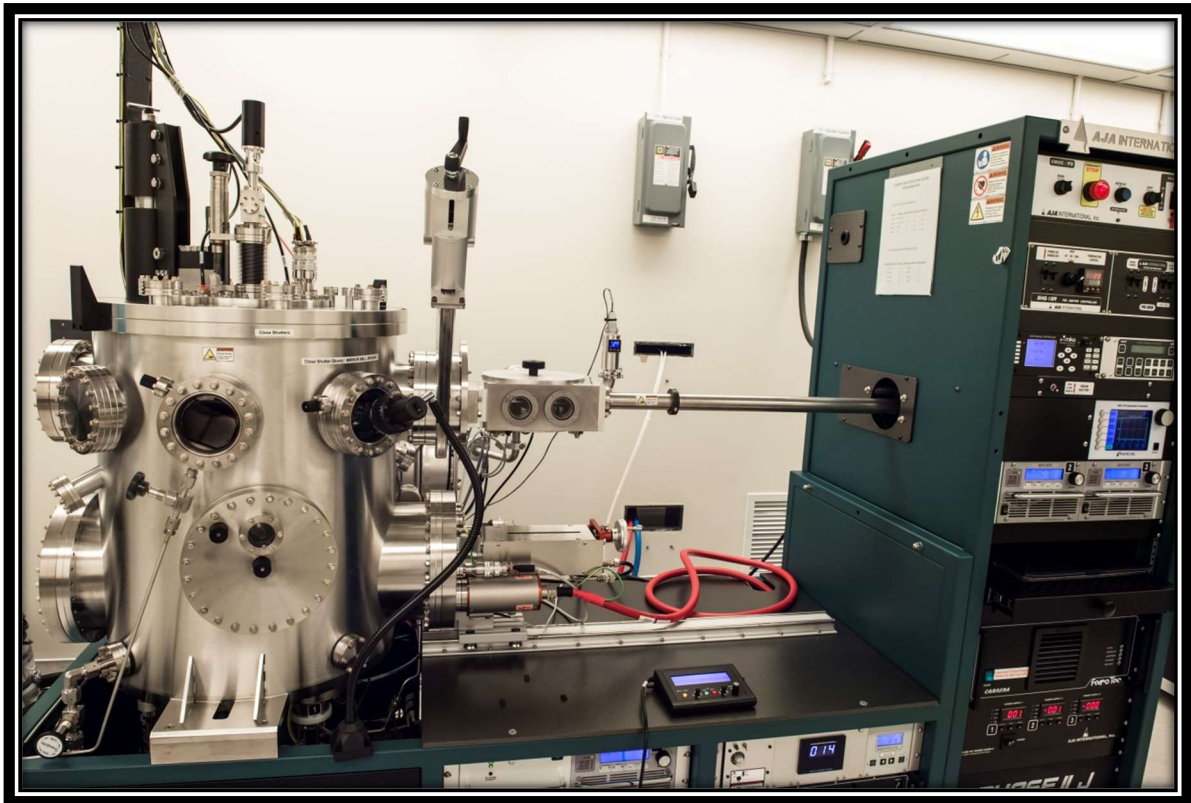




Nano-scale Fabrication & Characterization Facility

AJA ATC SERIES UHV HYBRID Sputter/Evaporation System Users Guide



The AJA UHV Hybrid Deposition system provides thin film coating of virtually any material quickly, cleanly and efficiently. The system is equipped with 6 sputter sources, One 4 pocket e-beam evaporator, basic sample etching, sample heating with indirect temperature monitoring and LN2 sample cooling. A variety of non-magnetic sputter source materials are available. The system has an ultimate vacuum in the order of 1.1×10^{-8} with a vacuum of 5×10^{-6} or better recommended for deposition.

Operation Procedure:

- 1) Log into both “Cr-Cleanroom” and “CR-Deposition Sputter System E-Beam AJA” using FOM.
- 2) Note the system pressure before loading. It is normally -8 Torr or better. If it is not, document the pressure in the FOM system and seek help from the NFCF staff.
- 3) The sample holder is stored in the load lock chamber.
- 4) Before venting the load lock, verify the manual valve between the main chamber and the load-lock is closed. If it is open, the chamber vacuum/cryo pump will be impacted!**
- 5) Vent the load-lock system by placing the Mechanical Pump breaker switch in the off position. The venting process will take approximately 3 minutes. The load lock pressure is displayed on the side of the load lock. If it does not vent in a few minutes, verify your FOM login or log off and back into FOM.
- 6) Do not leave the system venting/vented. It must be pumping unless you are loading samples. Leaving the system venting drains our N2 supply.**
- 7) Remove the load-lock lid. Set the lid on the feet provided. Do not set the lid down on the sealing surface or it may become scratched and leak. Load your sample onto the sample holder.
- 8) Place the sample holder into the load-lock with the notch facing toward the main chamber and the clips located to the sides of the transfer arm.
- 9) Place the load lock cover on the load-lock and turn on the load-lock breaker to start the pump down procedure.
- 10) Once the load lock pressure has reached a minimum of $9e-6$ Torr, open the valve between the load-lock and the process chamber.

- 11) Make certain that the sample receiver in the chamber is at the up “14” position on the scale. Insert the transfer rod into the chamber.
- 12) While looking into the chamber, lower the sample receiver onto the sample holder. Make sure the three point gripper aligns with the pattern on the holder. This will depend on how you loaded it. The holder will flex downward if the alignment is not correct.
- 13) Verify the alignment at position 20 on the scale and rotate to correct. This prevents the arm from bending, if the fingers are misaligned.
- 14) Move the gripper to the down position of “25” on the scale. Make certain that the receiver is in the “lock” of the holder and not applying pressure against it. Turn the receiver to the right (clockwise from the top) until it stops to lock it into place.
- 15) Raise the receiver until the sample holder lifts from the transfer arm. Watch to make certain it rises evenly. Pull the arm from the chamber and close the load lock gate valve.
- 16) Adjust the sample height to the desired position for deposition. The Evaporator is calibrated to “14” on the scale. Sputtering must be set “25” if using any of the peripheral guns. Gun #1 is the exception.
- 17) Close window shutters to avoid coating the glass.
- 18) Log into the software using your individual log in password assigned to your research group.
- 19) **For sputtering: turn off the ION gauge. It must be on during evaporation.** Continue by following the procedure for “Sputtering” or “Evaporation”.

Sputtering Guide

- 1) Follow the operation procedure to load your sample.
- 2) To create and/or modify layers and processes refer to the AJA Phase II J manual located in the three ring binder at the system.
- 3) Process Notes:
 - a. Process pressures run at a minimum of 3 mTorr.
 - b. Bias clean runs at a maximum of 50 watts
 - c. DC sputter runs at a maximum of 600 watts. Normal being 100-200 watts.
 - d. RF sputter runs at a maximum of 300 watts. Normal being 50 -100 watts.
 - e. Gas flow for Ar sputtering is normally from 50-75 sccm.
 - f. Contact NCF staff if process development support is needed.
- 4) Be aware that the RF power supply is shared between Gun#4 and Gun #6. They can individually be selected with the switch button in the software. They cannot be co-sputtered.
- 5) Load the desired process.
- 6) Verify the location of **Sputter Gun #1**. If using gun #1 it has to be rotated manually into the chamber center for deposition. If not using gun #1, rotate it to the side of the chamber to avoid contamination or conflict with other sources.
- 7) Verify the location of **Sputter Gun #6**. If using gun #6 it must be tilted to **30 Degrees**. When not using gun #6 it must be at 0 **Degrees tilt** or it will interfere with gun #1 and the crystal rate monitor for the evaporator.
- 8) Move the receiver height to the desired target to substrate distance if you have not already done so. "25" is optimized for the peripheral sputter guns.
- 9) Once the desired vacuum level has been reached, **turn off the Ion gauge** and wait a few minutes for the filament to cool.
- 10) Run the desired process.

- 11) To unload, make certain that the sample receiver in the chamber is at the “up” position. The up position is “14” on the linear scale.
- 12) Open the load lock gate valve. Insert the load arm. Align the receiver onto the transfer arm. Make certain the clips and two screw heads are to the side and screw heads align to the holes on the transfer arm.
- 13) Lower to “20” and verify alignment. Lower the receiver to position “25”. It should fit onto the load arm without bending or wobbling.
- 14) Once the sample holder rests evenly in the arm pocket, rotate the arm counterclockwise from the top until it stops and lift the receiver to “14”. It should be clear of the sample holder.
- 15) Once the sample holder is clear, remove the sample holder and the load arm.
- 16) Close the load-lock gate valve to the main chamber before venting!
- 17) **Turn on the main chamber ION gauge.**
- 18) Shut off the breaker for the load-lock.
- 19) Once the load-lock is vented, remove the cover and your sample.
- 20) Place the empty sample holder back in the load lock with the clips to the side and a notch toward the main chamber.
- 21) Pump the load-lock back down by turning the breaker back on.
- 22) Fill out the logbook data sheet for evaporation or sputtering.
- 23) Press the log out button to log off the computer software.
Do not exit the software, simply log off.
- 24) Log out of FOM.

Evaporation Guide

- 1) Follow the operation procedure to load your sample.
- 2) Move the receiver height to the desired target to substrate distance. The chamber tooling factor was set up at "14" on the z scale.
- 3) If using rotation or heating, you can log into the laptop using your research group password.
- 4) Turn on the rotation using the laptop if required. You may also control it manually using the rotation controller panel.
- 5) If needed, turn on the heat using the laptop. Note that the heat will not turn on unless the rotation is on first. The maximum temperature is 850C.
- 6) **Make certain sputter gun number#1 is rotated to the right side of the chamber. If it is in the center the e-gun shutter will crash into it and your deposition will coat the bottom of the sputter gun or evaporate the shutter!**
- 7) **Make certain Gun #6 is at 0 degrees tilt or the rate monitor will be blocked and the gun will interfere with the motion of Gun#1.**
- 8) Make certain the Ion gauge is on and the vacuum level is below $1e-7$ Torr. Normally it will be in the -8 Torr range.
- 9) Select the correct data set in the genius controller. Information on using the genius controller is located in the three ring binder.
- 10) Use the joysticks to entire manual, select the material data set and return it to automatic.
- 11) Using the Inficon controller, select the desired process, layer configuration and material film. Verify the process and film parameters for your desired material and given deposition.

Verify rate, thickness, and all other process parameters in the event that something was changed since your previous run.

- 12) For new and/or unique recipes that require changes to parameters other than rate and thickness, contact NCF staff well in advance of your run. We will create one for you.
- 13) Press the "Start layer" button on the Inficon controller.
- 14) Press "Start layer" button again on the Inficon controller.
- 15) The software will prompt you for the pocket position. Make sure the e-gun is in the correct pocket. If it is not, release the locking knob, rotate it to the correct pocket and lock it back into place.
- 16) Press the HV button to turn on the High Voltage.
- 17) Acknowledge the e-gun is aligned to the correct pocket by pressing continue.
- 18) Open the shutter and view the beam using the mirror. Note the level of material and anything else that looks unusual.
- 19) If there is a problem press "Stop layer", "Next menu" and then press "Reset" on the Inficon deposition controller if necessary. This will abort the process. Also, remember to turn off the HV.
- 20) When the run is complete, turn off the high voltage.
- 21) Turn off the rotation and heat if applicable.
- 22) Allow sample to cool if necessary.
- 23) Verify the z-height it set to "14". Open the load-lock gate valve and insert the transfer arm.
- 24) Align and lower the receiver onto the transfer arm. Make certain the clips are to the side and the screw heads align to the holes on the transfer arm.
- 25) Lower the receiver to position "25". It should fit onto the load arm without bending it.

- 26) Once the sample holder is lowered, rotate the arm counterclockwise from the top until it stops.
- 27) Lift the receiver to "14". It should be clear of the sample holder.
- 28) Remove the sample holder and the load arm from the chamber.
- 29) Close the load-lock gate valve to the main chamber before venting!
- 30) Shut off the breaker for the load-lock.
- 31) Once the load-lock is vented remove the cover and your sample.
- 32) Place the empty sample holder back in the load lock.
- 33) Pump the load-lock back down by turning the breaker back on.
- 34) Fill out the logbook data sheet.
- 35) Log out of the computer software. Do not close it!
- 36) Log out of FOM.

Cryo Holder Procedure

- 1) Make a request at least 24 hours in advance to have staff fill the 50 liter LN2 dewar.**
- 2) Log into FOM. This allows the load lock to vent and provides the pressure for the LN2 flow.
- 3) Note the system pressure before loading. It is normally -8 Torr or better. If it is not, document the pressure in the FOM system and seek help from the NFCF staff.
- 4) The copper cryo sample holder is stored near the machine.
- 5) Before venting the load lock verify the manual valve between the main chamber and the load-lock is closed. If it is open, the chamber vacuum and cryo pump will be impacted!**
- 6) Vent the load-lock system by placing the Mechanical Pump breaker switch in the off position. The venting process will take approximately 3 minutes.
- 7) Do not leave the system venting/vented. It must be pumping unless you are loading samples. Leaving the system venting drains our N2 supply.
- 8) Remove the load-lock lid. Set the lid on the feet provided. Do not set the lid down on the sealing surface or it may become scratched and leak.
- 9) Remove the sample holder and transfer the clips to the copper holder. Mount your sample.
- 10) Place the sample holder into the load-lock with a gripper opening toward the chamber.
- 11) Place the load lock cover on the load-lock and turn on the load-lock breaker to start the pump down procedure.

- 12) Once the load lock pressure has reached a minimum of $9\text{e-}6$ Torr, open the valve between the load-lock and the process chamber.
- 13) Make certain that the sample receiver in the chamber is at the “up” position. The up position is “14” on the linear scale. Insert the transfer rod into the chamber.
- 14) While looking into the chamber, lower the sample receiver onto the sample holder. Make sure the three- point connector aligns with the pattern on the holder. This will depend on how you loaded it. The holder will flex downward if the alignment is not correct. Verify the alignment at 20 on the scale and rotate to correct. This prevents the arm from bending, if the fingers are misaligned.
- 15) Move the gripper to the down position of “25” on the scale. Make certain that the receiver is in the “lock” of the holder and not applying pressure against it. Turn the receiver 30 degrees to the left (clockwise from the top) to lock it into place. Verify that it turns without the holder moving at first. Once it locks, the entire holder will rotate.
- 16) Raise the receiver until the sample holder lifts from the transfer arm. Watch to make certain it rises evenly, pull the arm from the chamber and close the load lock gate valve.
- 17) With the z-height at “14”, cut the tie wrap holding the cryo holder and rotate it to the chamber center.
- 18) Lower the holder down carefully onto the cryo arm while centering it.
- 19) Once it is resting onto the arm, turn rotate the gripper counterclockwise to release it and raise the z-height back to “14”.
- 20) Secure the cryo arm in the center with a tie wrap.
- 21) Open the LN₂ liquid valve on the dewar to start flowing the LN₂.
- 22) The supply N₂ should be opened to help increase the flow and cooling.

- 23) Maximum cooling temperature will occur at around 90 minutes.
- 24) Close window shutters to avoid coating the glass.
- 25) Perform your desired evaporation process. The LN2 holder can only be used for evaporation.**
- 26) Shut off the LN2.
- 27) Do not move the cooling arm while it is cold!**
- 28) Do not try to transfer the sample while it is cold or the heater glass cover will shatter!**
- 29) Allow the sample holder to warm up for at least 8 hours after cooling is shut off!**
- 30) Transfer the holder back to the gripper.
- 31) Move the cryo arm back to the chamber side and secure it with a tie wrap.
- 32) Transfer the cryo holder back to the load lock arm.
- 33) Remember the z-height adjustment is different for the cryo holder and it does not lock into place. BE CAREFULL during transfer!**
- 34) Log out of FOM.