Introduction

The Arradiance ALD XT-P is full-featured ALD system capable of depositing a wide range of materials conformally over flat and patterned substrates and micro-particles (powders). Both metals and dielectrics can be deposited and multi-material coatings can be produced as well.

Features and Specifications

1) 300 Watt plasma head for remote Plasma-Enhanced ALD (PEALD)
2) Substrate heating to 500°C for thermal ALD
3) Pulsed Vapor Push for low vapor pressure precursors
4) Rotating cartridges for uniform coating of micro/nano particles
5) Platen suitable for up to 8” substrates
6) O₂, N₂, NH₃, H₂ and Ar gases for both thermal and plasma ALD
7) Integrated gas safety interlock to prevent dangerous reactions

Precautions

1) System temperature must be below 80°C before opening chamber. Do not defeat interlock!
2) Do not alter any recipe other than the number of cycles
3) Do not change any system parameters or attempt to overcome any interlocks
4) Only staff may change or load precursors
Operating Procedure

Before beginning, you will need to determine what materials you would like to deposit. You can check on FOM to see if the correct precursor is loaded for your process. If it is not, contact NUFAB staff and they will advise you as to when the system can be prepared for your process.

When using powder samples, drums should be taken back to your lab for loading and unloading of particles – do not fill particles inside of NUFAB. Loading of particles is not compatible with cleanroom protocols. Never touch the drums with bare hands, use nitrile or latex gloves for handling and filling with particles. Always transport in and out of cleanroom in sealed plastic bags. Please contact staff to learn proper loading procedure.

1) Log onto the ALD system in FOM.
2) Vent the chamber and gently open its door
   a. The ‘vent’ button can be found on the main screen and is highlighted in figure 5
   b. If the knob securing the chamber door is in place, you will need to release it and move it to the side
   c. If loading a substrate, place it onto platen with deposition side facing upwards
   d. If loading powder sample, insert drum through the chamber door (see Figure 2)
   e. It is possible to deposit on both powders and wafers simultaneously – this may be valuable for measuring the deposited film on a ‘witness sample,’ as that may be simpler than measuring the deposition on the actual particles

Figure 2: Chamber door open – chuck for loading flat substrates and slot for inserting particle drum
3) Close door and secure with rotating knob
4) Pump chamber to base pressure – you will hear a series of clicks when pumping begins
   a. The pump button can be found on the main screen, next to the vent button, and is highlighted in figure 5
   b. If depositing on powder samples, be sure to press the drum motor button, located on the right side of the motor, before deposition

Figure 3: Chamber door closed – orange handle is for opening chamber

5) If ozone is to be used, follow steps in ‘Ozone Operating Procedure’ before moving on to next step
6) In recipe window, select ‘load’ and choose appropriate recipe.
7) In loaded recipe, find the number of cycles and select how many cycles to deposit
   a. DO NOT change any recipe parameters other than number of cycles
   b. NOTE: Some processes have multiple locations where you can enter number of cycles – the correct place will always be the last entry and will have a value of 50+. If you are not sure where to enter this value, ask staff – DO NOT GUESS
   c. Each cycle will produce one monolayer of deposited material.
8) Click on ‘Run Once’ to begin deposition
   a. A window will open to prompt for data log file name – enter the name of the log file you would like to create for the process or select ‘cancel’ if you would not like to create a log file (not recommended).
9) Once process has begun, a time will display on the recipe screen indicating time until completion
10) Once process has completed, stop the powder rotation if applicable, then release the knob holding the chamber door closed.

11) From the main program window, select ‘vent.’
   a. Note: The software will not begin the venting procedure until the chamber has reached the safe opening temperature of 80°C. For high temperature processes, this may take some time.
12) Remove samples and/or powder canister from the chamber
13) Close the door and tighten the knob securing the chamber door
14) Select ‘pump’ for the main window
15) Log out of FOM

**Ozone Generator Operating Procedure**

The Arradiance GEMStar XT-P system is equipped with three oxygen sources – purified water (which is cracked in situ to provide an oxygen source), molecular oxygen and ozone. Due to its high reactivity, ozone is preferred for some processes. When using an ozone process, follow these guidelines for starting the generator before the ALD deposition process and stopping the generator once deposition has been completed.

**Starting the Ozone Generator – Before process is started**

1) Turn on red power button (highlighted in green on figure below)  
   a. The ozone generator will make a high pitch whine – this is normal
2) Slowly rotate the oxygen knob (indicated in blue) clockwise 2-3 turns  
   a. The gauge may not indicate flow. This occurs when the line is already pressurized, resulting in no flow through the gauge. Once the ozone valve is opened during deposition, flow will be observable in pulses from this gauge
3) SLOWLY rotate the ozone output knob (highlighted in red) to its maximum value
4) Ensure that the ozone output pressure gauge (indicated in blue) shows about 10 PSI

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![Figure 6: Ozone generator with user inputs marked](image-url)
Stopping the Ozone Generator – After process is completed

1) SLOWLY rotate the ozone output knob (indicated in red) to zero
2) Slowly rotate the oxygen knob (indicated in blue) counterclockwise until the oxygen is off (you will feel resistance)
3) Turn off the red power button (indicated in green)