

# B4 Nitride Furnace Instructions

The Nitride furnace is a LPCVD furnace capable of depositing standard stoichiometric ( $\text{Si}_3\text{N}_4$ ) silicon nitride, as well as silicon rich/low stress silicon nitride.

*The Nitride furnace is a MOS CLEAN process, samples already processed in Anneal 1, Anneal 3 or Anneal 4 cannot be processed in the Nitride Furnace.*

## Sample Constraints:

- Silicon or fused silica wafers only, no glass or other semiconductors
- Furnace grown or deposited films, PECVD films allowed
- No evaporated, sputtered or spun films
- 3, 4 and 6" whole wafers preferred, other sizes can be accommodated
- No photoresist, no polyimide.
- MOS clean required within 6 hrs of furnace run

## Process Constraints:

- **Do not change any of the recipe parameters except, loader speed and deposition times** unless you have been given permission to do so by the machine manager.
- Allowed parameters that can be changed are listed for each recipe.
- Do not create any new recipes without staff permission.
- Maximum temperature is 800 C.

The system components are controlled by a microprocessor Tymkon sequencer. There is a Window based PC that operates two software modules. A *recipe editor* (**Tymedit**) for modifying and creating recipes, and a *host computer* software (**Tymplex**) that will download files to the *Tymkon* sequencer and monitor interlock and fault conditions.

The basic sequence of steps for operating the machine is:

1. Log into the Coral for the proper furnace tube.
2. Select, Edit, and Save the desired recipe with the *TymEdit Recipe Editor* files are located in User Data folder
3. Download the edited process file to the Tymkon using the Tymplex software
4. Select the active recipe
5. Run the process to load, deposit and unload the furnace
6. Run the standby state process when you are finished
7. Log out of the CAC system.

## 1. Log into the CAC

## 2. Selecting, editing, and saving the Process files using ITS TymEdit

- 2.1 Click on the minimized blue *ITS Tymkon Recipe Editor* icon on the lower menu bar. The ITS TymEdit window should now be active in the screen. There are 4 tabs on the top of the window for this software: *Setup, Edit Process, Temperature, and Edit Configuration*.
- 2.2 Select the *Files* tab if not already selected. This will display the currently loaded file on the bottom, and allow you to OPEN a file, or SAVE the existing one.
- 2.3 Click on the **OPEN** button, now a window will appear displaying a list of process files (recipe info is listed at the end of the instructions). Select the desired file associated with the tube level you are working on and click **Open**.
- 2.4 The editor will load the file and automatically go to the Edit Process tab. The upper left will display the different recipes under that file. When selected the sequencer info will be displayed on the upper right. **Deposition time should be only parameter that needs to be changed, if you need to alter gas ratios then contact a staff person in charge of the tool.**

**Temperature set points are fixed, you there is no need to change the temp set point. Loading is performed at the deposition temperature.**

**Set the load and unload speed in the lower right of the screen, 10%=5 inches per minute.**

- 2.5 Once the changes have been made, select the *Files* tab again. The file name will be colored pink, indicating a change has been made.
- 2.6 Select the **SAVE** button, then **SAVE** again in the dialog box
- 2.7 Select **YES** when prompted to replace the existing files.

### **3. Download file to the Tymkon**

- 3.1 Using the *TymPlex* software, select the *Tool 4* tab, and in the lower left quadrant of the screen , select the *download* tab.
- 3.2 Choose the *Download file to the Tymkon* button, then select the B4 Nitride file that you previously edited in the new window that opened (Note: this can only be done in the idle state with no other recipes running, you will need to have reset the standby process in order to download a new file).
- 3.3 After the download is complete, the currently loaded file will go from being displayed in red to black.

### **4. Select the Active Recipe**

- 4.1 Once the download of the file has completed, choose the *Operate* tab in the lower left quadrant of the window.
- 4.2 Using the *select recipe* pull down menu in the lower right area of the screen, choose the recipe you want to run. The recipe should be displayed in the window below it in faded gray text.
- 4.3 Select the **SELECT RECIPE** button, the gray text should turn to black –it is now the actively loaded program.

### **5. Run the Process**

- 5.1 If the tube was in a standby state when you logged in the loader should have been closed, Thefurnace will unload the paddle and hold in that state for you to load the wafers. If the furnace is already open and you download a new recipe you can press

**HOLD** then **STEP** to advance to the **UNLOAD HOLD** step so you don't need to wait for the vent steps again.

- 5.2 Load your samples and Press Run to resume the process. The process will proceed to load, deposit and unload you samples automatically.
- 5.3 A process can be prematurely ended by pressing the **HOLD** then **STEP** buttons. If you want to extend a time, press the **HOLD** button for the desired amount of additional time then resume the normal timer with the **RUN** button.

**6. Run the Standby Recipe when you are finished to close the loader.**

- 6.1 If you are finished with the tool and nobody is waiting to load wafers after you, select and run recipe 1, Tool Standby. This will close the loader, pump down the tool, and set the temp to the idle state.

**7. Log out of the CAC system**

## Recipe 2 Standard Nitride

Parameters that can be changed:

**Cycle 3 and 6: Unload/Load speed (10%=5 in/min)**  
**Cycle 14: Deposition time**

**Leave temperature settings as is!**

Temp	775 C
Pressure	200 mTorr
SiH <sub>2</sub> Cl <sub>2</sub>	40% = 60 sccm actual flow
NH <sub>3</sub> flow	98% = 196 sccm actual flow
Index of refraction	2.0
Stress	1100 MPa Tensile
Deposition rate	30 A/min (4" wafers single spaced)

## Recipe 3 LS Nitride N=2.2

Parameters that can be changed:

**Cycle 3 and 6: Unload/Load speed (10%=5 in/min)**  
**Cycle 14: Deposition time**

**Leave temperature settings as is!**

Temp	800 C
Pressure	200 mTorr
SiH <sub>2</sub> Cl <sub>2</sub>	84% = 126 sccm actual flow
NH <sub>3</sub> flow	11% = 22 sccm actual flow
SiH <sub>2</sub> Cl <sub>2</sub> :NH <sub>3</sub> ratio	5.7
Index of refraction	2.18
Stress	200 MPa Tensile
Deposition rate	20-30 A/min (4" wafers single spaced)*

*\*Dep rate varies depending on life of furnace liner. For critical thickness find out current rate from staff or users, or run a test dep to obtain updated rate.*

## Recipe 4 HTO

Parameters that can be changed:

**Cycle 3 and 6: Unload/Load speed (10%=5 in/min)**  
**Cycle 14: Deposition time**

**Leave temperature settings as is!**

Temp	800 C
Pressure	400 mTorr
SiH <sub>2</sub> Cl <sub>2</sub>	44% = 66 sccm actual flow
N <sub>2</sub> O flow	98% =196 sccm actual flow

Deposition rate ~7.5 A/min (4" wafers single spaced)\*

## Recipe 5 HDR HTO – Higher Dep Rate HTO

Parameters that can be changed:

**Cycle 3 and 6: Unload/Load speed (10%=5 in/min)**  
**Cycle 14: Deposition time**

**Leave temperature settings as is!**

Temp	800 C
Pressure	400 mTorr
SiH <sub>2</sub> Cl <sub>2</sub>	44% = 66 sccm actual flow
N <sub>2</sub> O flow	98% =196 sccm actual flow

Deposition rate ~15 A/min (4" wafers single spaced)\*

## Recipe 6 500 mTorr NH<sub>3</sub> Anneal

Parameters that can be changed:

**Cycle 3 and 6: Unload/Load speed (10%=5 in/min)**  
**Cycle 13: Anneal time**

**Leave temperature settings as is!**

Temp	800 C
Pressure	500 mTorr
NH <sub>3</sub> flow	80% = 160 sccm actual flow