

Tool Identifier	LPCVD Silicon nitride
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Documented by	Suresh



People List

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THINGS MUST FOLLOW:

- **NEVER** touch boats or wafers with your hands even if you are wearing gloves. Use **ONLY** the appropriate boat holder. Boat Holder must be clean also.
- Use **ONLY** clean tweezers or vacuum wand dedicated for that tube. Clean these implements often using alcohol, DI water and clean wipes.
- **ALWAYS** clean wafers using either piranha or RCA type clean right before loading them into the tube. Wafers must be clean and dry. Use spin rinse dryer whenever possible. Never load a contaminated wafer or boat into the tube as this will contaminate the tube as well.
 - Wafers and boats coming out of the tube are extremely hot. Do **NOT** set them on clean wipes, vinyl gloves or anything else which will melt. Set hot items on clean stainless steel bench or on dedicated quartz carrier.
- **ALWAYS** wear a face mask when loading and unloading your wafers into tube to minimize contamination from your breath.
- **ALWAYS** minimize the time that the boat and loader remains out of the furnace and makes sure the purge nitrogen is set to 5.0 liters or better to keep room air out of the tube.
- **ALWAYS** store dummy wafers in the tube which they are assigned. Dummy wafers not needed for a run, may be safely stored at the load station in a clean quartz carrier. Promptly return dummies back to the appropriate tube when your run is finished.

Specifications

- **Substrate:** Si only.
- **Substrate size:** 4" only.
- **Types of depositions:** Silicon nitride only
- **Pressure range** : 50 mTorr – 1 Torr (depends on the quantity of gas inside the chamber)
- **Temperature range:** 650oC- 900oC
- **Gases presently connected to system:** SiH₄,NH₃, N₂
- **Mass Flow Controller (MFC) Limit/Range :**
SiH₄ : 100 sccm, **NH₃:** 500 sccm, **N₂:** 1000 sccm

Operating Procedure

Things needed before entering the clean room

1. Switch On the mains.
2. Ensure that the heater switches in ON position.
3. Open the TWO cooling water valves. One for Process tube cooling and the other for Pump.
4. Check for the GN₂ pressure (from N₂ plant). Minimum 5 bar pressure is required for smooth operation.
5. Check for the PN₂ (5N purity) pressure (from cylinder). Minimum 4 bar pressure is required for smooth operation.
6. Check for the SiH₄ and NH₃ gases. Ask PRADEEP or SANDEEP to open these specialty gas valves. Minimum 2 bar pressure is required for smooth operation.
7. Ensure that the exhaust is ON. Contact PRADEEP or SANDEEP.

SWITCH ON Procedure after entering the clean room

8. Check the Log book for any remarks from the previous run. Contact system owner if any remarks have been written.
9. Press the GREEN push button switch located right to the touch screen.(If any alarm comes, the alarm page automatically displayed without login)
10. Click on LOGIN and enter the password by using the on-screen key board.
11. Press ENTER. The following screen is displayed.
12. Click on “Silicon nitride” button on the top tool bar. The OVERVIEW page is displayed.
13. Do not change the settings in the CONFIGURATION page. Contact system owner if it is required.

Editing the RECIPE

14. Go to RECIPE page by pressing the “RECIPE” button located on the bottom tool bar.
15. Press OPEN located at the top right corner for 2 seconds. A beep will be heard and some of the cells in the recipe page will be highlighted in green background.
16. Click on the cell to change its value. A small pop up key pad is displayed.
17. Enter the required value (within operational limits) and Press ENTER. See Appendix for the operational limits on temperature, Pressure and Gas flow ranges.
18. Some cells in the rows TEMP CONTROL and STEP MODE have only toggle button to change the settings. Press the cell once to change it into YES and vice-versa.
19. Ensure that the steps GAS EVACUATION and TUBE EVACUATION are set to ON.
20. Set the BOAT CONTROL to IN in pre-standby step.
21. After editing all the cells press the SAVE button in the RECIPE page for 2 seconds.
22. Press OPEN once again to make the current recipe as active.

Boat-Out and Loading the wafers

23. After saving the recipe press OPERATION button located on the bottom tool bar.
24. Press VENTING button to release the chamber pressure. It will take 5-8 minutes to reach atmospheric pressure. Inform system owner if you observe the venting time is too long.
25. Now press the BOAT-OUT button. It will take 2-3 minutes for complete boat out.
26. Load the Cleaned wafers in the required slots. Handle the wafers with care and do not touch the wafer boat and process tube interior with gloves.

Running the Recipe

27. Ensure that the recipe is saved after editing.
28. Press OVERVIEW button located at the bottom left corner.
29. Now press RUN on the top left located below the top tool bar and the RUN button starts blinking indicated that the process is started.
30. During process if any alarm comes refer Alarms page for corresponding action.

SHUTting DOWN the system

1. Do not switch off the mains power directly from outside in any case (Power failure is exceptional).
2. Wait for the temperature of the three zones to ramp down up to 300oC.
3. Press SHUT DOWN located on the top right corner. A small pop up window with RUN and CLOSE buttons is displayed.
4. Press RUN (in the pop up window). The Shut down in the pop up window starts blinking.
5. After 3-5 minutes, the R/V valve will be closed then the pump will be off automatically.
6. Do not press the RED push button located to right of the touch screen. This will stop the cooling water supply to the process tube.

Check List before Leaving the System

1. Make entry in the log book.
2. Ensure that the specialty gas valves are closed. Let PN2 gas be flowing during ramp down.
3. Ensure that the cooling water is available to the system.

Alarms

1. Tube 3 No water flow detected.
Indication: ORANGE indicator flashes.
Reason: cooling water pressure is not sufficient.
Action: Increase the water pressure.
2. Tube 3 No Air flow detected
Indication: ORANGE indicator flashes.
Reason: GN2 pressure from N2 plant is less than 4 bar.
Action: Increase the GN2 pressure
3. Tube 3 No Gas flow is detected
Indication: ORANGE indicator flashes.
Reason: Either SiH4 or NH3 pressure is low.
Action: Increase the pressure.
4. Tube 3 process has escaped the limit of process pressure
Indication: ORANGE indicator flashes.
Reason: Improper set values of the process pressure and gas flow.
Action: set the gas flow and process pressure according to Appendix B.
5. Tube 3 process has escaped the limit of heater temperature.
Indicator: ORANGE indicator flashes.
Reason: Operating the outside the allowed temperature range.
Action: Set the temperature values within the allowed range.

These are the generally observed alarms during process run. If you observe any alarm other than those described above please contact the system owner.

Action to be taken after Alarm

Alarms 1, 2 and 3 : The process automatically resumes once the required action is taken.
Alarms 4 and 5: Reset the alarm in the alarm page. Then go to OVERVIEW page and press RUN to resume the process.

Appendix A

Allowed Temperature ranges

1. Minimum Temperature: 650oC
2. Max. Temperature: 900oC
3. Min. ramp rate: 5oC/ min
4. Max. ramp rate: 20oC/min

Note: Do not change the temperature values in the CONFIGURATION page.

Appendix B

Allowed pressure and gas flow ranges

Gas flow (sccm)	Throttle valve position	
	80%	10%
50	39 mTorr	3.62 Torr
100	57 mTorr	≤ 5 Torr
150	72 mTorr	≤ 5 Torr
200	85 mTorr	≤ 5 Torr
250	97 mTorr	≤ 5 Torr
300	107 mTorr	≤ 5 Torr
350	117 mTorr	≤ 5 Torr
400	128 mTorr	≤ 5 Torr
450	136 mTorr	≤ 5 Torr
500	146 mTorr	≤ 5 Torr

- a) Gas flow column in the tables is the total gas inside the process tube.

Standard recipes:

- 1) SiH₄: 40 sccm, NH₃: 50 sccm and N₂: 400 sccm
Temperature: 780°C, Pressure: 300mT, Time: 20min
This recipe gives a silicon nitride film with thickness about 17-19 nm.
This recipe used for monitoring the process.

For any other recipes, please contact the system owner.