

Atomic Layer Deposition (ALD) Savannah S-100 operating instructions



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Training procedure

Users have to contact Dr. Alan Seabaugh for approval of using this ALD. Include the desired material, running temp, detailed substrate information in the email. Once get approved, contact Fei Cheng at fcheng2@nd.edu for scheduling the training. For problems, clarifications of procedures, or general information pertaining to this machine, please contact lab staff at staff-ndnf-list@nd.edu

System Cleanliness

Only clean semiconductor wafers or wafers with exposed **Al** or **Pt** metal pads are allowed inside the chamber at all deposition temperatures. Deposition on **Au** is allowed up to 200 °C. Absolutely NO photoresists, tape, other metals, or plastics etc! If you are not sure whether your desired process is allowed or not, get approval!!

All users wanting to reserve the machine for longer than 8 hour periods and/or more than 4 days a week are required to apply for user to fcheng2@nd.edu or other staff include how long of reservations and how often you are planning to use the machine.

Standby Conditions

1. Check the heater temperatures are set at the following values (White indicator is the Set Point and Red is the Actual reading):
 - #6 (Bellow) at 150°C.
 - #7 (Tee) at 150°C.
 - #8 (Reactor outer) at deposition temperature (>80°C).
 - #9 (Reactor Center) at deposition temperature (>80°C).
 - #10 (ALD Valve) at 150°C.
 - #11 (TDMA_Hf) at 75 °C.
 - #12 & 13 at 0.
2. Check Chamber Pressure < 0.3 Torr.
3. Check N₂ flow rate is set to 20 sccm.
4. Manual valves for ALL precursors are closed (horizontal position or full clockwise direction). There is no manual valve for the H₂O line or the Ozone line.

5. Ozone Generator will be off at all times when not in use by the recipes. This generator is controlled thru the software and the recipe “**set standby conditions**” recipe can be used to turn off the ozone generator.

Start procedure (Running a deposition)

1. **Check your samples: clean? Yes. Any metal? Al or Pt OK. Any PR? NO!**
2. Log into iLab and enable the machine.
3. Verify Standby conditions.
4. Set the chamber temperature as needed, preset temperature recipes can be loaded and ran as needed (chamber default at 200 degree).
5. Prepare samples and have them ready when you open the chamber lid. It is highly recommended to co-load a clean Si piece to check the film thickness by Ellipsometry.
6. Press “Vent” button to vent the chamber.
7. Load sample(s) when chamber reaches atmosphere and then close the lid.
Minimize the time that the chamber is open to air!
8. Press “Pump” button on the control computer to pump down the reactor.
9. **(Recommended)** Deposition using standard recipes.
 - a. Right click choose inside of table and select “load recipe”
 - b. Open directory: C:/My Documents/Users/Standard/ and choose one of the standard recipes:

File name: Al2O3_200_10nm

Al₂O₃ 200 °C (90 cycles for 10 nm growth rate: 0.11 nm/cycle)

File name: Al2O3_300_10nm

Al₂O₃ 300°C (85 cycles for 10 nm growth rate: 0.117 nm/cycle)

#9: 300 °C #8: 270 °C

File name: HfO2_300_10nm

HfO₂ 300°C (136 cycles for 10 nm growth rate: 0.074 nm/cycle)

#9: 300 °C #8: 270 °C

File name: AL2O3_HfO2_300_3nm

Al₂O₃/ HfO₂ 300°C (26 cycles for 3 nm / 40 cycles for 3 nm)

#9: 300 °C #8: 270 °C

File name: HfO2_AL2O3_300_3nm

HfO₂/Al₂O₃ 300 °C (40 cycles for 3 nm / 26 cycles for 3 nm)

#9: 300 °C #8: 270 °C

- c. If you want to deposit films with a different thickness then calculate the cycles and change the number of cycles in the “go to” row.

10. Select "Start" when ready to start your recipe.
11. Open required precursor during the 2 minutes warm up.
12. Wait for the recipe to finish.
13. Turn off any precursor that is turned on.
14. Once finished select "Vent" to vent the chamber.
15. Remove your samples
16. Press "Pump" to pump down the chamber.
17. Run "**Set Standby Conditions**" to return the system to standby conditions.
18. Disable the machine in iLab and leave in the note what material / thickness has been done.

Valve Numbering

Valve 0 : TDMA_HF

Valve 1 : TMA

Valve 2 : Currently unused (liquid HfD-CO₄, HfMe(CpMe)₂(OMe))

Valve 3 : Currently unused (Empty)

Valve 4 : Ozone

Valve 5 : Water

Line AC 1 : Ozone Generator Power (Value "1" for On, Value "0" for Off.)