Atomic Layer Deposition (ALD)
Savannah S-100
User Manual

University of Notre Dame

Department of Electrical Engineering

This page intentionally left blank.

Training procedure

Contact Mark Richmond at mrichmon@nd.edu for instructions on how to get trained.

Contacts

For problems, clarifications of procedures, or general information pertaining to this machine, please contact one of the following personnel.

Mark Richmond	**631-6478**	**Richmond.7@nd.edu**
Dave Heemstra	**631-6733**	**dheemstra@nd.edu**
Mike Thomas	**631-7493**	**Thomas.20@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 photoresist, 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 mrichmon@nd.edu and include how long of reservations and how often you are planning to user the machine. If Mark is unavailable then contact dheemstra@nd.edu or mthomas@nd.edu for approval. Once approval is received, send email to oxfordald-pcs@anemone.nano.nd.edu with the information of your use and your contact information.

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 N_2 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 H_2O 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 Coral 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.
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
      Al_2O_3 200 ^oC (90 cycles for 10 nm growth rate: 0.11 nm/cycle)

      File name: Al2O3_300_10nm
      Al_2O_3 300^oC (85 cycles for 10 nm growth rate: 0.117 nm/cycle)
      #9: 300 ^oC #8: 270 ^oC

      File name: HfO2_300_10nm
      HfO_2 300^oC (136 cycles for 10 nm growth rate: 0.074 nm/cycle)
      #9: 300 ^oC #8: 270 ^oC

      File name: AL2O3_HfO2_300_3nm
      Al_2O_3/ HfO_2 300^oC (26 cycles for 3 nm / 40 cycles for 3 nm)
      #9: 300 ^oC #8: 270 ^oC

      File name: HfO2_AL2O3_ 300_3nm
      HfO_2 /Al_2O_3 300 ^oC (40 cycles for 3 nm / 26 cycles for 3 nm)
      #9: 300 ^oC #8: 270 ^oC

   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 3 minute 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 chamer.
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 Coral and complete the Run Data Collector.

Valve Numbering

Valve 0 : TDMA_HF
Valve 1 : TMA
Valve 2 : Currently unused
Valve 3 : Currently unused
Valve 4 : Ozone
Valve 5 : Water
Line AC 1 : Ozone Generator Power (Value “1” for On, Value “0” for Off.)