

Microproducts Breakthrough Institute Nano Micro Fabrication Facility

AJA Sputter Tool System Operation

| Revision | Date | Description | Curator |
|-----------------|-------------|--------------------|----------------|
| 0 | 4/13/09 | New document | Todd Miller |
| 1 | 11/13/09 | Overall update | Jack Rundel |
| 2 | 10/16/13 | Update | Thomas Lindner |

System Description

The AJA sputter tool is a sputter down system capable of deposition on substrates up to 6" in diameter using both DC and RF power. The system has four cathode positions, currently configured with three 3" cathodes and one 2" cathode (configured for magnetic materials). The system is capable of reactive gas sputtering, has a load lock, substrate heating (up to 200°C), and substrate bias.

Safety and Equipment

Consistent with fabrication floor policy, safety glasses **MUST** be worn when operating the sputter tool.

Users must wear gloves when loading/unloading substrates and when changing targets. Fingerprints are sources of volatile oils that can lead to contamination of the chamber and degradation of the vacuum.

If an anomalous response is experienced when operating the system, stop work and report the circumstances to MBI staff immediately.

Part I: Normal Operation

Verifying the System Status

1. Make sure the system is not used by checking the online reservation system, the presence of a reservation tag on the tool, and by checking the position of the substrate transfer arm and the indicators on the laptop screen. E.g. if a process is running one of the cathode shutter indicators will be green, if a process is finished, a system notification will be visible in the center of the laptop screen.
2. If the system is unused, check the vacuum indicators:
 - a) The main chamber vacuum should be in the range of $2 - 4 \times 10^{-6}$. The indicator for this is in the center of the rack insert above the lap top screen.



- b) The vacuum in the load lock chamber typically reads 2×10^{-6} . The indicator is found on the instrument above the load-lock, as shown in the picture below.



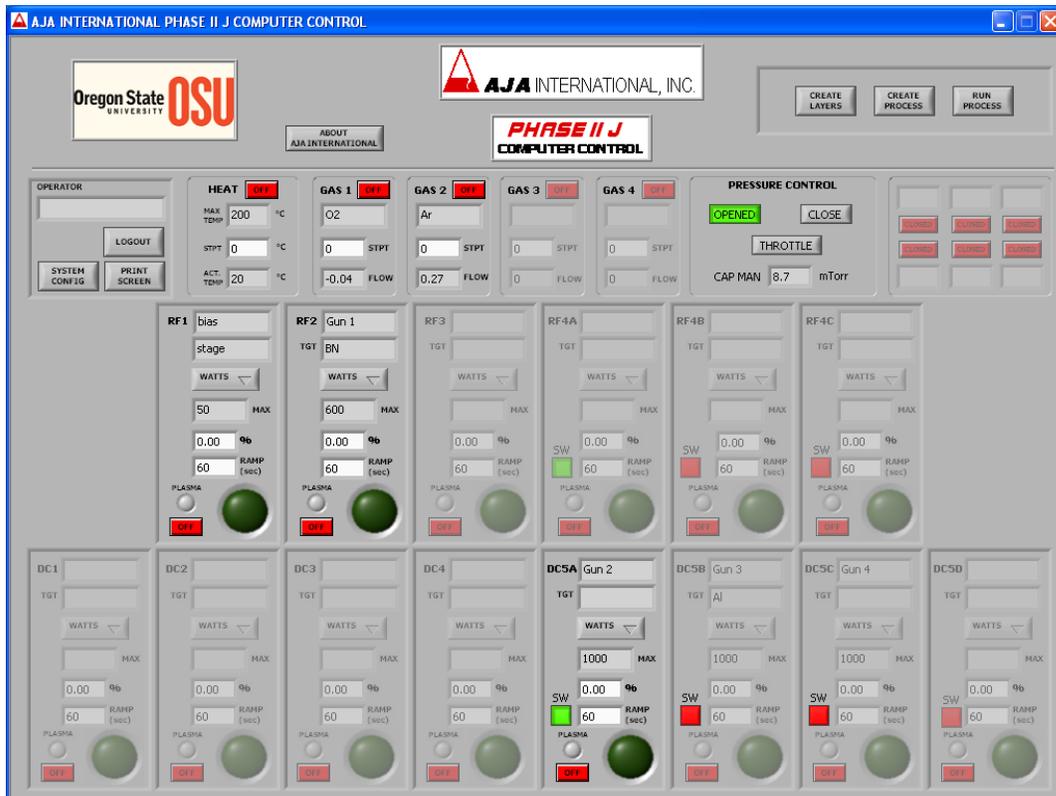
Load/Unload Sequence

1. Verify that the load lock gate valve is closed.
2. Vent the load lock and remove the load lock cover.
3. Load the sample(s) onto the platen. Ensure the platen is properly seated in the forks of the load arm: centered between the forks and pushed to the extreme right.
4. Wipe the load lock cover and o-ring with a clean, dry Kimwipe.
5. Replace the load lock cover and pump down the load lock.
6. When the load lock pressure drops to 10^{-4} Torr or less, open the load lock gate valve.
7. Slowly move the load arm into the main chamber.
8. Transfer the platen from the load arm forks to the rotor by meeting the following criteria: (1) the rotor must seat into the platen; (2) the platen must lift off the load arm forks; (3) the stage must NOT contact the load arm forks.
9. Move the load arm completely out of the main chamber.
10. Close the load lock gate valve.
11. Turn the rotation on.
12. If you intend to adjust the working distance beyond the load/unload position, carefully note the value indicated on the rotor position gauge prior to adjustment. You will need to return the pedestal to this load/unload position in order to retrieve the platen.
13. Configure the deposition recipe(s).
14. Run the deposition recipe(s). Be sure to close the observation window shutter when actively sputtering.
15. When the deposition process is complete, turn the rotation off.
16. If the working distance was adjusted in Step 12, return the platen to the load/unload position.
17. Turn on the cold cathode gauge (push and hold "up arrow" button until "ON" is displayed).
18. Ensure the differential pressure between the main chamber and the load lock is low.
19. Open the load lock gate valve.
20. Slowly move the load arm completely into the main chamber.
21. Transfer the platen from the rotor to the load arm forks by lowering the rotor until it fully exits the platen.
22. Slowly move the load arm and platen completely out of the main chamber.
23. Close the load lock gate valve.
24. Vent the load lock.
25. Remove the sample(s). Load the next sample(s) if appropriate.
26. Wipe the load lock cover and o-ring with a clean, dry Kimwipe.
27. Replace the load lock cover and pump down the load lock.

Recipe Selection and Settings

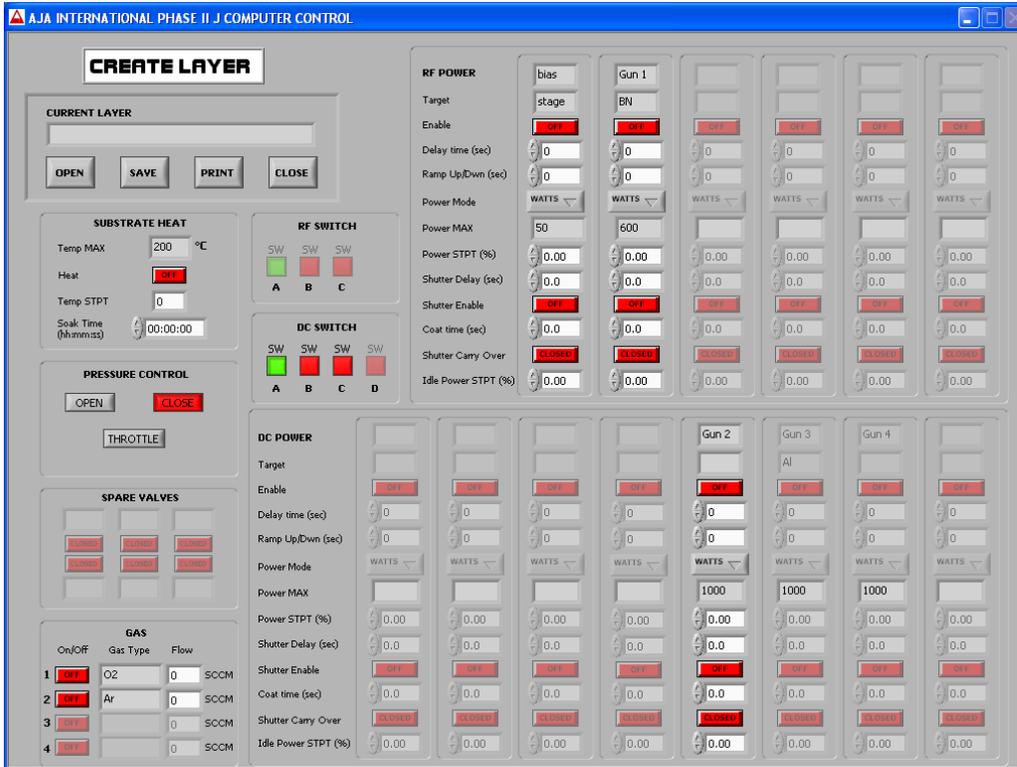
A recipe consists of one or more layers combined to a process. The steps described below can be used to either run an existing process, or create a process or verify an existing process recipe stored on the system.

When the system is idle the laptop displays a standard screen shown below:



1. Create a layer:

On the standard screen hit the button “Create Layers”. This brings forward the “create layer” window, shown below.

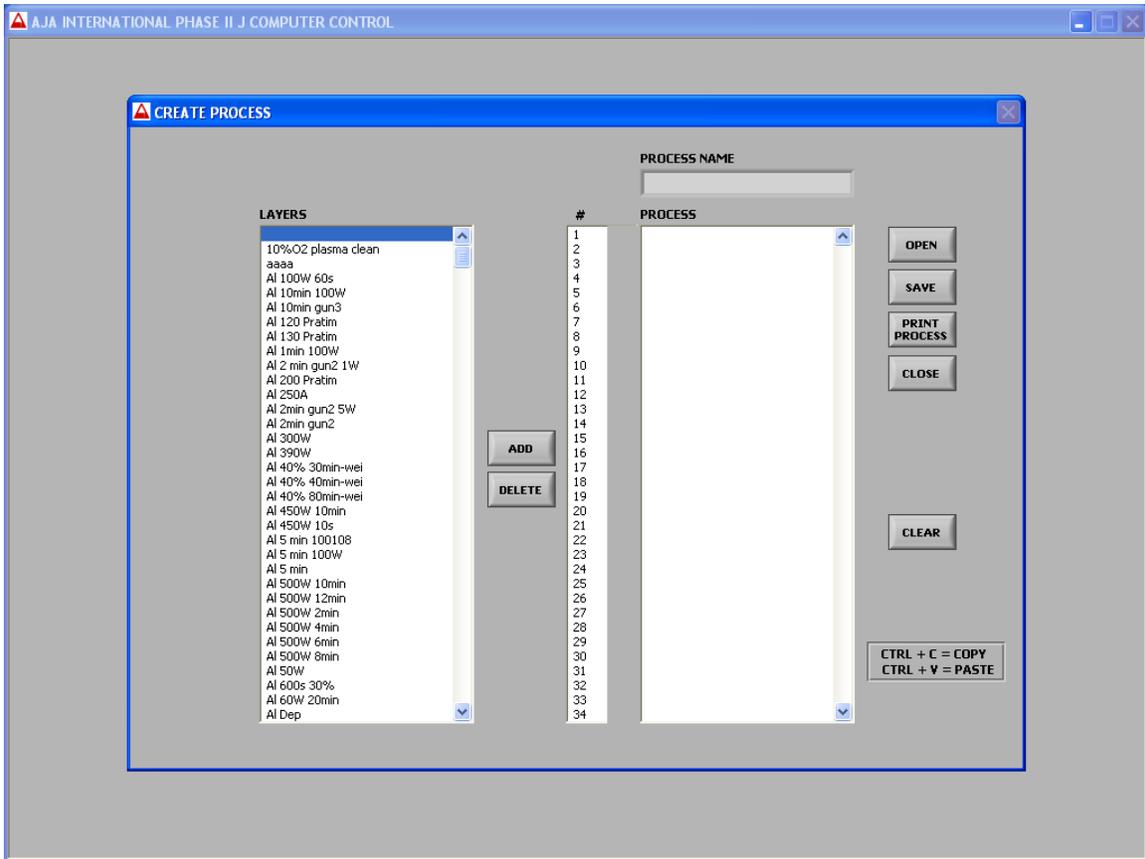


This window is used to select parameters for the functions of substrate heat, pressure control, gas flow, and gun activation. These functions can be defined individually and called out as separate layers, or they work in parallel. In order to let the system reach an equilibrium state, it is advisable to execute these functions in series, i.e. separate out several layer definitions.

When all parameters are defined, hit the save button and pick a descriptive filename. When this window is only used to check an existing recipe, use “close” to go back to the standard screen.

2. Create a process:

On the standard screen hit “create process”. The window shown below will appear.



Highlight each layer that you want to include in the process and click on “ADD” in the center of the screen. Once the complete list of layers appears under “PROCESS” save the process with a unique name.

3. Run a process:

On the standard screen hit “RUN PROCESS”. The window shown below will appear. Scroll through the list of processes and click on the one you want to run.



Click on “RUN”. The window shown below will appear in the middle of the screen:



“Set working distance” refers to step 12 in the Load/Unload procedure above. The substrate rotation is turned on with the potentiometer on the control panel under the load lock chamber. Items 3-5 on the list are set as default on this AJA tool.

Your chosen program will activate one of 4 cathodes for the deposition step. Make sure that the layer definition switches to the desired cathode and that the right target is mounted in this position.

Use tracking, data logging

After each run, write down the process parameters in the respective sheet in the folder labeled “Sputter Tool Log”. This is for the benefit of all users as they will see what material(s) were used in it prior to their own setup.

Target changes (details below) are recorded in 2 different places:

- The configuration screen on the laptop.
- A paper log sheet taped to the electronics rack.

If there are any questions about the configuration contact the system curator, or the user who noted the target change, or the last user who logged a sputter run.

Target and shielding change

Target changes are part of the training, sometimes require a little bit of practice. The following images illustrate the key steps in the process.

First the main chamber has to be vented to atmospheric pressure. It is advisable to also vent the load lock chamber to reduce pressure against the transfer valve.



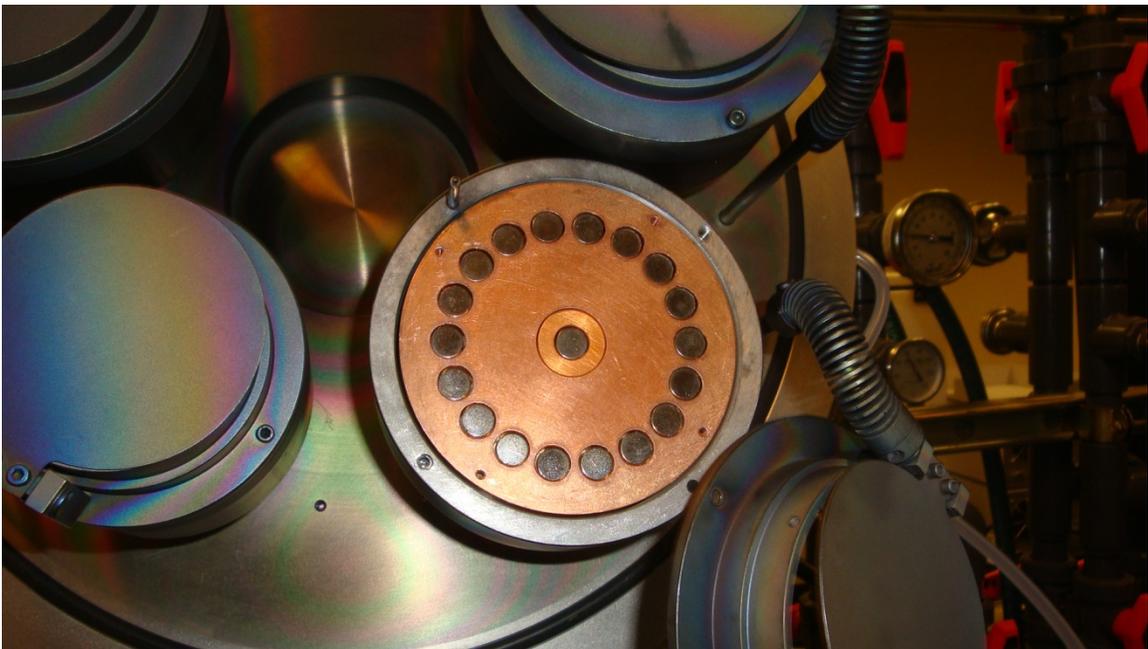
The two switches are labeled “Vacuum Pumps” and underneath “Main Chamber” and “Load Lock”, respectively.

The vacuum gauge on the load lock will indicate $7.2 - 7.6 \times 10^2$ once it reaches atmospheric pressure (normal pressure is 760 torr).

The vacuum gauge for the main chamber will indicate “off”. Once atmospheric pressure is reached the main flange on top of the chamber will show a visible gap, and it is possible to flip the top up until it rests on the hinge in a tilted back configuration shown below.



Mounting a target starts with the cathode Cu electrode exposed as shown in the picture:



Metal targets can be mounted directly onto the cathode. If a ceramic target is installed in bulk form, it is advisable to insert a Cu mesh, which is usually kept with the ceramic targets. If the ceramic target is bonded to a Cu backing plate, a special clamping ring is to be used. This will be kept with those targets and is easily recognized by its shape.

The clamping ring is mounted with 4 screws. Care has to be taken to use only the slightest force, which is sufficient if the screws are inserted straight. Any tilt will result

in the screw getting stuck and possibly breaking off. The image below shows a clamped target.



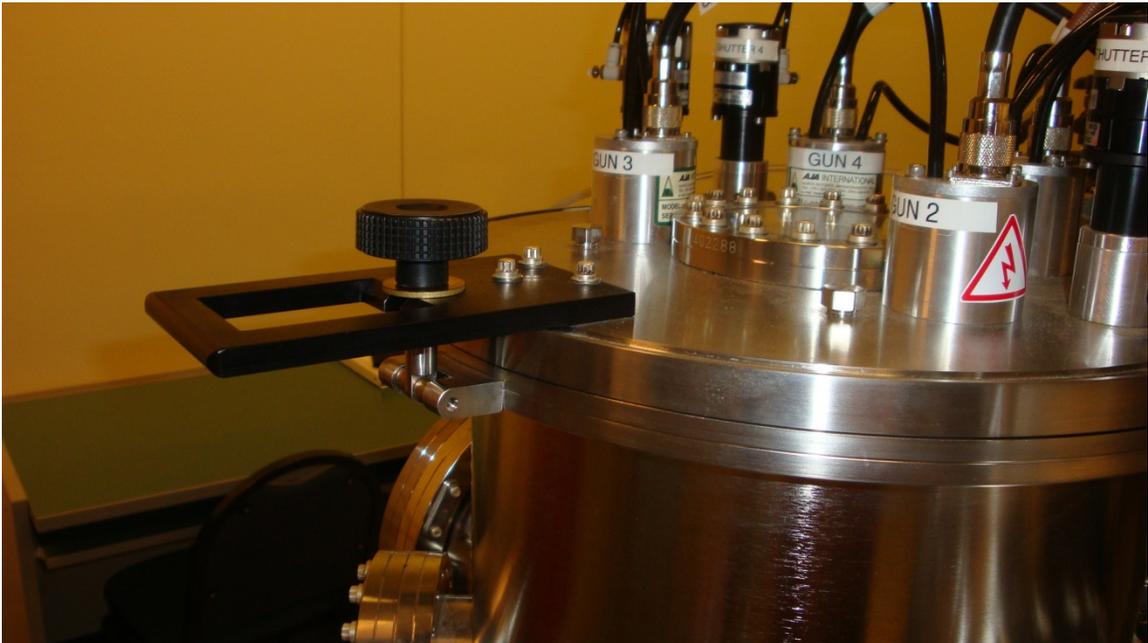
Now the dark-shield and the chimney have to be installed. The dark-shield is aligned with one or two pins that protrude from the housing of the cathode. The two bolt-holes in the dark-shield have to align with the threaded holes in the cathode.



The chimney sits on top such that it can be attached with two bolts which simultaneously go through the dark-shield and screw into the cathode. Final assembly is shown below.



After closing the shutter, the system should be inspected for loose flakes and any particles on the flange surface or on the Viton O-ring should be wiped off. After closing the lid the manual clamp has to be engaged and tightened.



Now both the main and the load lock pump can be restarted and the entire system pumped to base pressures.

Part II

Troubleshooting

- Known issues and recovery procedures
- Arcing response

Maintenance Schedule

- Shielding changes
- Chamber clean
- Mechanical pump oil change
- Turbo pump refurbish

Repair log

- Events, dates, helpful info
- Time drawing

Standard recipe descriptions

- Settings and results (dep rates)

Training Checklist

- Emergency off
- Load/unload
- Recipe selection and modifications
- Target and shield change, MBI staff notification
- Log entries
- Configuration update
- Tool reservation and respect for reserved time