E-Beam Evaporator Instructions

Log Book Reminder

Fill out the log book any time you use this or any other system in the clean room. The E Beam evaporator is critical to most clean room users' results. Unlogged useage of any system in the clean room constitutes grounds for suspension of your access to the clean room.

Signing up

You may sign up in advance for **at most** two slots in the white areas of the sign up sheet. Other users may relieve you of any slots beyond the allowed two. Most evaporations can be completed within the standard two hour time frame. You may however sign up for a slot three hours long within the white areas for exceptional evaporations. If you need to pump down to a very low base pressure, then you will have to sign up for the indicated block of time during low use periods as noted below: i.e. between midnight and 6:00AM on weekdays, or at "slow" times on weekends.

Punctuality

The E-beam is already a bottle-neck in many people's processing. Please do not make it worse by starting late. If you have not loaded your samples and begun the pump-down within twenty minutes of your start time, other users who are ready may take your spot. If you are more than 30 minutes late [1] starting and it's your own fault, give up your spot, and call the user signed up to use the system after you.

Evaporating

1. Water supply, Main Power, Ion Gauge Filament (Red light will be off) and High Voltage key switch should all be turned off.

2. Find the sources that you will need. Whatever you do, don't clean a graphite crucible with solvents at this stage – it will take a long time for the solvents to evaporate and adequate vacuum to be reached. **PLEASE do not use other people's sources!** If public sources are low, please indicate this in the log book, the notice board, AND notify someone (Lee McCarthy, Bob Hill, or Jack Whaley).

3. Press STOP and the big red button glows.

4. Wait for the Hoist light to illuminate. This should take 2-3 minutes. Raise the bell jar.

5. **checklist**

   - Check the crystal after turning the deposition monitor's power on and pressing `xtal`. If the "crystal life" reads more than 18 or will by the end of your evaporation, change the crystal. As a rule of thumb, every 1000Å of Au that you evaporate will correspond to one "crystal life" unit. Turn the deposition monitor off then on again, and make sure that the new crystal is okay (`xtal` will show a crystal life of 0 and the "rate" should fluctuate about zero by $\approx \pm 0.1$

[1] The intent of this rule is to not let you force others to accommodate your being late. **If** you can finish on time, then proceed.

Å/sec)before pumping down. If the previous user has evaporated more than ≈ 5000Å of SiO_2 then a new mirror and new crystal will be required

- Take a look at the mirrors in the bell-jar window – if seeing through them is impossible, then the top mirror will have to be changed before you evaporate.
- Make sure that the shutter does not hit the crystal holder when it opens. If it does, then the shutter will have to be rotated with respect to its shaft by loosening the set screw. Shaking the crystal holder during an evaporation can open the electrical connection to the crystal, and ruin your run.
- Note down in the log-book if you have changed the crystal and/or mirror.
- **CHECK** which sources are in place and that they are in the proper hearth position.

6. Clean the inside of the evaporator with the vaccuum cleaner. Remove any visible flakes.

7. Load your sample and appropriate sources.

8. Wipe the surface on which the bell jar sits with an isopropanol soaked clean wipe. The bell-jar o-ring itself should not be wiped. If you can see flakes etc. on the o-ring, then try to remove them with a **gloved** finger (change your gloves afterwards!), and please leave a note on the notice board, so that we can check the o-ring and clean and re-grease it as necessary.

9. Hoist the bell jar down.

10. Press the START button, hang the "IN USE" sign and start an entry in the logbook.

11. Wait till high vacuum valve operates and high vac indicator lights up, then turn on the ion gauge. The system should cross over to high vac. within 3–5 minutes. If it takes much longer than this, consider venting and looking for flakes on the o-ring, or the surface it sits on.

12. Wait until the desired pressure is reached. 1.5×10^{-6}T is adequate for many ohmic contacts, while lower base pressures, e.g. high 10^{-7}T are desirable for e.g. Schottky contacts. If you really need base pressures below high 10^{-7} range, then you must sign up for multiple slots during low use times: i.e. midnight-6:00AM on weekdays, or on weekends.

13. Turn on the cooling water valve and switch on the main circuit breaker for the high voltage power supply.

14. Make sure the film parameters are set correctly. Press the `PROG` button to edit film parameters. Use the arrows, `C` and `E`, to move the cursor. After changing a value (such as the film #), press the `E`, the down arrow key. When all the settings are correct, press the `PROG` button again to return to the main display. Press `zero` to zero the film counters. The film parameters in use is displayed in the lower left corner and can be changed with the `PROG` button as mentioned above.

15. Turn the key on the high voltage control panel on, and switch on the HV (red button). The voltmeter should read about 10kV. You should not adjust this voltage. Make sure that the filament current vernier is turned down to zero.

16. Turn on the gun (red button) and slowly increase the filament current vernier, until you can just see a glowing spot on the source, but do not in any event turn the vernier above ≈ 1.5 at this stage.

17. Adjust the `up-down` and `left-right` knobs until the beam is at the center of source.

18. Adjust the sweep amplitudes. Sweeping the beam is most important for the public large gold source. Not sweeping the beam on this source can lead to a hole being drilled right through it. Don't turn the sweeps so high that the edges of the "puddle" are alternately freezing as you're evaporating. For the public large gold source, this will mean sweeping over an area slightly smaller than a dime. Do not sweep the beam on small tungsten crucibles (bazookas)

19. Turn the filament current vernier up to the approximate current needed for your evaporation – need to melt a puddle in the source. Watch for any "spitting". You should always be watching the source whenever you adjust the vernier.

20. Open the shutter and adjust current to obtain the desired rate.

21. Watch the source. If you see something drop into a source, then **STOP** your evaporation, **DO NOT** evaporate anything more, and leave notes in the logbook and on the notice board. Someone has to clean up the chamber before every source is contaminated by falling junk. One "flake" falling into it could reduce a source metal from semiconductor grade down to pawn shop grade.

22. Once the desired thickness is reached, close the shutter. Turn down the filament current vernier then turn off the current (white button), the sweeps and the gun.

23. Let the source cool down for a minimum of 5 minutes, longer for very hot sources like Ni and Ta before rotating the turret. Check data on on the monitor, press `Zero` and change the film # using the `PROG` key (see step 14) if another film needs to be deposited then repeat steps 16 to 22.

24. Switch off the high voltage. Turn off the power to the deposition monitor. Complete your entry in the logbook. **You must wait for at least 10 minutes while the sources cool down before venting.** Wait 15 minutes if Ni was evaporated last, and at least 35 minutes if Ta or Nb was evaporated last. Only at the end of that time, turn off the main circuit breaker, the cooling water, and the ion gauge. Push STOP to vent. Raise the bell jar. Remove your sample. Vacuum up the inside of the evaporator around the hearths. Wipe down the surface that bell jar sits on. Lower the bell jar, press START button and turn the sign to "Help Yourself".

New Crucibles

Mat.	Pos.	Hearth /Cruc.	Film #	Dens.	Z ratio	tool-ing	Comments
Ag	4	C					
Al	1	C	6	2.25	1.080	118	
Al_2O_3	1		6	3.97	0.50	169	
Au	4	C	4	19.3	0.381	138	Bazookas can be used at 20–30Å/sec
AuGe	3	C	5	17.63	0.397	151	Composition unpredictable unless you practically empty the crucible
Cr	3	H	6	7.2	0.305	140	Do not evaporate more than 200Å of *Cr* in the E Beam evaporator
Ge	3	C	6	5.35	0.516	130	
MgO	1		6				
Ni	1	H	1	8.91	0.331	140	Prone to spitting. Cool down for 15 minutes before venting
NiCr	1	H	6	8.23	0.321		
Nb	4	C	6				Cool down for at least 35 minutes before venting.
Pd	1	H	6	12.0	0.357	140	
Pt	1	C	6	21.40	0.245	140	Prone to spitting. Evaporate at 1.5Å/sec or less
Si	2	H	2	2.32	0.712	150	Cool down very slowly after evaporating lest you crack the source.
SiO			6	2.13	0.87	132	
SiO_2	1	C	6	2.2	1.07	140	Please change the crystal and the upper mirror after evaporating oxide
SrF	1	C	6	4.28	0.727	140	
Ta	1	H	6	16.6	.262		Requires extremely high current, **Minimum 35 minute cool down** Hearth # 3 may be used. Call me before you try Ta.
Ti	3	H	3	4.50	.628	139	

Table 0.1: Materials permitted in the E-Beam. Contact Jack Whaley and or Lee McCarthy **BEFORE** you evaporate anything else.