to be deposited. At this time you will also need to re-program the Q-pod for that material & any successive materials that you wish to deposit as well. You will need to restart from section 6.2 for processing purposes.
 - 6.3.11 Slide Motor Control switch to **OFF**
 - 6.3.12 Press **FILAMENT** to turn the filament off, on the ION GAUGE CONTROLLER.
 - 6.3.13 Wait several minutes for the crucible to cool before venting the chamber.

- 6.3.14 Place the Auto Control rocker switch to its **STANDBY** position and allow time for valves to close, and then switch to **VENT**. Allow two to three minutes to vent chamber. Return to **STANDBY** position.
- 6.3.15 Switch Hoist rocker switch to **RAISE** to lift the chamber. Return switch to center position.
- 6.3.16 Remove carousel and remove your samples.
- 6.3.17 Remove any source materials you may have installed, and vacuum out any particles from the chamber.
- 6.3.18 Wipe down any chamber assembly that may have flakes or particulate on them, pay special attention to chamber base plate and wipe chamber seal O-ring every time it is opened with isopropyl alcohol.
- 6.3.19 Replace carousel and switch Hoist rocker switch to **LOWER**.
- 6.3.20 Once the chamber bell jar is seated, switch the Auto Control rocker switch to **START**. Ensure that the chamber pumps down and crosses over into high vacuum.
- 6.3.21 Close the Q-pod software, and log off the PC.
- 6.3.22 Tool should be left in a good state for the next student to use. If you have any problems with tool, make a note in the logbook, contact CSSER staff, and complete a Service Request form on the CSSER website.

You must coat the chamber with aluminum after deposition of Gold or other mid gap materials; you may start that deposit at 5E-5 as opposed to a regular deposition.

7.0 Forms

7.1 Log Sheet

CHA Log Sheet												
Date	Name	Start Time	End Time	Material	Density	Z Ratio	Tooling Factor	Base Pressure	Deposit Pressure	Current	Rate	Thickness Actual

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