

tube6D-nitride

STANDARD OPERATING PROCEDURE

This equipment donated by Intel

CORAL
Name: *tube6D-nitride*

Model: Thermco LPCVD silicon nitride reactor

Number:

Location: ICL

What it does: Low-pressure chemical vapor deposition reactor.

Introduction: THERMCO “tube6D-nitride” Furnace is a Low Pressure Chemical Vapor Deposition (LPCVD) Reactor, designated to deposit Silicon Nitride (Si₃N₄) thin films on Silicon wafers up to 6 inch in diameter.

The Silicon Nitride film is deposited by the reaction between DichlorSilane (SiCl₂H₂) and Ammonia (NH₃) at temperatures in the range of 750 C – 800C.

The process runs in the “Reaction Rate Limited Regime”; i.e. operating at low pressure the mean free path of the reactant gases is high and assures an uniform gas supply, so the mass transfer to the Silicon substrate does not limit the deposition rate. In this regime the deposition thickness is a linear function of time.

The gases are injected into the reactor at the Load zone, and the vacuum port is located at Source zone end.

The temperature profile is tilted, with a higher value at the Source end to compensate the gases depletion due to the vacuum pump action. The system low pressure is maintained by vacuum pump speed control at constant gas flow. The Silicon Nitride deposition process parameters are:

- Temperature : 775 °C
- Pressure: 200 mTorr
- SiCl₂H₂ flow: 50 sccm
- NH₃ flow: 150 sccm
- deposition rate is constant: 23 Å/ min
- Thickness uniformity across the wafer : < 1 % @ 1,500Å
- Refractive index: n = 2.0

The THERMCO furnace is controlled by the TMX tube computer; while the SEMY supervisor system is used to monitor the system and to edit and store the process recipes.

The THERMCO “tube6D-nitride” horizontal reactor is for CMOS process only.

Safety: SiCl₂H₂ and NH₃ are toxic gases; their Material Data Safety Sheet (MSDS) is in the yellow binder.

The system has hardware and software safety interlocks, to prevent any SiCl₂H₂ and NH₃-related hazard

High temperature: many furnace parts can be hot. Use caution when handling them.

- Procedure:
1. Do “Engage Machine” command in CORAL for ICL “tube6D-nitride” machine, before you start. The wafers should have been RCA cleaned less than 4 hours before and your process must be approved by the PTC.
 2. Pull the tube boat out as follows:
 - On the SEMY terminal double click on “RUN” ; the “Minispec Loader” pops up on the screen.
 - From the OPTION/ TUBE menu choose “6D”
 - Click on File/Open menu , select the “NITRIDE BOUT OUT” minispec and click OK
 - On Minispec Loader window click “Compile & Send”; Compile Status window will be show up.

Wait until the OK button is active, then click on it: the recipe was successfully sent to the TMX tube computer

Note: The tube should be in “Standby” mode to accept a new recipe; if it is in “Complete” status, push the “STOP” button on the tube TMX display to bring the system in ” Standby “ mode. If the tube is in the HOLD mode the push START & STOP buttons in that sequence, to bring it in Standby mode.

- On the tube TMX display push the “START” button; the system will go in Processing mode, and the boat will come out in 30 minutes.

3. Pull the central quartz boat from the tube paddle Using the pick up tool, place it on the designated Si₃N₄ transfer quartz plate, unload the dummy wafers and place your wafers and the monitors with the flat up, in the quartz boat. Place the quartz boat back in the central position on the tube paddle, with the wafers front side facing the Source Zone end.

4. Start the processing recipe, by following these steps:

- On the SEMY terminal double click on “RUN” icon; the “Minispec Loader” pops up on the screen.

- From the OPTION/ TUBE menu choose “6D”

- Click on File/Open menu , select the “775DEP” minispec and click OK

- On Minispec Loader window click “Compile & Send; the Compile Status window and the Variable Delay Entry window will show up. On the Variable Delay Entry window input the deposition time and push “ENTER”, input the deposition time again to confirm and wait until the OK button on the Compiler Status window is active, then click on it: the recipe was successfully sent to TMX tube computer.

Note: The tube should be in “Standby” mode to accept a new recipe; if it is in “Complete” status, push the “STOP” button on the tube TMX display to bring the system in ” Standby “ mode.

- On the TMX tube display push “START” button, the system will go in “Processing” mode.

5. When the process is finished, take the quartz boat from the tube paddle, Using the pick up tool and place it on the designated transfer quartz plate. Remove your process wafers and monitor wafers from the quartz boat and replace them back with the original dummy wafers. Place the quartz boat back on the tube paddle and put the boat in by following these steps:

- On the SEMY terminal double click on “RUN” icon; the “Minispec Loader” pops up on the screen.

- From the OPTION/ TUBE menu choose “6D”

- Click on File/Open menu , select the “NITRIDE BOAT IN” minispec and click OK

- On Minispec Loader window click “Compile & Send”: the Compile Status window shows up.

Wait until the OK button is active, then click on it: the recipe was successfully sent to the TMX tube Computer.

Note: The tube should be in “Standby” mode to accept a new recipe; if it is in “Complete” status, push the “STOP” button on the tube TMX display to bring the system in ” Standby “ mode.

- On the tube TMX display push the “START” button; the system will go in Processing mode, and the boat will start going in.

“Disengage” machine in CORAL, after you input the test data from the monitor wafers into the comments section.