Chapter 6.53

Oxford Plasmalab 80plus PECVD System

(oxford2 - 584)

1.0 Equipment Purpose

1.1 PlasmaLab 80plus® PECVD system, made by Oxford Instruments, is a multipurpose tool capable of depositing silicon oxide, silicon nitride, amorphous silicon, and other films (under staff permission). The machine is controlled by a PC that runs the PlasmaLab 800 software. Compound III-V semiconductor materials may also be processed in this tool on a carrier wafer.

2.0 Material Controls & Compatibility

2.1 No organic material and/or photoresist-covered wafers are allowed in this tool.

3.0 Training Procedure & Applicable Documents

3.1 Exam Tool - this tool requires an online exam before qualification.

3.2 Timeline (estimated time to completion: 1 week)

3.2.1 Get trained by any qualified member.

3.2.2 Take the online test in the Nanolab office (open 8A-12P, 1P-5P).

3.2.3 Arrange a qualification session with a superuser to show competency on the tool.

3.3 CDs in NanoLab Office.

3.4 Material Safety Data Sheet for all the process gases listed in Section 8.0 in the MSDS blue binders.

4.0 Definitions & Process Terminology

4.1 **Non-MOS Tool:** Non-MOS wafers, which may contain materials not compatible with MOS processes, are allowed in this tool. Even though all the process gases used are MOS grade, the cross-contamination from non-MOS wafers may impact the electrical/parametric behavior of the fabricated IC/transistor devices. Oxford2 is a non-MOS Tool. **Please note, that non-MOS processes run in this tool cannot continue in the MOS clean furnace path. Therefore, all films deposited in this machine are non-MOS, thereafter.**

4.2 **PECVD:** Plasma Enhanced Chemical Vapor Deposition. This kind of process uses RF-generated plasma to assist the deposition reaction to take place at a temperature lower than required by a similar LPCVD process.

5.0 Safety

5.1 Follow general safety guidelines for the lab; the safety rules outlined in Chapter 1.01 - Marvell NanoLab Chemical Hygiene Plan and the following:

5.2 **Burn Hazard:** The wafer is heated up to over 350°C. Extreme care must be taken when loading and unloading samples.

5.3 **RF, UV/Visible Radiation:** Do not look into the plasma for a long period of time. Do not touch RF cables and all other electrical wires.

5.4 **Chemical Hazard:** If a process gas leak is suspected or detected, press the red **Emergency Off Button** on the lower left side of the chamber. Active the **HAZMAT** alarm, then evacuate the lab.

6.0 Statistical/Process Data

6.1 Problem and comment section under the equipment section of Mercury.

6.2 Enable the message of Oxford2.

7.0 Available Processes, Gases, Process Notes

Available Processes

7.1 **Silicon Oxide PECVD:** uses N_2O and 10%SiH_4 in Ar**,** deposition rate >50 nm/min.

7.2 **Silicon Nitride PECVD:** uses NH_3 and 10%SiH_4 in Ar, deposition rate <20 nm/min.

7.3 **Amorphous Silicon PECVD:** uses 10%SiH_4 in Ar, deposition rate > 40 nm/min.

Available Gases

7.4 **N_2O:** used in the silicon oxide process as the source of oxygen.

7.5 **10%SiH_4 in Ar:** used in all processes as the source of silicon.

7.6 **NH_3:** used in the silicon nitride process as the source of nitrogen.

7.7 **Ar:** used as a dilutant to improve the uniformity of film deposition.

7.8 **CF4 (20%CF_4 with O_2:** used for process chamber cleaning.

7.9 **BCl_3:** used in the silicon carbide process as the source of boron dopant. Not connected yet.

7.10 **H_2 :** used for the special annealing process.

Process Notes

7.11 Before loading your samples into Oxford2, make sure all the non-metal and non-compound III-V wafers/samples are cleaned at msink8. This is a standard non-MOS furnace clean for Si-based processes. Samples with exposed metal film need to be cleaned at msink1 pre-furnace metal clean bath. Compound III-V materials should be cleaned at msink16 or msink18.

7.12 Samples with photo-resist or any other organic film are not allowed in the system.

7.13 When loading wafers/samples, make sure to secure your sample in place on the baseplate. Otherwise, the wafer may move during the process, and the uniformity of the film will not be optimum.

7.14 After deposition, the wafer/sample is very hot. Cool your wafer on the heat sink provided at the site. Do not put the wafer back into your wafer box before it has cooled down to room temperature.

7.15 The plasma chamber needs regular cleaning to prevent film buildup and to discourage showerhead patterns. There are two clean recipes corresponding to whether you want the tool to idle at 150°C or 350°C. 02clean5.rec runs an O_2 plasma for 2 hours and then idles at 350°C. 02cln150c.rec runs an O_2 plasma for 2 hours and then idles at 150°C. Of the two,

02clean5.rec is the preferred recipe as it keeps the baseplate at a higher temperature and outgasses it more effectively. You must clean for a number of minutes equal to the amount of time you run your plasma deposition.

7.16 The chamber temperature for the PECVD process can be set between 100ºC to 400°C. It is set to be 350°C for all the standard processes.

7.17 The maximum process pressure is 1 Torr for the system.

7.18 Typical deposition rates of the standard recipes are OXIDE = 617 Å/minute (*ox350a.rec*), NITRIDE = 130 Å/minute (*nit350a.rec*) and Amorphous Si = 215 Å/minute (*asi150a.rec*).

7.19 Low-stress nitride (LSN) may be obtained with the use of low-frequency power (380 kHz) in addition to the usual high-frequency power (13.56 MHz) in the OXFORD2 PECVD tool. The addition of the low-frequency power results in increased ion bombardment and densification of the film giving compressive stress to the original tensile stress of the Nitride. Using the recipe *nitrhilo.rec* with a high-frequency pulse of 24 sec and low-frequency pulse of 6 sec gives a deposition rate of ~ 150 Å/minute with the stress of ~ 25 MPa for a 1200 Å Si_xN_y film on Si.

7.20 A PECVD oxide comparable to OXFORD PECVD4 may be obtained from OXFORD2 with the use of low-frequency power (380 kHz) in addition to the usual high-frequency power (13.56 MHz). The addition of the low-frequency power results in increased ion bombardment and purification of the film with lower incorporated H. Using the recipe *OXIDETES.REC* with a high-frequency pulse of 26 sec and low-frequency pulse of 12 sec, both at 25 watts, gives a film with an index of refraction of 1.456 and a deposition rate of 500 Å/minute.

7.21 For H_2 anneals please contact staff first. The valve for this gas must be opened to the tool first. Typical H_2 anneal parameters are, 600mT, 180 sccm of H2, and 100 - 250W of power.

7.22 It is quite common to see PECVD showerhead holes becoming enlarged. This is caused during high-power processing (on an 80 Plus this is typically during plasma cleaning). Any holes that have slightly sharper edges will form an intense discharge over the hole (due to the high fields generated by the sharper edges). This can be seen as a 'bright spot' in the plasma located over the hole during the cleaning process. This can cause some erosion of the hole and widening of the hole opening (on the outlet side only). Eventually, the bright spot burns itself out, i.e. the erosion removes the sharp edges and hence the bright spot no longer occurs at that hole. This may happen for several holes during the initial run-up of the system until the showerhead 'stabilizes' itself.

7.23 We only allow Al_2O_3/carbide slides in OXFORD2 as the constituents of microscope slide soda-lime glass are, 73%SiO_2, 14%Na_2O, 9% CaO, 4% MgO, 0.15% Al_2O_3, 0.03% K_2O, 0.02% TiO_2, 0.1% Fe_2O_3 are all either dopants or deep-level traps. Further, Na and K have high velocities for diffusion.

8.0 Equipment Operation

Log On Procedures

8.1 Enable the oxford2 on the Mercury.

8.2 Check that the system LCD panel is on and displays that the tool is controlled via the remote PC.

8.3 Double-click the ‘PC Plus” icon on the PC. Wait until the **Access** page shows up on the screen. Click the **Access** drop-down menu, and a list of User Names will show up. Select **OXFORD2** and enter the password, which is given to qualified users. Click the **Proceed** button, and the **Master Menu** panel will show up on the screen.

The **Master Menu** panel has five buttons:

8.3.1 **Manual**: Reserved for equipment staff.

8.3.2 **Display**: It gives users three screen display options.

Status Page: This page displays all the current system information, e.g. pressure, temperature, process gas flows, that are important to the user (see Section 11.1).

Vacuum Page: This page displays information on the system hardware (see Section 11.2).

Process (Recipe) Page: This page displays the detailed information of a selected recipe (see Section 11.3).

8.3.3 **Edit**: This page allows users to edit recipes.

8.3.4 **Select**: Used to select process recipes to be executed. When this button is clicked, a list of available recipes will be displayed. Double-click the recipe to select. When a recipe is selected, the text on this button changes to **Start**. Click it to start running the selected recipe. When the recipe is completed or aborted, the text on this button returns to **Select**.

8.3.5 **Quit**: Use this button to log out of the system when the process is finished/aborted and no new process is selected. When a process is running, the text on this button changes to **Abort**. Click it to stop the process manually.

Loading and Unloading Wafers/Samples

8.4 Click the **Select** button, and then double-click one of the **[Vent + Pump/Purge]** recipes. Click the **Start** button to start the process.

8.5 Click the **Display** button on the **Master Menu** and select the **Status** option. Check the substrate temperature displayed on the left bottom of the screen. If the temperature is not what the recipe dictates, wait until it reaches that temperature. It may take about an hour to heat up or cool down to the desired temperature.

Wait until the gas vac/gas pod interlock is set to **FAULT**.

Press and hold both **HOIST** buttons down at the same time. After 5 seconds of holding, turn the chamber switch on the front of the tool to **OPEN**. Keep the button pressed until the top section of the chamber begins to lift up. Continue holding both **HOIST** buttons down until the chamber completes its lift and swings backward. When it stops moving, release both **HOIST** buttons.

8.6 Check the chamber wall and susceptor. It should be clean with a thin layer of pre-coated film on top. If not, see Section 10.1 for troubleshooting.

8.7 Load/unload wafers/samples. Take the cautions listed in Sections 8.12 to 8.16.

8.8 Turn the chamber switch to **CLOSE**. Press and hold both **HOIST** buttons down at the same time. The top section of the chamber will swing forward and then it will lower over the baseplate. When the chamber is completely closed, release both **HOIST** buttons.

Running a Process Recipe

8.9 Click the **Select** button, and then double-click the process recipe to be executed. Click on the **Start** button to begin the process. Available process recipes are listed in Appendix Section 11.0.

8.10 Most of the process recipes are set up for 1, 2, 3, 4, and 5 μm film thicknesses. If a more precise film thickness is needed, use the **Abort** button to terminate the deposition step at the target time.

8.11 While running your recipe, due to RF network problems, the top bar on the status page will read **RF Failure**. Make sure to press the **OK** button next to it to successfully continue the process. Needs to be fixed.

8.12 Follow Sections 9.4 to 9.9 to unload and/or reload wafers/samples.

Post Deposition Chamber Clean

8.13 After you are finished using the Oxford2, the chamber needs to be plasma cleaned.

8.14 You must run 02clean5.rec for the total time of your deposition + an additional 20% overetch.

8.15 Due to a PLC error, the tool will not begin a countdown of the timer for this recipe. You need to set a timer and start the timer once you visually confirm the plasma has ignited.

8.16 Once the timer has been completed, abort the process.

8.17 You may disable oxford2 on Mercury once you have aborted the process.

9.0 Troubleshooting Guidelines

~~**9.1 Problem: After enabling Oxford2, you find that the clean recipe is running or aborted.**~~

~~Cause: The clean recipe needs more time to finish or the tool has gas/RF stabilization problems.~~

~~Solution: Wait for the cleaning recipe to finish.~~

~~Or abort the cleaning recipe. Vent the chamber. If the chamber looks clean, you can process your wafers/samples. Remember to run either clean recipe after your process has finished.~~

9.2 Problem: After starting a recipe, the tool does not respond and the actual process parameters remain zero.

Cause: There is a communication problem between the main system and the PC.

Solution: Check that the system LCD panel is on and displays the control is via the remote PC. If not, report on Mercury, and the equipment staff will reset the system.

9.3 Problem: After starting a recipe, it takes a long time to pump down to base pressure. The pressure will not stabilize when process gases start flowing.

Cause: The pump/blower may be overloaded and triggered off.

Solution: Report on Mercury. Equipment staff will restart the pump/blower.

9.4 Problem: When running the [Nitride] recipe, the NH_3 fluctuates first, and then a gas stabilization re-alarm appears on the PC screen

Cause: The NH_3 delivery system needs to be replaced. (Equipment staff is working on this problem)

Solution: Click the **OK** button to the right of the alarm. The Process will continue without problem.

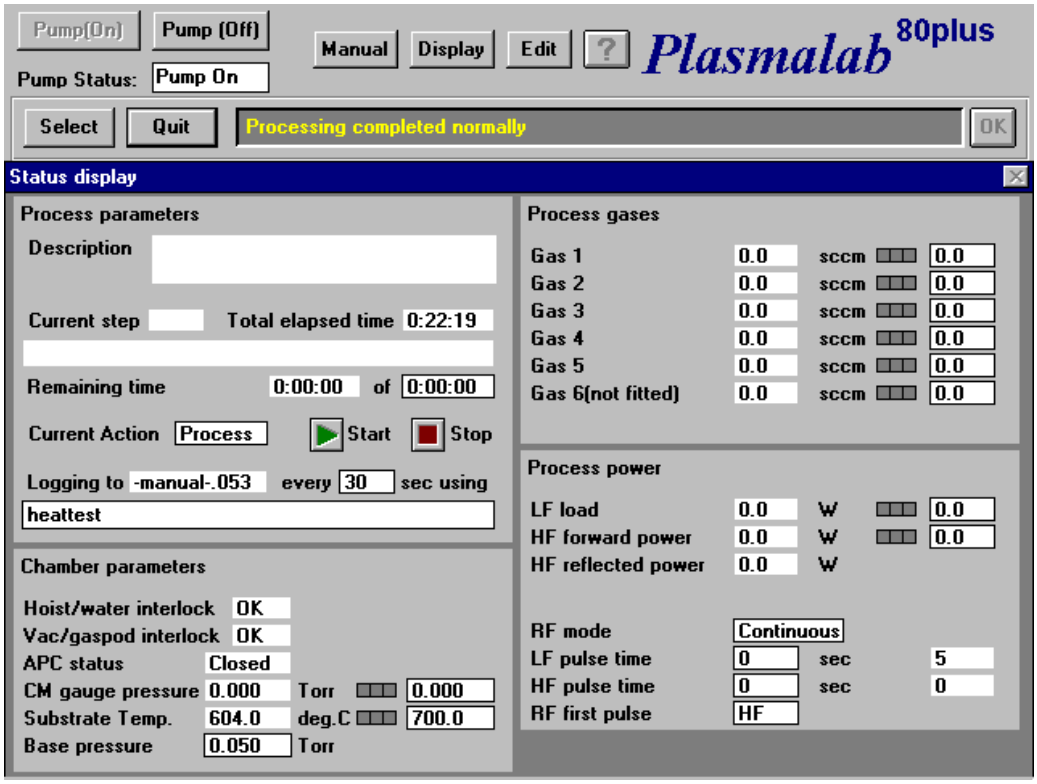
9.5 Problem: When running a recipe, a process gas starts to flow, then decrease, and finally, the process is aborted.

Cause: The gas cylinder is empty or a valve is shut off on the gas line.

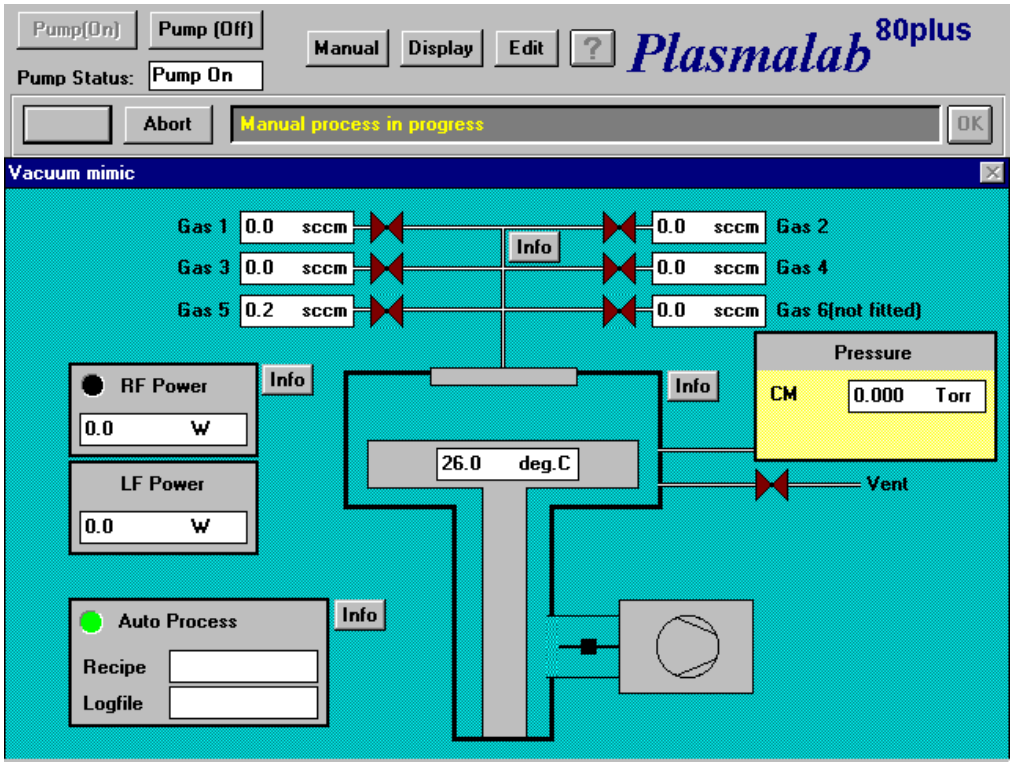
Solution: Report on Mercury.

10.0 Figures & Schematics

Display Status Page



Display Vacuum Page



Display Process (recipe) Page

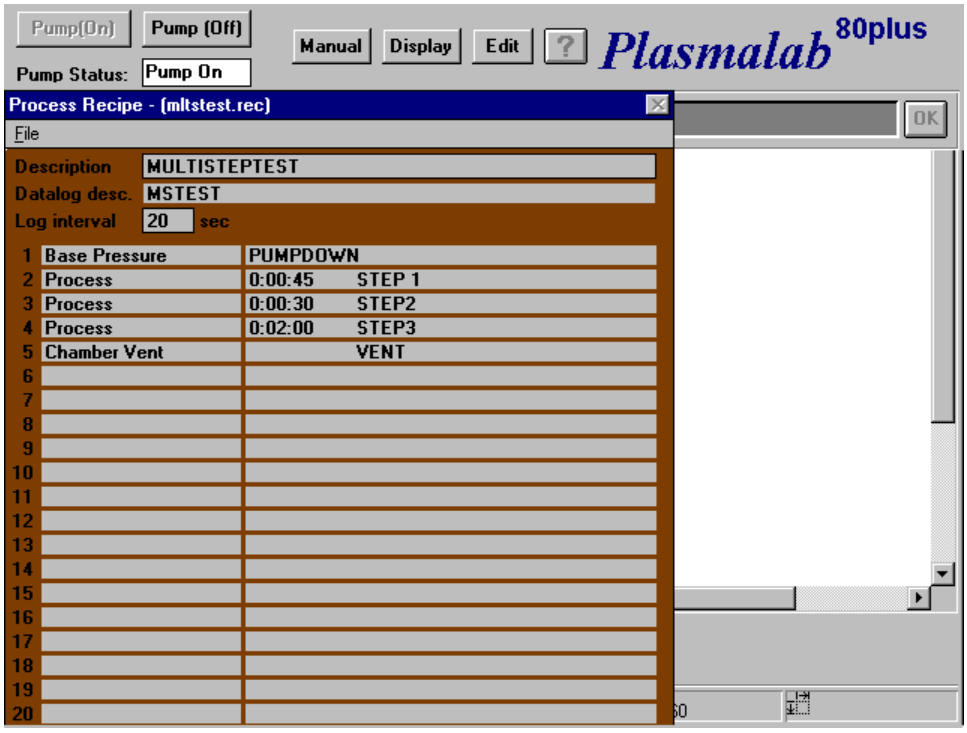


Diagram 1 - Typical Process Recipe Page

11.0 Appendices

11.1 Vent Recipe

```
--------------------------------------------------------------------------
T Vent with 2 pump/purge cyelcs                    ventrt.rec
W Creator  02-NOV-12    E Installation Engineer
E Editor
L LogPars                      0
--------------------------------------------------------------------------
A StepTime       13 sX  Process          0:01:00
A StepTime       29 sX  Process          0:01:00
A StepTime       45 sX  Process          0:01:00
A StepTime       61 sX  Process          0:01:00
A Vent           77 sX  Chamber Vent
!-------------------------------------------------------------------  12
A Process   15       D   1st pump
O Gas1f    0.0       S   N2O
O Gas2f    0.0       S   Ar
O Gas3f    0.0       S   10%SiH4/Ar
O Gas4f    0.0       S   NH3
O Gas5f    0.0       S   CH4
O Gas6f    0.0       S   BCl3
O RFfwd    0.0       s   HF forward power
O LFpower  0.0       s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse  0         s   HF pulse time
O LFpulse  0         s   LF pulse time
O CMpress  0.000     s   Process pressure
O SubTemp  0.0       s   Substrate temp.
!-------------------------------------------------------------------  28
A Process   15       D   1st purge
O Gas1f    0.0       S   N2O
O Gas2f    200.0     S   Ar
O Gas3f    0.0       S   10%SiH4/Ar
O Gas4f    0.0       S   NH3
O Gas5f    0.0       S   CH4
O Gas6f    0.0       S   BCl3
O RFfwd    0.0       s   HF forward power
O LFpower  0.0       s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse  0         s   HF pulse time
```

```
O LFpulse  0         s   LF pulse time
O CMpress  0.200     s   Process pressure
O SubTemp  0.0       s   Substrate temp.
!------------------------------------------------------------------ 44
A Process   15       D   2nd pump
O Gas1f    0.0       S   N2O
O Gas2f    0.0       S   Ar
O Gas3f    0.0       S   10%SiH4/Ar
O Gas4f    0.0       S   NH3
O Gas5f    0.0       S   CH4
O Gas6f    0.0       S   BCl3
O RFfwd    0.0       s   HF forward power
O LFpower  0.0       s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse  0         s   HF pulse time
O LFpulse  0         s   LF pulse time
O CMpress  0.000     s   Process pressure
O SubTemp  0.0       s   Substrate temp.
!------------------------------------------------------------------ 60
A Process   15       D   2nd purge
O Gas1f    0.0       S   N2O
O Gas2f    200.0     S   Ar
O Gas3f    0.0       S   10%SiH4/Ar
O Gas4f    0.0       S   NH3
O Gas5f    0.0       S   CH4
O Gas6f    0.0       S   BCl3
O RFfwd    0.0       s   HF forward power
O LFpower  0.0       s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse  0         s   HF pulse time
O LFpulse  0         s   LF pulse time
O CMpress  0.200     s   Process pressure
O SubTemp  0.0       s   Substrate temp.
!------------------------------------------------------------------ 76
A Vent      2        D   Vent Chamber
O SubTemp  0.0       s   Substrate temp.
!------------------------------------------------------------------ 79
```

11.2 Clean Recipe

```
--------------------------------------------------------------------------
T Clean Chamber post 5 micron deposition                02clean5.rec
W Creator  04-FEB-05    E Installation Engineer
E Editor   19-SEP-14      Installation Engineer
L LogPars                        0
--------------------------------------------------------------------------
A StepTime        12 sX  Chamber Clean       1:30:00
A StepTime        18 sX  Process             0:02:00
A StepTime        34 sX  Process             0:05:00
A StepTime        50 sX  Process             0:02:00
!------------------------------------------------------------------ 11
A Clean     5         D   Chamber clean
O RFfwd    200.0      s   HF forward power
O LFpower  0.0        s   LF power
O CMpress  0.950      s   Process pressure
O SubTemp  350.0      s   Substrate temp.
!------------------------------------------------------------------ 17
A Process   15        D   Post clean pump
O Gas1f     0.0       S   N2O
O Gas2f     0.0       S   Ar
O Gas3f     0.0       S   10%SiH4/Ar
O Gas4f     0.0       S   NH3
O Gas5f     0.0       S   CH4
O Gas6f     0.0       S   BCl3
O RFfwd     0.0       s   HF forward power
O LFpower   0.0       s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF         s   RF first pulse
O RFpulse   0         s   HF pulse time
O LFpulse   0         s   LF pulse time
O CMpress   0.000     s   Process pressure
O SubTemp  350.0      s   Substrate temp.
```

```
!------------------------------------------------------------------ 33
A Process   15       D   Post clean purge
O Gas1f     0.0      S   N2O
O Gas2f    1000.0    S   Ar
O Gas3f     0.0      S   10%SiH4/Ar
O Gas4f     0.0      S   NH3
O Gas5f     0.0      S   CH4
O Gas6f     0.0      S   BCl3
O RFfwd     0.0      s   HF forward power
O LFpower   0.0      s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse   0        s   HF pulse time
O LFpulse   0        s   LF pulse time
O CMpress  0.900     s   Process pressure
O SubTemp  350.0     s   Substrate temp.
!------------------------------------------------------------------ 49
A Process   15       D   pump down to standby
O Gas1f     0.0      S   N2O
O Gas2f     0.0      S   Ar
O Gas3f     0.0      S   10%SiH4/Ar
O Gas4f     0.0      S   NH3
O Gas5f     0.0      S   CH4
O Gas6f     0.0      S   BCl3
O RFfwd     0.0      s   HF forward power
O LFpower   0.0      s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse   0        s   HF pulse time
O LFpulse   0        s   LF pulse time
O CMpress  0.000     s   Process pressure
O SubTemp  350.0     s   Substrate temp.
!------------------------------------------------------------------ 65
```

11.3 Oxide Recipe

```
---------------------------------------------------------------------
T Oxide PECVD 1 micron                          oxide1.rec
```

```
W Creator  31-JAN-05    E Installation Engineer
E Editor   27-FEB-15      user
L LogPars                    0
-------------------------------------------------------------------------
A StepTime        13 sX  Process          0:01:00
A StepTime        29 sX  Process          0:01:00
A StepTime        45 sX  Process          0:20:00
A StepTime        61 sX  Chamber Vent
A Vent            77 sX
!-------------------------------------------------------------------  12
A Process   15       D   Pre-Deposition Pump
O Gas1f     0.0      S   N2O
O Gas2f     0.0      S   Ar
O Gas3f     0.0      S   10%SiH4/Ar
O Gas4f     0.0      S   NH3
O Gas5f     0.0      S   CH4
O Gas6f     0.0      S   BCl3
O RFfwd     0.0      s   HF forward power
O LFpower   0.0      s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse   0        s   HF pulse time
O LFpulse   0        s   LF pulse time
O CMpress   0.000    s   Process pressure
O SubTemp  350.0     s   Substrate temp.
!-------------------------------------------------------------------  28
A Process   15       D   Pre-Depostion Purge
O Gas1f     0.0      S   N2O
O Gas2f   200.0      S   Ar
O Gas3f     0.0      S   10%SiH4/Ar
O Gas4f     0.0      S   NH3
O Gas5f     0.0      S   CH4
O Gas6f     0.0      S   BCl3
O RFfwd     0.0      s   HF forward power
O LFpower   0.0      s   LF power
C RFmode   Continuous s   RF mode
```

C firstRF HF s RF first pulse
O RFpulse 0 s HF pulse time
O LFpulse 0 s LF pulse time
O CMpress 0.200 s Process pressure
O SubTemp 350.0 s Substrate temp.
!---------- 44
A Process 15 D Deposition
O Gas1f 800.0 S N2O
O Gas2f 0.0 S Ar
O Gas3f 100.0 S 10%SiH4/Ar
O Gas4f 0.0 S NH3
O Gas5f 0.0 S CH4
O Gas6f 0.0 S BCl3
O RFfwd 20.0 s HF forward power
O LFpower 0.0 s LF power
C RFmode Continuous s RF mode
C firstRF HF s RF first pulse
O RFpulse 0 s HF pulse time
O LFpulse 0 s LF pulse time
O CMpress 0.900 s Process pressure
O SubTemp 350.0 s Substrate temp.
!---------- 60
A Process 15 D Post-Deposition Pump
O Gas1f 0.0 S N2O
O Gas2f 0.0 S Ar
O Gas3f 0.0 S 10%SiH4/Ar
O Gas4f 0.0 S NH3
O Gas5f 0.0 S CH4
O Gas6f 0.0 S BCl3
O RFfwd 0.0 s HF forward power
O LFpower 0.0 s LF power
C RFmode Continuous s RF mode
C firstRF HF s RF first pulse
O RFpulse 0 s HF pulse time
O LFpulse 0 s LF pulse time
O CMpress 0.000 s Process pressure

O SubTemp 350.0 s Substrate temp.

!---------- 76

A Vent 2 D Vent Chamber

O SubTemp 350.0 s Substrate temp.

!---------- 79

11.4 Nitride Recipe

T Nitride PECVD 1 micron nitride1.rec

W Creator 31-JAN-05 E Installation Engineer

E Editor 26-AUG-13 Super-User

L LogPars 0

A StepTime 16 sX Process 0:02:00

A StepTime 32 sX Process 0:01:00

A StepTime 48 sX Process 0:28:30

A StepTime 64 sX Process 0:01:00

A StepTime 80 sX Process 0:01:00

A StepTime 96 sX Process 0:01:00

A StepTime 112 sX Process 0:01:00

A Vent 128 sX Chamber Vent

!---------- 15

A Process 15 D Pre-Deposition Pump

O Gas1f 0.0 S N2O

O Gas2f 0.0 S Ar

O Gas3f 0.0 S 10%SiH4/Ar

O Gas4f 0.0 S NH3

O Gas5f 0.0 S CH4

O Gas6f 0.0 S BCl3

O RFfwd 0.0 s HF forward power

O LFpower 0.0 s LF power

C RFmode Continuous s RF mode

C firstRF HF s RF first pulse

O RFpulse 0 s HF pulse time

O LFpulse 0 s LF pulse time

O CMpress 0.000 s Process pressure

O SubTemp 350.0 s Substrate temp.

!---------- 31

A Process 15 D Pre-Depostion Purge

O Gas1f 0.0 S N2O

O Gas2f 200.0 S Ar

O Gas3f 0.0 S 10%SiH4/Ar

O Gas4f 0.0 S NH3

O Gas5f 0.0 S CH4

O Gas6f 0.0 S BCl3

O RFfwd 0.0 s HF forward power

O LFpower 0.0 s LF power

C RFmode Continuous s RF mode

C firstRF HF s RF first pulse

O RFpulse 0 s HF pulse time

O LFpulse 0 s LF pulse time

O CMpress 0.200 s Process pressure

O SubTemp 350.0 s Substrate temp.

!---------- 47

A Process 15 D Deposition

O Gas1f 0.0 S N2O

O Gas2f 0.0 S Ar

O Gas3f 100.0 S 10%SiH4/Ar

O Gas4f 30.0 S NH3

O Gas5f 0.0 S CH4

O Gas6f 0.0 S BCl3

O RFfwd 20.0 s HF forward power

O LFpower 0.0 s LF power

C RFmode Continuous s RF mode

C firstRF HF s RF first pulse

O RFpulse 0 s HF pulse time

O LFpulse 0 s LF pulse time

O CMpress 0.900 s Process pressure

O SubTemp 350.0 s Substrate temp.

!---------- 63

A Process 15 D Post Deposition Pump1

O Gas1f 0.0 S N2O

O Gas2f 0.0 S Ar

O Gas3f 0.0 S 10%SiH4/Ar

O Gas4f 0.0 S NH3

O Gas5f 0.0 S CH4

O Gas6f 0.0 S BCl3

O RFfwd 0.0 s HF forward power

O LFpower 0.0 s LF power

C RFmode Continuous s RF mode

C firstRF HF s RF first pulse

```
O RFpulse    0       s   HF pulse time
O LFpulse    0       s   LF pulse time
O CMpress   0.000    s   Process pressure
O SubTemp  350.0     s   Substrate temp.
!------------------------------------------------------------- 79
A Process   15       D   Post-Deposition Purge1
O Gas1f     0.0      S   N2O
O Gas2f    200.0     S   Ar
O Gas3f     0.0      S   10%SiH4/Ar
O Gas4f     0.0      S   NH3
O Gas5f     0.0      S   CH4
O Gas6f     0.0      S   BCl3
O RFfwd     0.0      s   HF forward power
O LFpower   0.0      s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse    0       s   HF pulse time
O LFpulse    0       s   LF pulse time
O CMpress   0.200    s   Process pressure
O SubTemp  350.0     s   Substrate temp.
!------------------------------------------------------------- 95
A Process   15       D   Post-Deposition Pump2
O Gas1f     0.0      S   N2O
O Gas2f     0.0      S   Ar
O Gas3f     0.0      S   10%SiH4/Ar
O Gas4f     0.0      S   NH3
O Gas5f     0.0      S   CH4
```

O Gas6f 0.0 S BCl3

O RFfwd 0.0 s HF forward power

O LFpower 0.0 s LF power

C RFmode Continuous s RF mode

C firstRF HF s RF first pulse

O RFpulse 0 s HF pulse time

O LFpulse 0 s LF pulse time

O CMpress 0.000 s Process pressure

O SubTemp 350.0 s Substrate temp.

!---------- 111

A Process 15 D Post-Deposition Purge2

O Gas1f 0.0 S N2O

O Gas2f 200.0 S Ar

O Gas3f 0.0 S 10%SiH4/Ar

O Gas4f 0.0 S NH3

O Gas5f 0.0 S CH4

O Gas6f 0.0 S BCl3

O RFfwd 0.0 s HF forward power

O LFpower 0.0 s LF power

C RFmode Continuous s RF mode

C firstRF HF s RF first pulse

O RFpulse 0 s HF pulse time

O LFpulse 0 s LF pulse time

O CMpress 0.200 s Process pressure

O SubTemp 350.0 s Substrate temp.

!---------- 127

A Vent 2 D Vent Chamber

O SubTemp 350.0 s Substrate temp.

!---------- 130

11.5 Amorphous Silicon Recipe

T A-Si Test a-si2.rec

W Creator 13-AUG-15 E user

E Editor 31-AUG-15 Installation Engineer

L LogPars 0

A StepTime 12 sX Process 0:01:00

A StepTime 28 sX Process 0:24:00

A StepTime 44 sX Process 0:01:00

A Vent 60 sX Chamber Vent

!---------- 11

A Process 15 D Pre-Depostion Pump

O Gas1f 0.0 S N2O

O Gas2f 0.0 S Ar

O Gas3f 0.0 S 10%SiH4/Ar

O Gas4f 0.0 S NH3

O Gas5f 0.0 S CH4

O Gas6f 0.0 S BCl3

O RFfwd 0.0 s HF forward power

O LFpower 0.0 s LF power

C RFmode Continuous s RF mode

C firstRF HF s RF first pulse

O RFpulse 0 s HF pulse time

O LFpulse 0 s LF pulse time

O CMpress 0.000 s Process pressure

O SubTemp 150.0 s Substrate temp.

!---------- 27

```
A Process   15       D   a-Si Deposition
O Gas1f    0.0       S   N2O
O Gas2f    400.0     S   Ar
O Gas3f    100.0     S   10%SiH4/Ar
O Gas4f    0.0       S   NH3
O Gas5f    0.0       S   CH4
O Gas6f    0.0       S   BCl3
O RFfwd    30.0      s   HF forward power
O LFpower  0.0       s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse  0         s   HF pulse time
O LFpulse  0         s   LF pulse time
O CMpress  0.900     s   Process pressure
O SubTemp  150.0     s   Substrate temp.
!------------------------------------------------------------------ 43
A Process   15       D   Post-Deposition Pump
O Gas1f     0.0      S   N2O
O Gas2f     0.0      S   Ar
O Gas3f     0.0      S   10%SiH4/Ar
O Gas4f     0.0      S   NH3
O Gas5f     0.0      S   CH4
O Gas6f     0.0      S   BCl3
O RFfwd     0.0      s   HF forward power
O LFpower   0.0      s   LF power
C RFmode   Continuous s   RF mode
C firstRF  HF        s   RF first pulse
O RFpulse   0        s   HF pulse time
O LFpulse   0        s   LF pulse time
O CMpress   0.000    s   Process pressure
O SubTemp  150.0     s   Substrate temp.
!------------------------------------------------------------------ 59
```

A Vent 2 D vent

O SubTemp 150.0 s Substrate temp.

!---------- 62