

Organic Evaporator SOP

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Safety Information and Overview

Advanced Science Research Center	Graduate Center CUNY
Date	5/29/2025
SOP Title	AJA E-Beam Metal Evaporator SOP
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Department	NanoFabrication Facility
Room and Building	ASRC G.263

Section 1 – Process or Experiment Description

This SOP is only for the general use of depositing thin films. Only approved users are allowed to use the equipment, after passing a qualification with the tool manager. Any maintenance will be done by trained staff members. Some maintenance creates additional hazards which will be described in the Instrument Manual.

*Note: Any sample preparation is to be done by the user, and this document does not cover any information related to sample preparation. Any materials listed outside of the approved list, must be discussed with the tool manager. NO high vapor pressure materials

Section 2 – Hazardous Substances

Substance Name: Chromium





Common Name: Chrome


Abbreviation: Cr

Substance Name: Silver

Abbreviation: Ag

Section 3 – Potential Hazards

Hazard	Hazard Sign	Hazard Description
Bright e-beam		Serious eye damage may occur if viewed directly at e-beam during use
Electric Shock		Tool operates in extremely high voltages (3-10kV).
Thermal		Sample(s) and sample plate can get hot to touch
Chrome		<p>Exposure to particulate or vapor form may present significant health hazards and is toxic to aquatic organisms.</p> <p>Under the high temperatures involved in e-beam evaporation, metallic Cr can oxidize into Cr(VI), especially in the presence of residual oxygen. This is highly toxic to aquatic organisms and is a known human carcinogen.</p>

Silver		<p>Silver is toxic to aquatic life in nanoparticulate or ionic forms.</p> <p>low acute toxicity, but chronic exposure (especially to nanoparticles or silver dust) may lead to:</p> <p>Argyria: A bluish-gray discoloration of the skin.</p> <p>Respiratory irritation from dust or vapor in poorly ventilated areas.</p>
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Section 4 – Routes of Exposure

Eye damage can occur if looking through the viewport window with the shutter open, and not wearing the appropriate protective eyewear.

Electric shock can occur when working with the high voltage feedthroughs or in the back of the electronics rack, without properly grounding the work area beforehand.

Thermal hazard is present if using the e-beam evaporator for a long period of time, which can heat up the plate and the sample(s).

Section 5 – Personal Protective Equipment

All personnel must wear the welding goggles whenever looking directly at the bright e-beam.

All trained staff must use the grounding rod to touch the working areas, before attempting any maintenance.

Section 6 – Waste Disposal

Kapton or copper tape that has silver and/or chrome on the top layer, must be disposed into the container found on the workbench. Staff will transport the container for waste disposal when the container is full.

Hazardous compound, element, or chemical name	State (L,G,S)	Hazardous	Non-hazardous	Which hazards?	How is waste managed?

Silver	S	x		Solid waste is toxic to environment, aquatic, and human health	Must be collected and disposed of as Hazardous waste
Chrome	S	x		Solid waste is toxic to environment, aquatic, and human health	Must be collected and disposed of as Hazardous waste

Tool operation

1. Precheck list

1. Check Main chamber Pressure (should be $<1\text{E-}7$, or $\text{E-}8$ Torr range)
2. Check load lock pressure (should be in -5 or -6 Torr range)
3. Check the cryo temp is between $10\text{-}12\text{K}$
4. Check the material you need is in the tool

2. Loading the Sample in Loadlock

1. Verify the gate valve is closed
2. Turn off pump to vent the loadlock
3. Remove sample holder and replace lid
4. Load sample onto substrate holder
 - o Make sure one arm of the propeller is pointing towards the main chamber

3. Loading the Sample in Main Chamber

1. Open the upper viewport shutter for visualize loading
2. Raise propeller to top sharpie line for load arm clearance
3. Spin propeller holder to line up with the blue circle
4. Open gate valve when pressure is less than $3\text{E-}5$ Torr
5. Rotate knob by loadlock to move the load arm all the way into the chamber
6. Lower propeller onto substrate holder.
 - o Continue moving it down to bend the load arm only slightly
 - o Propeller should insert into substrate holder relief and be flush

7. Rotate propeller clockwise to lock it to the substrate holder
8. Raise sample holder to top sharpie line
9. Move loadarm back to resting position using the knob
10. Close the gate valve
11. Close the upper viewport shutter

4. Preparing the Gun

1. Open E-beam Shutter
2. Turn on the Genius monitor
 - Make certain it is in manual mode
 - Should say 9.45kV
3. Turn on the camera switch (Under laptop)

5. Selecting a Material and Recipe

1. Select the material by crucible number from the E-BEAM POCKET drop-down menu
2. Click E-beam index start
3. When movement is complete a popup "E-beam move complete" → click OK
4. Select recipe in the Inficon "Process Menu"
5. Verify the film is the same as the recipe for correct density and z-ratio for sensor
6. Press "Start"

6. Film Deposition

1. Turn emission knob to ramp current
 - Increase at most 20 mA/minute
 - Each click is 3mA
2. Open the lower shutter and adjust shutter angle to see the crucible in the monitor attached to the camera
3. Once you see a rate verify the shutter is closed and turn off the camera
4. Increase emission current to get to the desired rate.
 - Increase and soak
 - Increase at most 20 mA/minute
 - Each click is 3mA
5. Open substrate shutter to deposit on sample
 - zero the thickness monitor
6. Close substrate shutter when desired thickness is reached
7. Ramp down current by turning the emission knob.
 - Do this over several minutes till → 0mA

**** If depositing another layer of different material repeat steps 5 and 6****

(5. Selecting a Material and Recipe, and 6. Film Deposition)

7. Turn Off the Gun

1. Turn off the HV on Genius Monitor
2. Close the E-beam shutter

8. Unload Sample

1. Verify load lock is $< 3\text{E-}5$ Torr
2. Open the gate valve
3. Move load arm all the way into the main chamber
4. Lower sample holder onto the load arm
5. Turn propeller counter-clockwise to release sample holder
6. Raise propeller to clear the sample holder
7. Rotate load arm handle to bring the sample holder back into the loadlock
8. Close the gate valve
9. Vent the loadlock to retrieve sample
10. Return the sample holder to the loadlock and replace lid
11. Always leave the loadlock under vacuum before you log off the tool
12. Record the deposition information in the log book

Common Errors and Troubleshooting

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Date: May 30, 2025

Reviewed/Revised:

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