UNIVERSITY OF NOTRE DAME

DEPARTMENT OF ELECTRICAL ENGINEERING

Atomic Layer Deposition (ALD)
Lesker ALD – 150LX
User Instructions

General Information

For problems, clarifications of procedures, or general information pertaining to this machine, please contact staff at staff-ndnf-list@nd.edu

Currently available precursors in this machine can be used for the depositions of only dielectric films which include Al_2O_3, SiN_x, SiO_2, HfO_2, TiO2, and ZrO2.

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.

Only Clean wafers are allowed in the chamber. Pieces should be placed on the 6"plate. Deposition on Au is not allowed. If you are not sure whether your desired process is allowed or not, get approval!!

NO Plastics
NO Tape
NO Photoresist
NO Thermal Grease
NO Metals without explicit approval
No TiCl4 use with water precursor

⚠ CAUTION

All the recipes in this machine are standard recipes and users are not allowed to edit the current recipes since the system will give you the option to key in the cycle counts, dose/purge time, equilibration time and RF power before every run. If you have any special requirements to make a new recipe please contact staff for assistance.

Operating Procedure:

1. Enable Lesker ALD in iLab
2. Login to the KJLC software with user id: Admin, Password : Admin
3. Check the following standby conditions to make sure the tool is in idle state:
   a) Status indicator is on Normal operation (green light)
   b) Gas flow reading for all three MFC are zero.
   c) PC rough valve closed
   d) LL iso valve opened
   e) LL Turbo pump is pumping the LL and the chamber, LL pressure at ~5e-7 and chamber pressure at ~0.002 (All three pump should be green)
   f) Sample holder in the LL
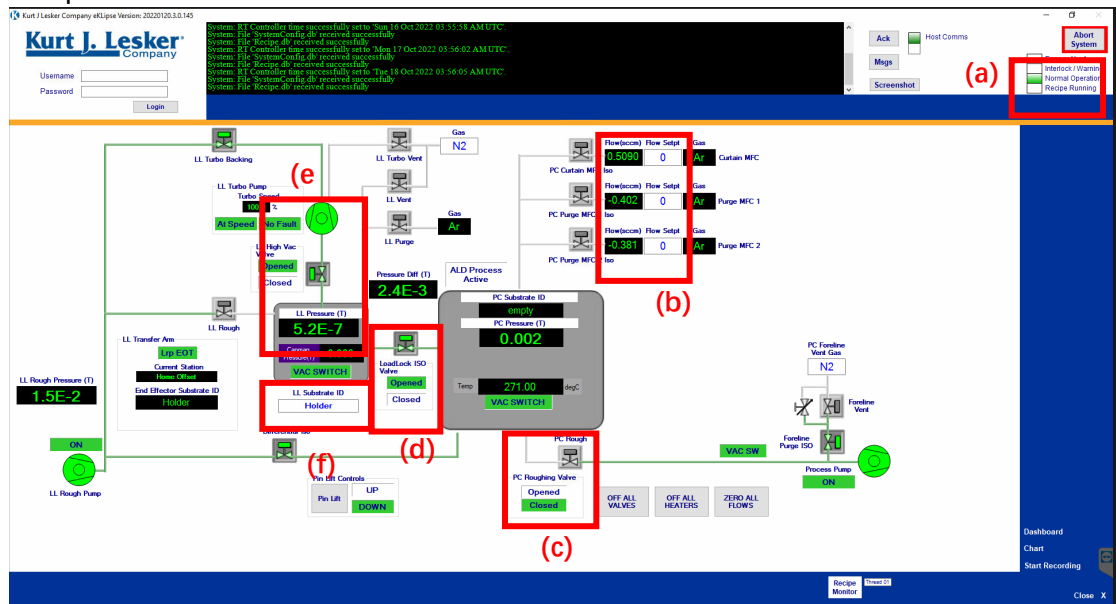
4. Run "**short term layup recovery**"
5. Check the chamber temperature and source temperature
   a) If chamber temperature is not the desire temperature, run the corresponding recipe to heat up or cool down the chamber. You can refer to the excel file **ALD-150LX - Si Substrate vs Heater** in the desktop to calculate your desired chamber temperature.
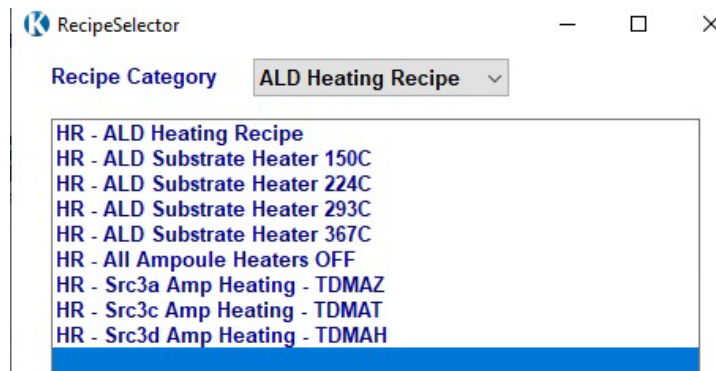
b) Source temperature: TDMAH: 85°C, TDMAZ: 75°C, TMA: RT, TiCl4: RT

6. Open the manual valve on the corresponding source, (and water source if running thermal ALD)
7. At this point it is recommended to season the chamber with the material that you are about to grow for 50 cycle counts(Refer to step 14 to run a process)
8. Run "**LL Vent**" to vent the loadlock
9. Open the loadlock and place the sample on the sample holder. If user want to use the in-situ ellipsometer to monitor the growth, place a piece (>10x10mm) of bare Si coupon (with native oxide, degreased with acetone/IPA) on the center of the holder
10. Enter "Substrate ID" on the vacuum screen below the LL chamber.
11. Run "**LL Pump**" to pump down the LL. The system will ask you to confirm if the LL door is closed. Press "skip" if the door is already closed. The system will ask you again to enter the "substrate id". Press "skip" to confirm and it will proceed to pump down LL
12. Run "**Sample Load**" to load the sample into the chamber
13. On the Google Chrome browser, open the film sense UI page (URL: http://169.254.1.1/) or http://fs.local
    a) Use Dynamic Measurements
    b) Choose the right model based on the material you are growing
    c) On the graph option, plot the thickness and the fit_diff (fit_diff should be less than 0.02 to get a reliable thickness reading)
    d) Press "Start Acq"
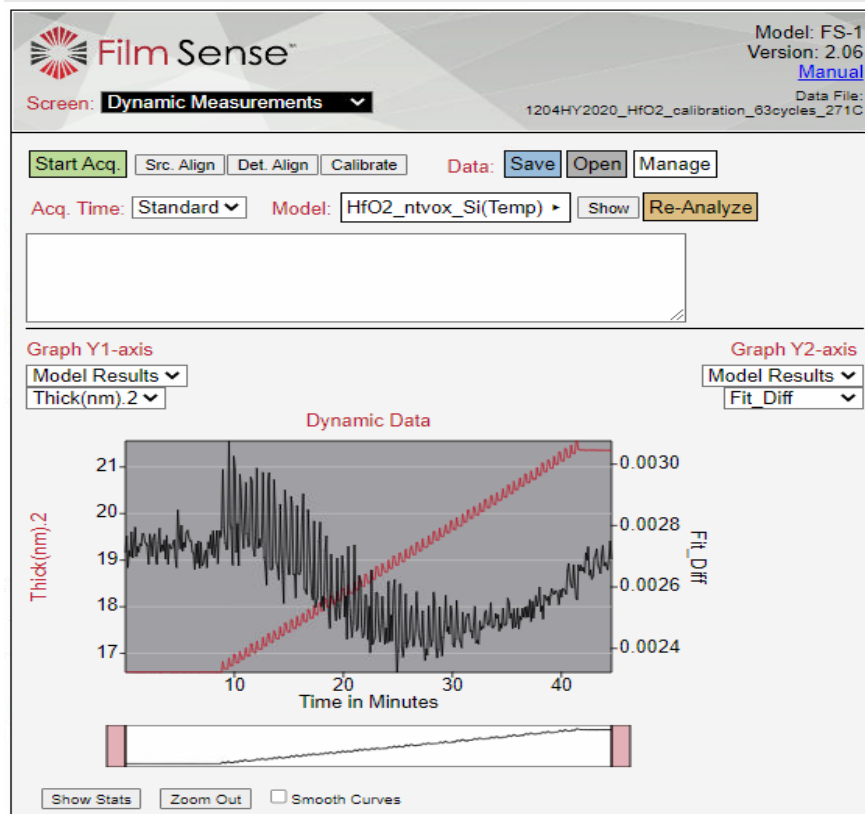
14. Run the desired ALD recipe
    a) On the pop-up window, key in the cycle counts and the equilibration time (at least 600s for chamber temp 271, 1200s recommended)

    Example: Thermal HfO2 recipe

Recipe Name	Step	Equipment Type	Equipment Name	Equipment Operation	Notes	Minimum	Maximum	Value
Parameter Setup- ALD HfO2 (TDMAH ...	6	System	ALD ChA Step 1 Time	Set Value = n.nn	Reactant A - Dose Time (...			200
Parameter Setup- ALD HfO2 (TDMAH ...	8	System	ALD ChA Step 2 Time	Set Value = n.nn	Reactant A - Purge Time (...			10000
Parameter Setup- ALD HfO2 (TDMAH ...	11	System	ALD ChB Step 1 Time	Set Value = n.nn	Reactant B - Dose Time (...			50
Parameter Setup- ALD HfO2 (TDMAH ...	13	System	ALD ChB Step 2 Time	Set Value = n.nn	Reactant B - Purge Time (...			20000
Parameter Setup- ALD HfO2 (TDMAH ...	14	Counter	ALD Cycle Setpoint	Set Value = n.nn	Total Number of ALD Cycl...			200
PR- ALD HfO2 (TDMAH + H2O)	12	Recipe	Dwell	N Seconds	Equilibration Time (Sec)			600

15. You can monitor the progress of the process in the Deposition screen chart
16. Repeat step 14 as many times as you wish until you get the desired film stack, no need to change Si coupon in between, for the second growth and so on, equilibration time can be reduced to 60 seconds
17. Run "**sample unload**" recipe to unload the sample to the LL
18. Run "**LL Vent**" to vent the LL and then remove the sample
19. Close the LL door and run "**Pump to Standby(LL Pump + Short Term Layup)**" to pump down LL and place the tool in idle state(This is very important and failing which lets the Argon gas flows through the chamber all the time)
20. Run the recipe **HR-All Ampoule Heaters OFF**
21. Close all the manual valves of the sources
22. Run the recipe **HR – ALD Substrate Heater 150C** to return back the process chamber temperature to 150°C
23. Verify the standby conditions as per step 3
24. Logout the software and lock the windows screen
25. Disable equipment in the iLab.

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