Standard Operating Procedure: Evaporator

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1. Lab Safety Information

- ✓ All GMU NFF users are required to complete the Lab Safety Orientation (LSO) before performing any lab work.
- ✓ Proper Personal Protective Equipment (PPE) should always be worn before entering the clean room: safety glasses, hair net, shoe covers, gloves, and lab coat. Additional PPE is available for specialized chemical work as needed.
- ✓ No shorts, sandals, tank tops, or spaghetti-strap shirts are allowed in the clean room!
- ✓ Material Safety Data Sheets (MSDS) are available in a binder in the gowning room.
- ✓ Read the SDS for any chemicals you plan to use before proceeding with your work. Any materials used in the clean room for the first time should be brought in after the approval of NFF staff.
- ✓ A safety buddy is required in the clean room with you when doing chemical work. They must remain in the clean room the entire time you are handling the chemical. Feel free to ask NFF staff if no one qualified is available!
- ✓ Prohibited clean room items: cardboard, pencils, cloth, hats/coats, and contact lenses.
- ✓ Accepted clean room items: plastic, pens, synthetic fabrics, clean room paper.

2. Evaporator Safety Information

- ✓ Any irregular system behavior should be reported to NFF staff promptly. Never attempt to fix the system yourself!
- ✓ All substrates are mounted to a holder with screws and clips. Use enough clips to firmly mount the substrate to the holder.
- ✓ Be careful when loading the holder so you don't drop it in the evaporator.
- ✓ Always ask for assistance from the NFF staff prior to installing a "boat" into the thermal source.
- ✓ Pump down the system once you are finished using it, and return the sample holder to the dry box.
- ✓ Do not put wafers with PDMS or any other unapproved materials into the vacuum chamber.
- ✓ Use of any deposition material that is not already available requires:
    - NFF review and approval
    - You or your lab to purchase the source (*ask if you need help*)
- ✓ When in doubt… ask NFF staff!
- ✓ Gloves can become contaminated when loading wafers or removing wafers. Always check your gloves and replace them when necessary.
- ✓ Failure to use the system safely and properly may result in your access to the system being reviewed and/or revoked.
- ✓ Fill out the logbook before you begin.
- ✓ If a new recipe is required ask for assistance from the NFF staff.

3. Principles of Evaporator

Evaporation is a form of physical vapor deposition (PVD). In evaporation, energy is supplied to a source target in the form of a beam of electrons (e-beam evaporation) or a thermal source of energy (thermal evaporation). Material is ejected from the target surface and travels under vacuum to create a film on the surface of a substrate. Many materials can be evaporated but the most common are metals. Evaporation creates thin films, less than one micrometer thick on the substrate.

At GMU NFF, we have KJL evaporator capable of e-beam and thermal evaporation having electron beam source with 6 X15cc “pockets”, and 2KW thermal source.

Figure 1. KJLC Evaporator System

4. Software Overview

4.1. Elements of the Vacuum Screen

The Vacuum Screen is shown in Figure 2. Elements of the screen are described below.

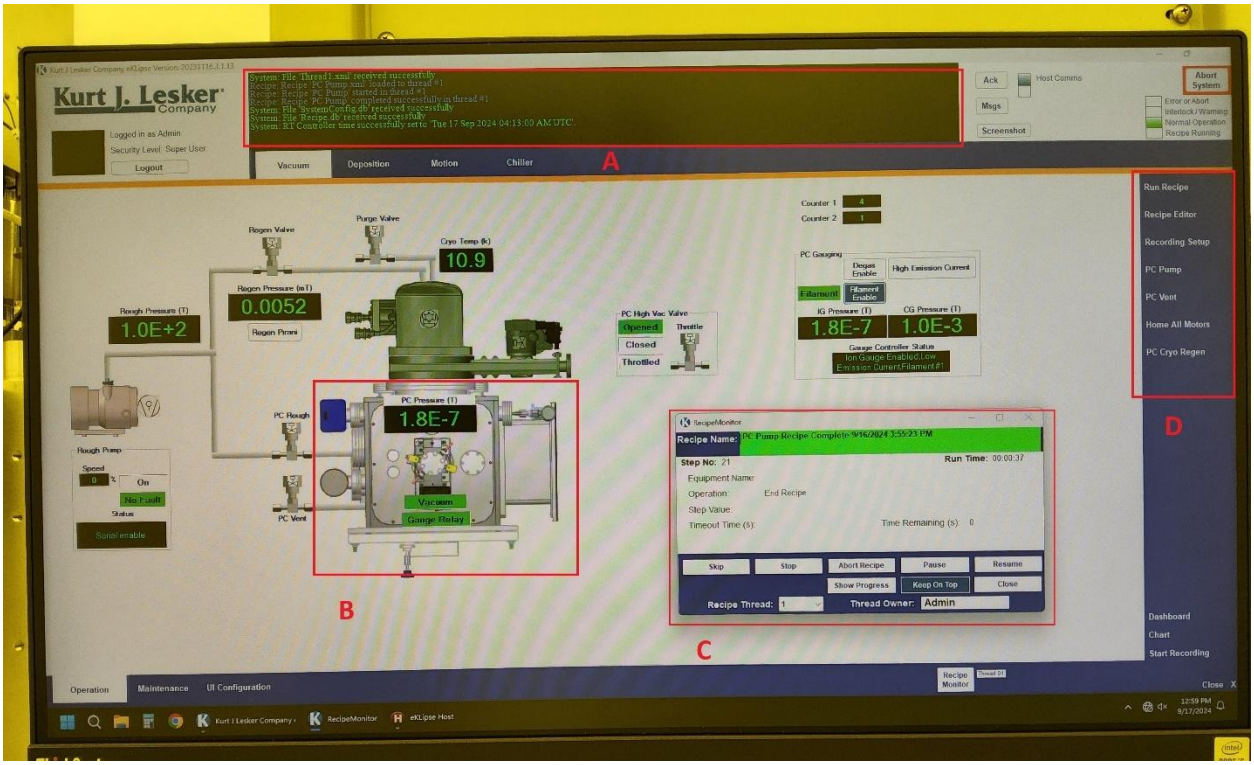

Figure 2

Box A - System Status Window. Provides a variety of status updates about the tasks the system has recently completed. These entries are stored in a log file, and they include any errors or issues that pop up during system operation

Box B - Process Chamber (PC). The chamber that your sample is secured in where sputtering takes place. The GUI indicates what the current pressure is.

Box C - Recipe Status Window. Displays the status of the current recipe, the step of the recipe that the system is working through, and how much longer is needed to complete the current step. This window appears on top of all other screens unless removed.

Box D - Process Bar: Buttons that initialize all main processes. This includes running recipes, pumping the chamber and venting the chamber. This bar is common to all screens.

4.2. Elements of the Deposition Screen

The Deposition Screen is shown in Figure 3. Elements of the screen are described below.

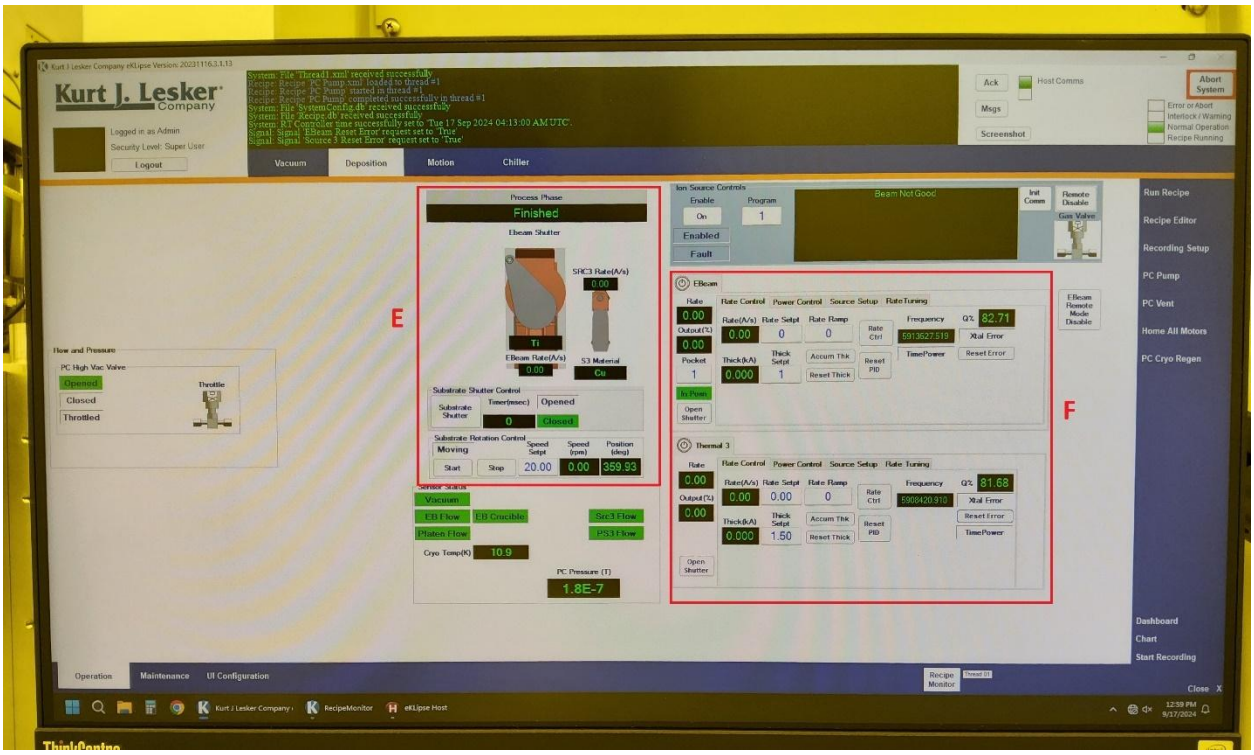

Figure 3

Box E - Source Overview Window: This GUI image provides useful information about the e-beam and thermal sources.

Box F - Source Status Window: This image shows useful information about the sources on the different tabs associated with each source.

4.3. Elements of the Motion Screen

A portion of the Motion Tab screen is shown in Figure 4. Elements of this screen are described below.

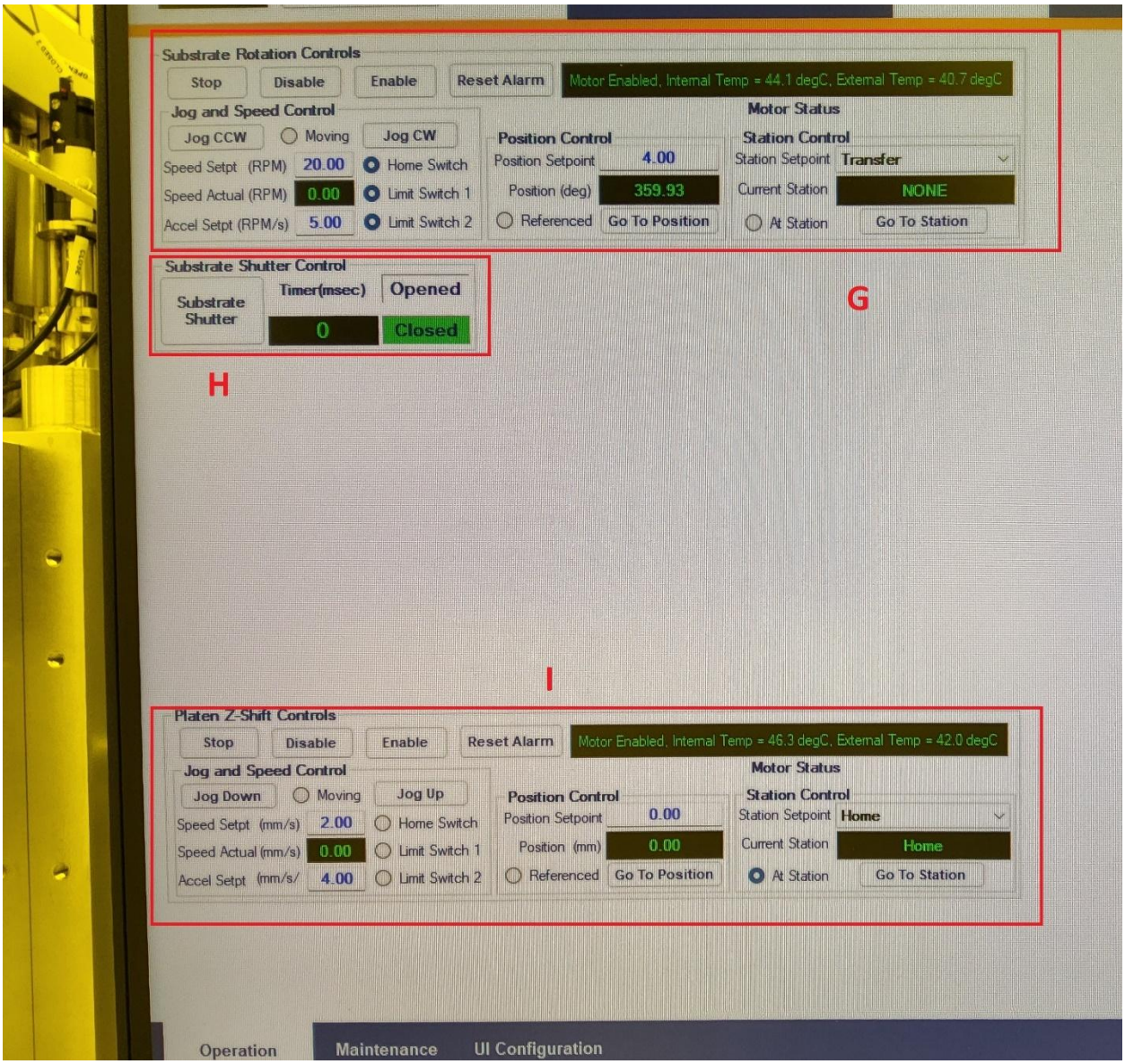

Figure 4

Box G - Station Control Menu: Allows you to go to the “Transfer” station once you finish processing a sample, which is needed to remove your sample when the chamber is vented.

Box H - Substrate Shutter Menu: Allows you to close the substrate shutter once you’ve loaded your sample, and open the substrate shutter once it is time to remove your sample.

Box I - Substrate Z-Shift Menu: Allows you to retract the substrate lift once you’ve loaded your sample, and extend the substrate lift once it is time to remove your sample.

5. Operation

5.1. Loading the sample

1. Vent the process chamber by selecting “PC Vent” from the process bar
2. Get the sample holder and ring from the dry box, and place it on a cleanroom wipe on the table near the evaporator.
3. Secure the sample to the holder using the screws and clips. Ensure it is firmly held in place by gently shaking the holder. Place the holder upside down into the ring.
4. When the chamber is vented, return the rotation value to the “Transfer” station, open the substrate shutters, and extend the lift head.
5. Place the ring / sample holder assembly onto the lip of the extended lift head.
6. Retract the lift head and close the substrate shutters.
7. Pump down the system by selecting “PC Pump” from the process bar.

5.2. Start a Recipe

8. Select “Run Recipe” from the process bar. The “Recipe Selection” box will appear and is shown in Figure 5.
9. Select the recipe you want to run. You can choose from e-beam deposition, thermal deposition or ion source.
10. Another window will pop up where you enter the details specific to the process you are interested in. There is a list of materials and deposition parameters on the front of the machine. The NFF staff will cover these parameters in system training.
11. Click “Continue Load” and the recipe will begin.

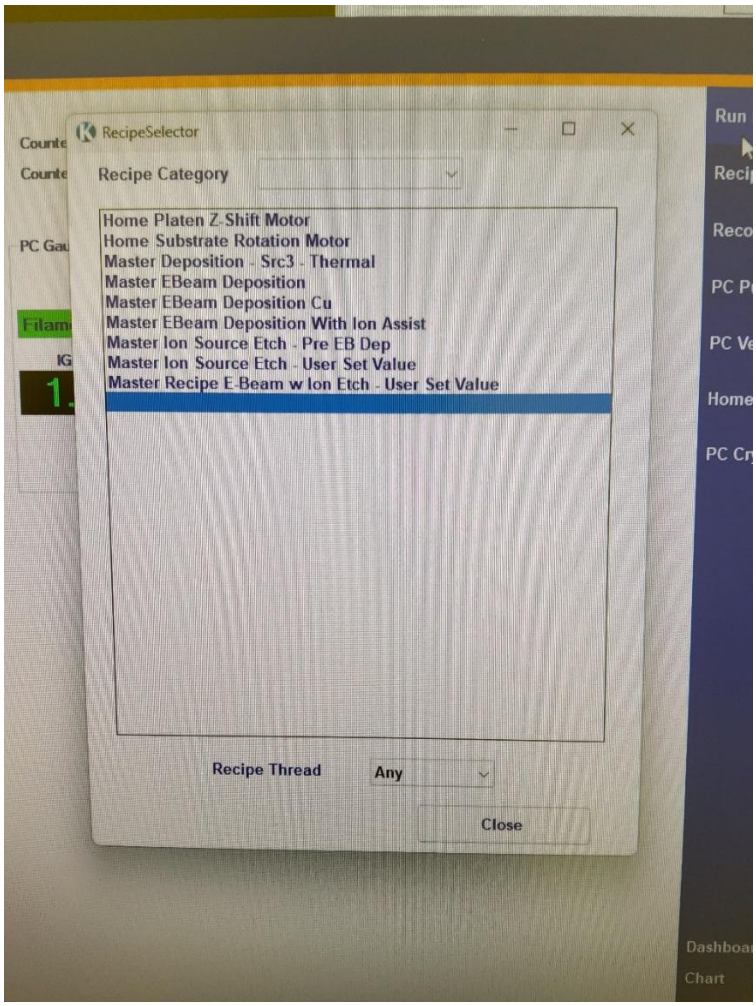

Figure 5

5.3. Unload the sample

12. At the end of the recipe, you need to vent the process chamber by selecting “PC Vent” from the process bar.
13. When the chamber is vented, return the rotation value to the “Transfer” station, open the substrate shutters, and extend the lift head.
14. Remove the ring / holder assembly from the lift head and place it on the cleanroom wipes on the table near the evaporator.
15. Retract the lift head and close the substrate shutters.
16. Pump down the system by selecting “PC Pump” from the process bar.
17. After removing your sample return the ring and holder to the dry box.