

University of Minnesota Nano Fabrication Center

Standard Operating Procedure

Equipment Name:	AJA II - Sputter System	Revision Number:	3
Badger Name:	Sputterer AJA2	Revisionist:	Kevin Roberts
Model:	ATC 2200	Date:	03/24/2020
Location:	Bay 3		

1 Description

The AJA sputter system utilizes ionized gas (Ar, O₂, N₂) to sputter material from source targets to substrates, depositing a thin film in the process. There are 6 shuttered guns on the system: 3 RF, and 3 DC.

2 Safety

- a. Be careful not to pinch your fingers while closing the load lock chamber lid

3 Restrictions/Requirements

- a. Must be a qualified user on the AJA-2 sputter system.
- b. There is a follow-up session required for this piece of equipment.

4 Required Facilities

- a. Compressed air
- b. Chilled water
- c. Cryo at 10-18K
- d. Vacuum
- e. Ar
- f. O₂
- g. N₂

5 Notes

- a. All AJA targets are dedicated in the system. Only staff members are allowed to change targets. The targets will be changed every few weeks as the needs of the majority users change.

6 Operating Instructions

a. LOGGING ON

- 1 Log in to the “AJA-2” on the MNC Badger system.
- 2 FILL OUT user info in LOG BOOK (before, during, and after the run).
- 3 Slide the laptop drawer out and open the laptop if it is not already.
- 4 If the AJA application is not open, on the desktop double click on “Phase II” to run the main operating software.
- 5 On the AJA-2 login screen, type in your assigned 4 digit Operator Access Code (password) and hit “Enter”.

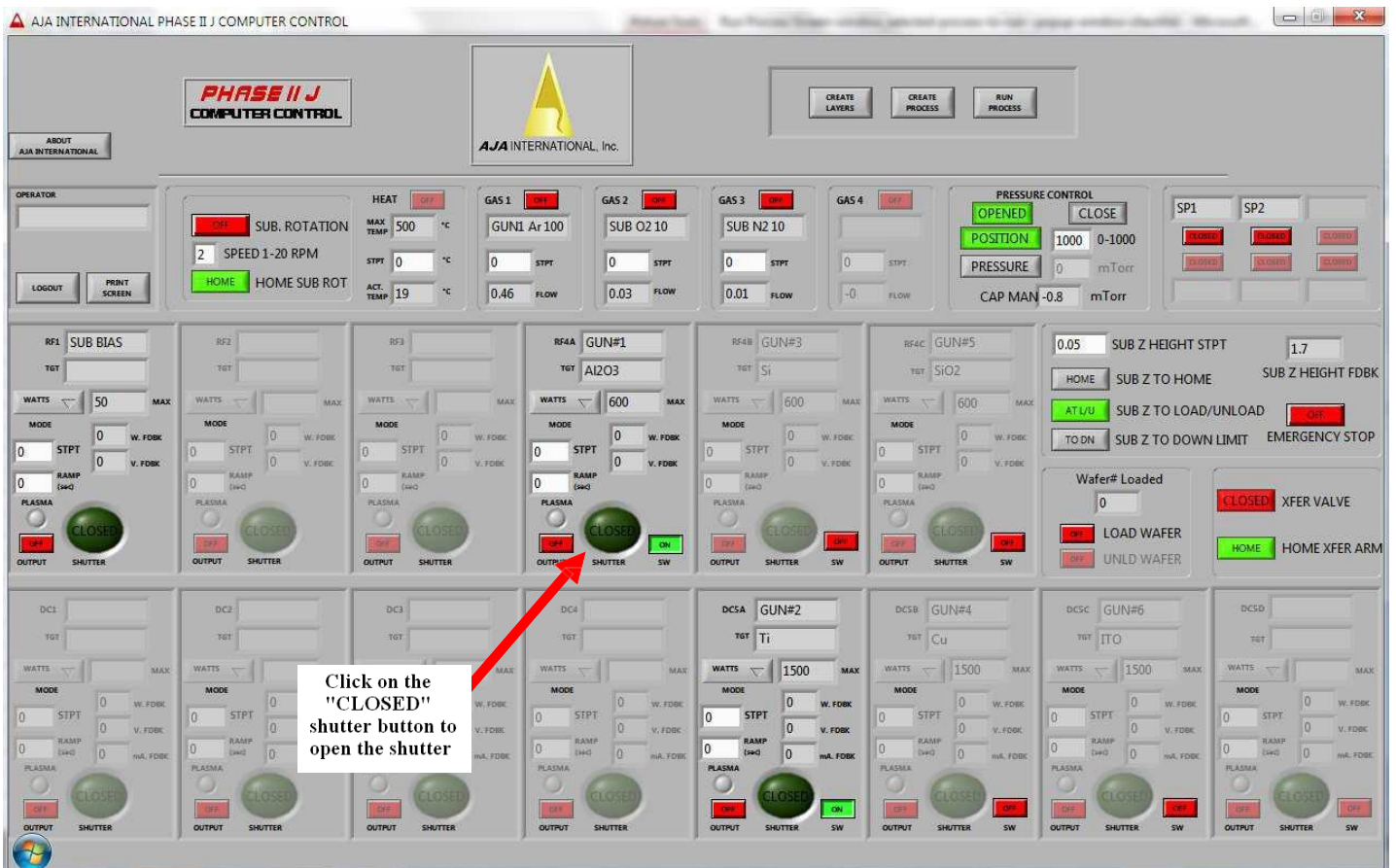
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b. TESTING THE SHUTTER

- 1 Ensure that the viewport shutter on the far left is open, and then turn on the LED lamp to illuminate the chamber.
- 2 On the main operator screen, click on the circular shutter button of the gun(s) you'd like to use to test the shutter. Look in the middle or right viewport and check to see that the shutter on the gun is opening properly. If not, contact an NFC staff member (so they can vent the system and fix the shutter). To close the shutter, click on the same circular shutter button.

*** See image below***



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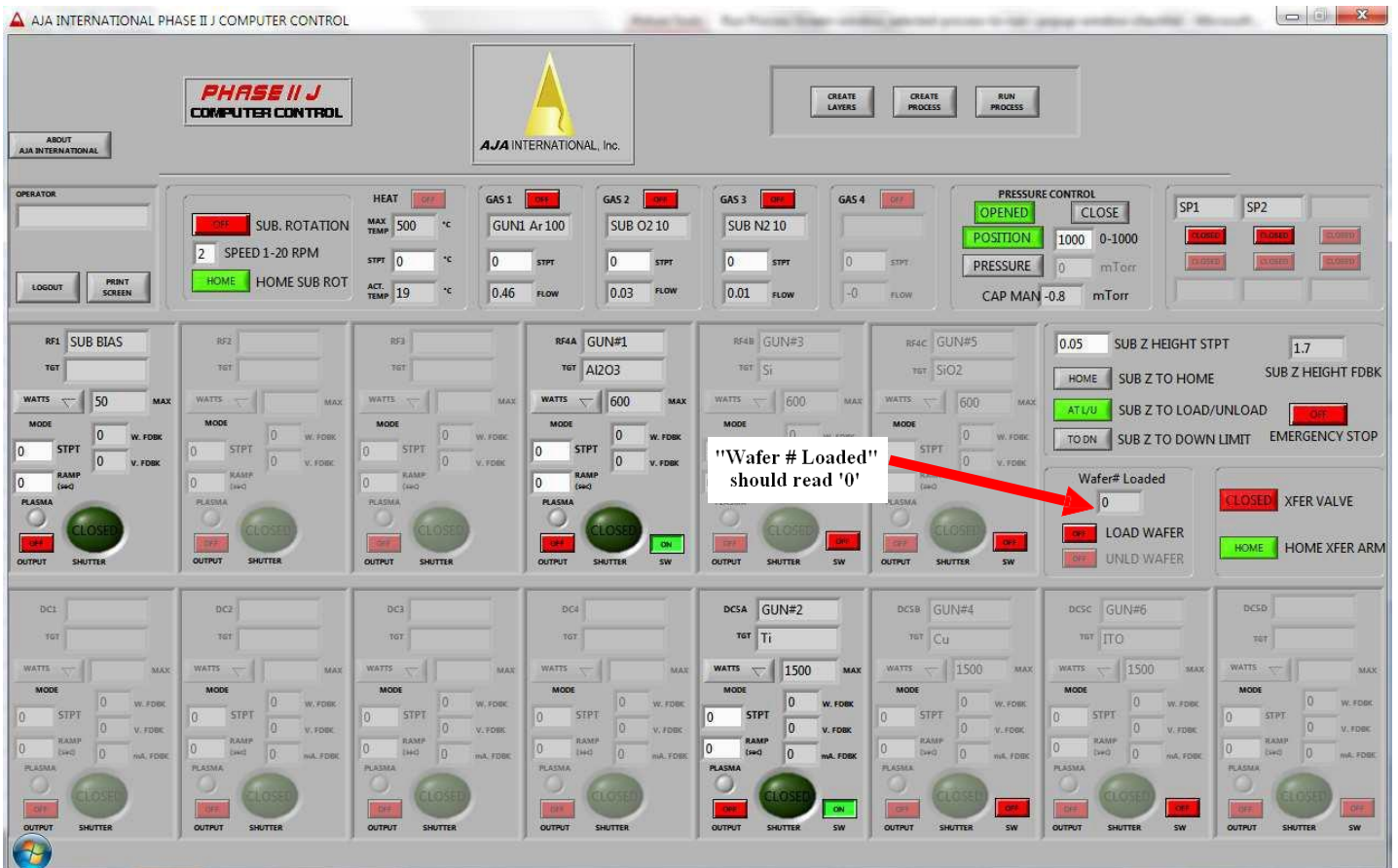
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c. SAMPLE LOADING

- 1 Ensure that there are no wafers loaded into the system. You should check in the chamber viewport first, and then look on the main operator screen under “Wafer # Loaded” which should read “0” (this means that the system assumes there are no wafers inside). If you see a wafer in the system, but the “Wafer # Loaded” reads “0”, then contact NFC staff.

*

See image below*



- 2 Turn off the load lock pump by shutting off the circuit breaker (it is located on the far right of the power rack, and labeled “Load Lock” below the circuit breaker).
- 3 Once the load lock pressure gauge reads 7.4×10^2 Torr, check to see if the load lock cover lifts easily. If not, wait another minute and try again. The load lock pressure gauge is located on the top-right side of the load lock chamber. Lift the door all the way up until it hits the door stop.

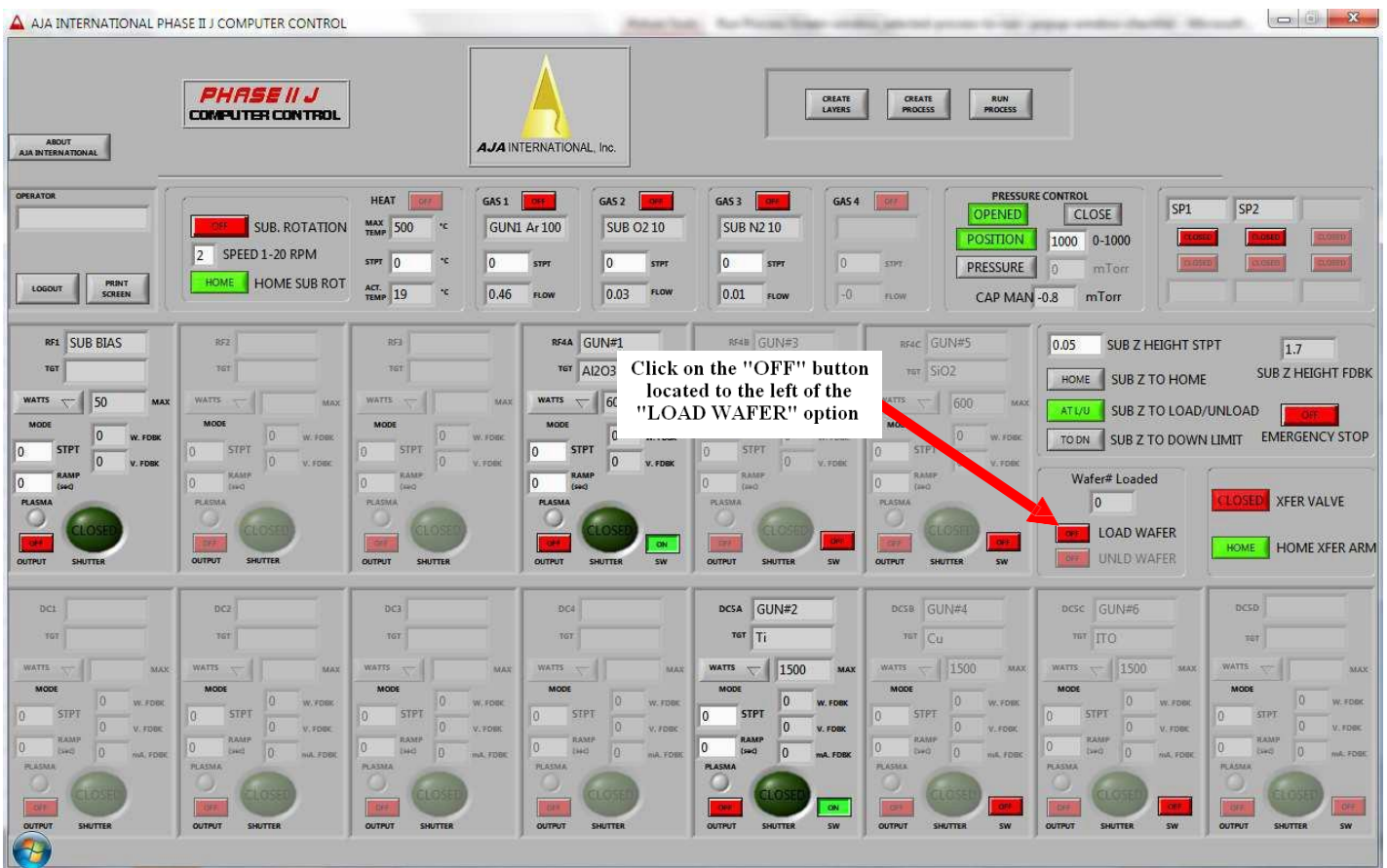
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- 4 Remove the sample holder from the load lock chamber. While holding the ring and plate together, flip the sample holder over so the retainer clips and adjustable screws are facing up. Load your substrate(s) and fasten them to the holder with the retainer clips
- 5 Turn on the load lock pump by flipping up the circuit breaker.
- 6 Once the load lock pressure gauge reads 1.5×10^{-3} Torr, you can load your sample into the main chamber by clicking the “OFF” button located to the left of the “LOAD WAFER” option on the main operator screen.

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See image below*



- 7 Once the wafer is loaded, and the transfer fork is back in the load lock, on the main operator screen the “Wafer # Loaded” should read “1”.

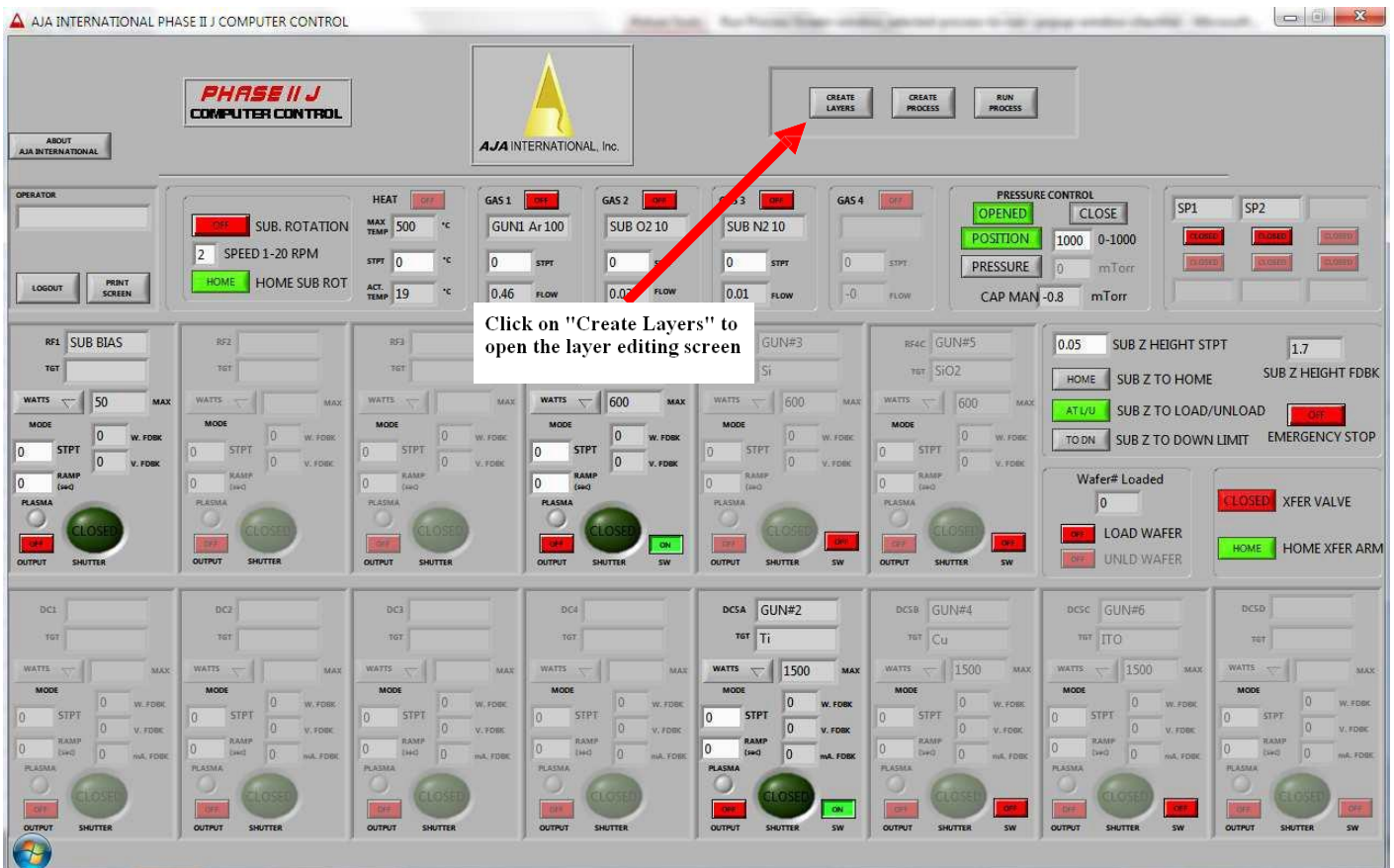
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d. PROGRAMMING OF LAYERS

- 1 On the main operating screen, click on “Create Layers”. This will open up the layer editing screen.

*** See image below***



- 2 On the layer editing screen, click on “OPEN” to view the layer templates.

*** See image on next page***

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- 3 A window should pop up with all of the available recipe layers (which you can view and edit). Select the appropriate layers to view/edit. For example, if you want to run Gun #2, then select a file which contains “G2” in the file name. When you open up the file, all of the previously saved parameters in that file will be visible. Some of these parameters may include: gun parameters (delay time, power, ramp up/down time, coat time, etc.), pressure setpoint, gas flow rates, z-height, etc.

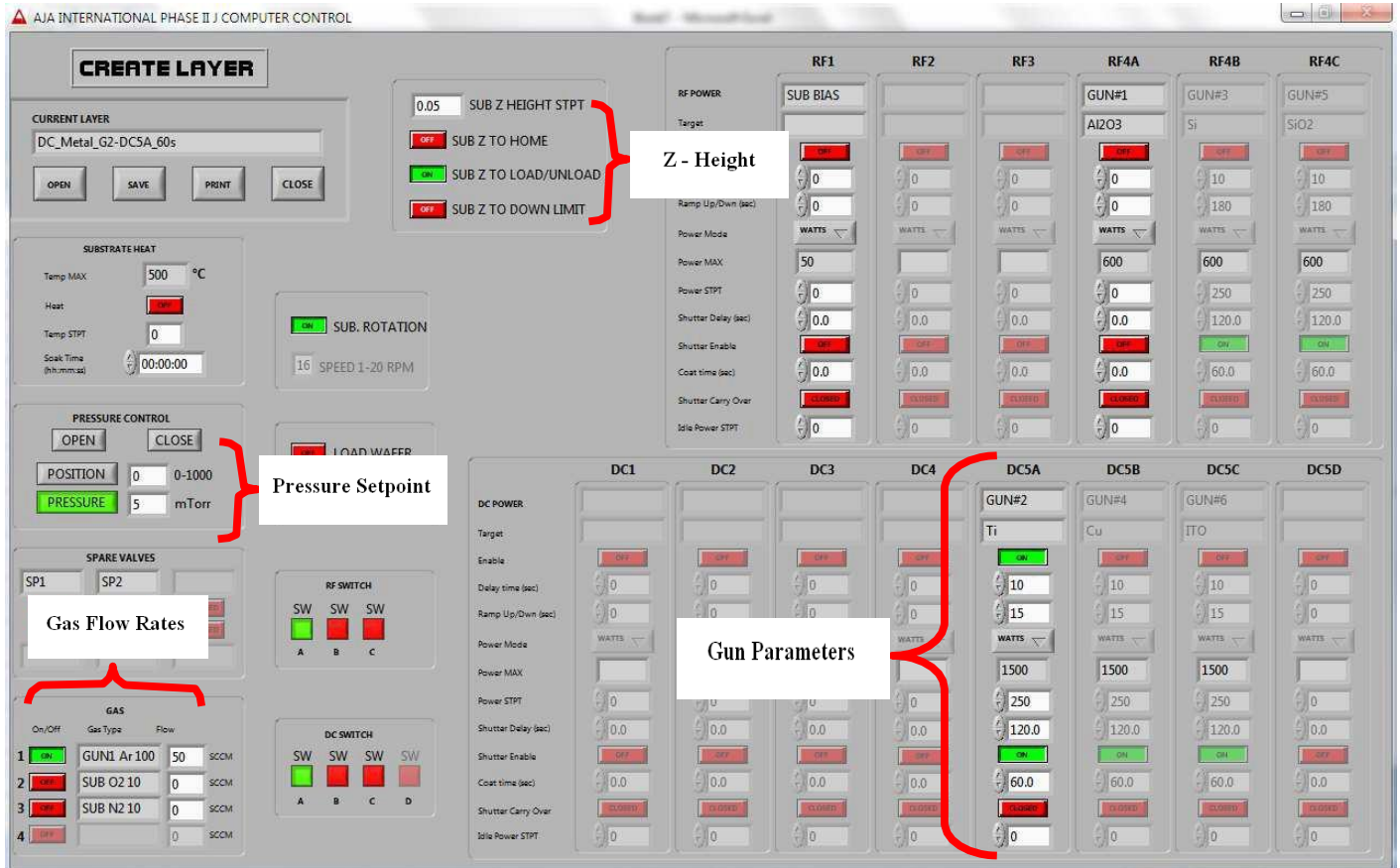
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See image on next page*

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Note: in the image below, a “G2” file is displayed. This particular file shown controls only one gun, in this case, Gun # 2 (G2). Notice that all of the other DC guns (as well as the RF guns) are “grayed out” or disabled (turned off) so that the only gun that will run during this layer is Gun #2.



- 4 Change the parameters as needed. The most common parameters that users will change are: coat time, power, gas flow rates, and pressure.

Attention: users that desire substrate heating should read steps 5, 6, and 7. If no heating is desired, then skip ahead to step # 8. The maximum allowable temperature for substrate heating is 500 °C.

- 5 To enable the substrate heater during a specific process layer, locate the “Substrate Heat” section on the left side of the layer editing screen, and press the red “OFF” button. It should now read “ON”.
- 6 Enter the desired temperature in the “Temp STPT” box. If you plan on using temperatures greater than 350 °C, then please read step # 8.

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- 7 Enter the desired soak time (this is the time that the system will “soak” at that temperature before going to any other parameters in that layer (i.e. gun parameters, etc.). Soak times are used to ensure that the substrate and all the adjacent fixtures have reached the desired temperature.
- 8 If you plan on using temperatures over 350 °C, then you must use additional layers that allow the system to soak for 15 minutes for each additional 50 °C increase. For example, if you want 500 °C, then after your 350 °C layer, you need to increase the temperature from 350 °C to 400 °C and soak for 15 minutes, and then increase again from 400 °C to 450 °C and soak for 15 minutes. Finally, you can increase from 450 °C to 500 °C and soak for 10 to 15 minutes. These are going to be referred to as “high-temp ramp soaks”. These “high-temp ramp soaks” will prevent the sample holder fixtures from being heated too quickly and warping.

* See image below for a low-temp layer example*



Note: in the image above, a “G2” file is displayed with the appropriate substrate heater parameters applied. So in the case of this layer shown above, the heater would turn on

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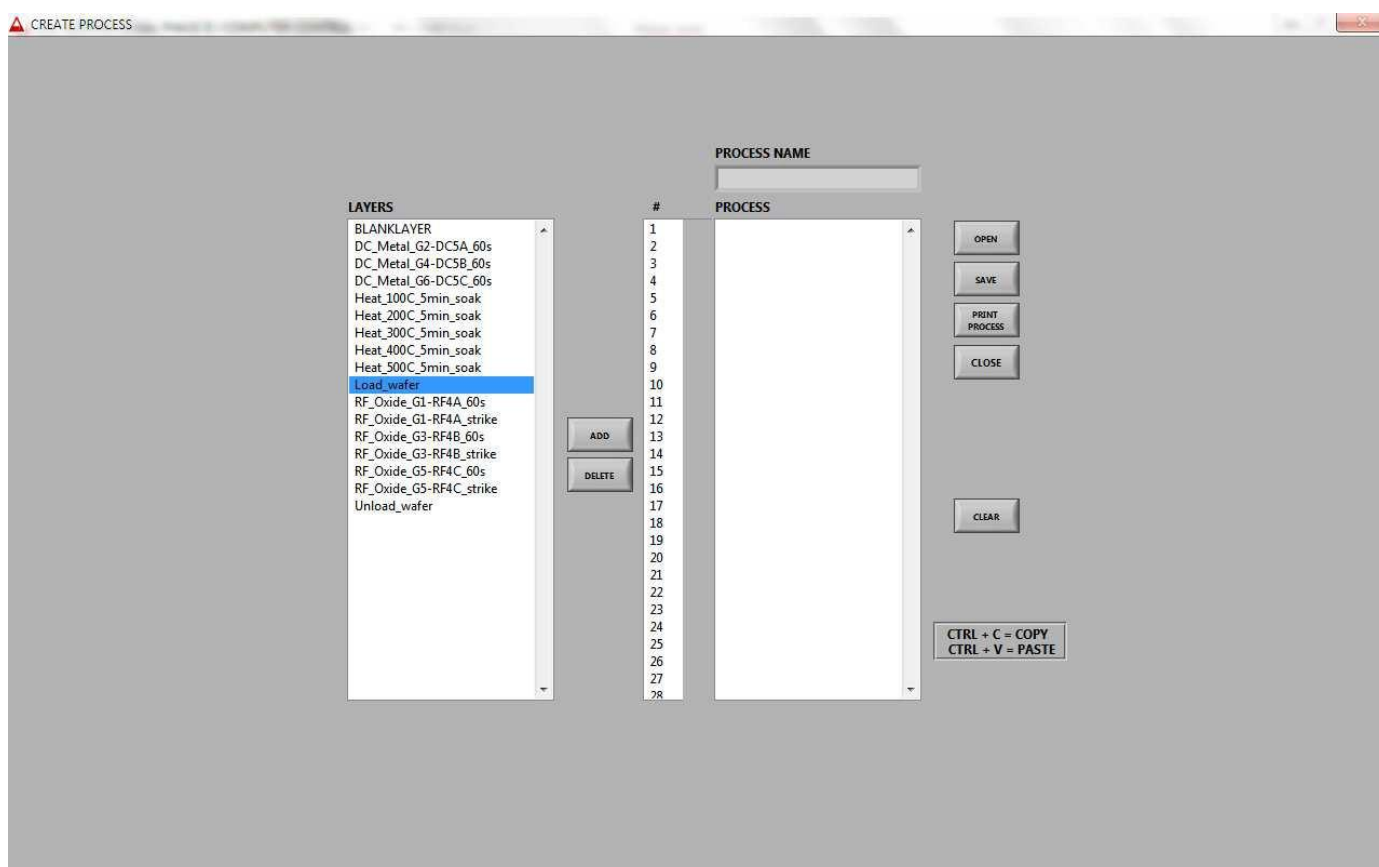
first and achieve a temperature of 100 °C. Next, the system would soak for 00:05:00 (which is 5 minutes). Once the 5 minute soak has expired, the system will remain at the 100 °C temperature and continue through the layer onto the gun & deposition parameters.

- 9 When you are finished editing your layer, click on “Save” in the upper left region of the screen. Type in a desirable file name. Be sure to include the pertinent details (i.e. gun # denoted as G1, G2, G3, etc. – coating time, etc.). Repeat previous **steps 2 through 9** for any additional layers desired.
- 10 When finished editing layers, click on “Close” in the upper left region of the screen.

e. PROGRAMMING OF PROCESSES

- 1 On the main operating screen, click on “Create Process”. This will open the process creation window.

*** See image below***



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- 2 Click on the first layer in the “Layers” box that you want to add to the process and click “Add”. This will add the desired layer to the “Process” box. If you make a mistake and want to remove a layer from the “Process” box, you can select the layer you want to remove and click “Delete”. If you want to remove all layers from the process box to start over, click “Clear”. **Every process must start with a “Load_wafer” layer, and every process must end with an “Unload_wafer” layer.**
- 3 When finished adding layers, click on “Save”. Type in the desired file name and hit “Enter” or click on “Ok”. When you are finished creating processes, you can click on “Close”, which will return you to the main operator screen.

f. RUNNING A PROCESS

- 1 On the main operating screen, click on “Run Process”. This will open the Run Process selection window.
- 2 Select the file you want to run by clicking on it.
- 3 Turn the data log feature on by clicking on the red “OFF” button located above the “DATALOG” option on the bottom left of the window. The button should now turn green and read “ON”. This will log the status of your run in case there are any problems.
- 4 Ensure that “Single File” is displayed (to the right of the green “ON” button).
- 5 Finally, click on “Open” to open/run the desired process.
- 6 As the process begins, you

Run Process

Finally, click on “Open” to open/run the process.

During the process, periodically monitor the gas flow rates, pressure, power, temperature, etc.

The pressure can be monitored accurately by looking at the “Main Chamber CM” pressure gauge located on the control rack to the right of the laptop computer.

Once the shutter opens for the gun during the process, you can look in the view ports and ensure that the plasma is stable, and that the shutter opens all the way, etc. When you are not looking in the chamber, be sure to CLOSE the view port shutters, so the view port glass doesn’t get coated up excessively.

At the end of your run, you will see a window pop up which says “Process complete”. Acknowledge the window by clicking “Ok”.

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e. DEPOSITING FILM

- 1 Select **Run Process** in upper left corner of screen.
- 2 Select **Browse** and choose the intended process. Make any notes you wish to save with the data log file of the run.

f. SAMPLE UNLOADING

- 1 If **Load Lock** is not already under vacuum, turn on **Load Lock Vacuum Pump** ("L.L." on computer screen).

Once the L.L. is in the 10^{-5} 's range, it is okay to proceed:

- 2 Open **Load Lock Gate Valve**.

g. LOGGING OFF

- 1 Pump down the Load Lock by returning the cover lid to this chamber, and then turn on the **Load Lock Vacuum Pump** ("L.L." on computer screen).
- 2 Make certain the **Load Lock Gate Valve** is closed.
- 3 Log out on the AJA screen, leaving the computer on the log in screen.
- 4 Fill out any remaining info in the log book.
- 5 Log out of the NFC Coral system.