R·I·T

Title: Applied Materials P5000

Semiconductor & Microsystems Fabrication Laboratory | **Revision: G** | **Rev Date: 04/21/2009**

Approved by:

______________________/__/__ ________________________/__/__

Process Engineer Equipment Engineer

1 SCOPE

The purpose of this document is to detail the use of the Applied Materials P5000. All users are expected to have read and understood this document. It is not a substitute for in-person training on the system and is not sufficient to qualify a user on the system. Failure to follow guidelines in this document may result in loss of privileges.

2 REFERENCE DOCUMENTS

- Material Safety Data Sheets
- Appropriate Tool Manuals

3 DEFINITIONS

n/a

4 TOOLS AND MATERIALS

4.1 General Description

4.1.1 The P5000 is a load locked system with 4 process chambers. **Chamber A** is for TEOS depositions, **Chamber B** is for Plasma Nitride depositions, **Chamber C** is for Oxide and Nitride etching and **Chamber D** is not active.

4.2 Wafer Cassettes

4.2.1 There are dedicated 6" wafer cassettes for the P5000 which are labeled.

5 SAFETY PRECAUTIONS

5.1 Hazards to the Operator

5.1.1 The system uses a number of different gases including silane and ammonia which are hazardous. Read and understand the material safety data sheets (MSDS) for all

gases used in the system and be familiar with the hazards and safety controls to prevent an accident before using the system.

5.1.2 The system uses a liquid source chemical for the TEOS depositions.

5.1.3 There are thermal, mechanical and electrical hazards inside of the machine. Do not operate with the covers off. Keep clear of the door when it is closing.

5.2 Hazards to the Tool

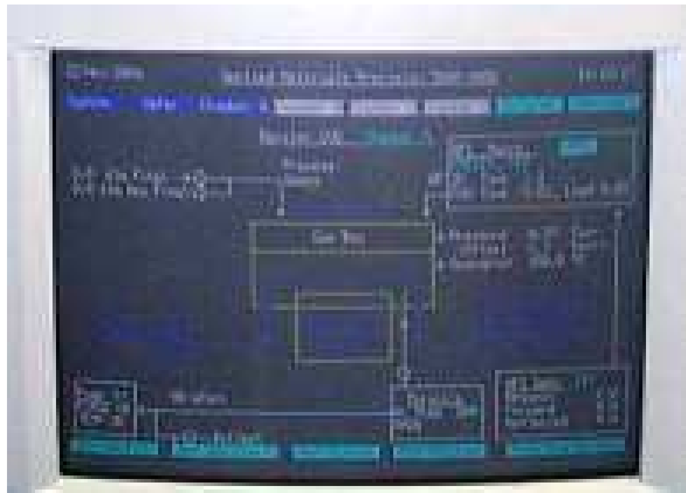
5.2.1 **Wafer Size**-The system is set up for 6 inch wafers. Smaller sizes may be run on the carrier wafers.

5.2.2 **Contamination-**Process only clean wafers in the system. No photoresist, gold or copper. *If you are not sure about a wafer please ask a staff member.*

5.2.3 **Non-Standard Substrates**-No wafer pieces or non-standard wafers may be processed without approval.

5.2.4 **Unapproved Recipes** -Unapproved recipes could cause damage to the system. Recipe changes need staff approval.

5.2.5 Make sure that chamber is pumped down before turning on the lamps.



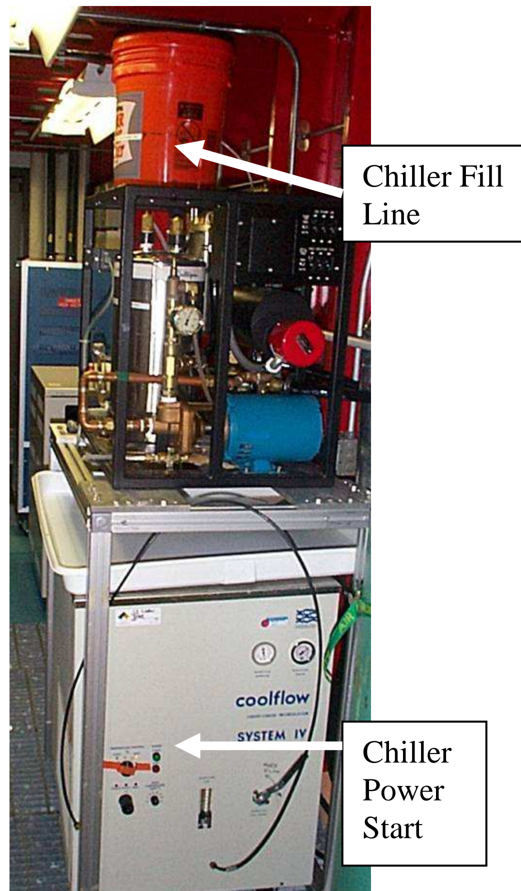
6 INSTRUCTIONS

6.1 Initial State Check

6.1.1 Verify that the *chamber* that you need to use is up, by checking the sign on the front of the machine.

6.1.2 Make sure that the P5000 is on and in the standby state. It is usually in this state if the computer is on. If the computer is off, check with a staff member.

6.1.3 In Service Chase 2755, verify that the nitrogen valve for the P-5000#1 is on. (Usually on)



6.1.4 In Service Chase 2755, make sure that the water level in the bucket on top of the chiller is close to the line, if not add water with the orange fill knob.

6.1.5 In Service Chase 2755, make sure that the chiller is on. If not, press **Power Start**.

6.1.6 On the computer clear any alarm lines. Go to **System, Fault Screen** and select **Clear Alarm Lines** on the top right.

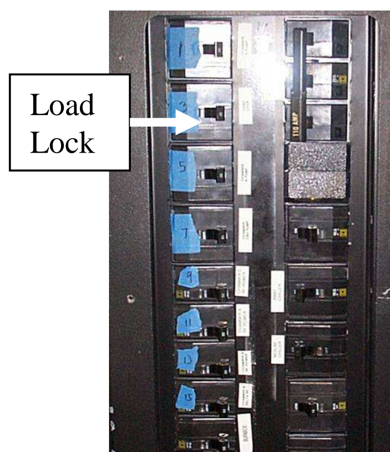
6.1.7 Make sure that the heat exchanger is on. Go to **System**, **Monitor Facilities**, **Heat Exchanger Frame, HX1** and select **On**.

6.1.8 Press the blue button on the hot box with a pen if the light is blinking. The hot box is located on the back of P-5000. After pressing the blue button, blinking light should go off. This will ensure the hot box does not overheat.

6.1.9 Home the robot.

6.1.9.1 Go to **Wafer** and **Control Handler.**
6.1.9.2 Select **Abort Load Chamber operation**
6.1.9.3 Select **Abort current loader operation**
6.1.9.4 Select **Abort automatic sequencing**
6.1.9.5 Select **Home all Robot Axes**.
6.1.9.6 You can check if this step is working by going to **Wafer** and **Monitor Handler**. If this step is working, numbers on each axis should be changing. After this step is done, there will be a message on the top telling you this step is done.

6.1.10 Make sure the **Load Lock Chamber** breaker is on. Also make sure the pump breaker is on for the chamber that you will use.



6.1.11 Make sure the load lock chamber is pumped down. Go to **Service**, **Vacuum Service**, **Loadlock Chamber**. Select **Pump On**. Go back to **Service**, **Vacuum Service**, **Load Chamber Idle** and select **Start Load Chamber Pump Down**.

6.2 Resetting the System

6.2.1 If the system needs to be reset, please contact a staff member.

6.3 Procedure for TEOS Depositions (Chamber A)

6.3.1 After verifying all items in the **Initial State Check**, pump down Chamber A. Go to **Service**, **Vacuum Service**, click on **Offline for Maintenance** for Chamber A and then select **Start Chamber pump down**.

6.3.2 On the back of the tool, make sure that the hot box temperature is 55°C.

6.3.3 Make sure that the TEOS temperature is 38°C. Go to **System**, **Monitor Remote Panel** and **Chamber A**.

6.3.4 The standard chamber temperature is 390°C. Warning! Do not energize lamps before chamber is pumped down!

6.3.4.1 Go to **Chamber A** (on top of the screen), **Chamber Service** and view the **lamps** temperature. The 1st number is the set point and the 2nd number is readout.

6.3.4.2 Change the lamp temperature to **390°C**, and start the chamber heating.

6.3.4.3 Wait about an hour for the chamber lamps to heat up and stabilize. The deposition rate and film stress will be most stable after 3 hours.

6.3.5 Now go to **Service**, **Vacuum Service**, under **Chamber A** click on **Offline for Maintenance** and then select **Put Online for Process**.

6.3.6 Wait for all temperatures (hot box, TEOS, chamber) to reach the proper settings before you perform your run.

6.3.7 Make sure that the system is in Automatic Mode. Go to **System**, **Control System**, click **Manual** and select **Automatic**.

6.3.8 Load the wafers with the flats up in the cassette. Make sure not to cross-slot the wafers and make sure that the cassette is well seated. If you are using carrier wafers, only process one at a time.

6.3.9 Select the recipe to be run. Go to **System**, **Enter Wafer Lot Name**, Click the blank next to **Cassette A** or **Cassette B**, select **New Lot Name**, click the blue square, enter in the lot name and select **Enter**. Select the blank blue square and then select the sequence name for the lot.

6.3.10 Start the run with the **Run** button on the front of the tool.

6.3.10.1 To quickly delete slots with no wafers go to **Wafer, Monitor Wafer** and select **Start Delete Range** and **Finish Delete Range**

6.3.11 Press **Unload** on the front of the tool after all of the wafers are done. (**Unload** will be flashing)

6.3.12 Select **System**, **Control System** and set to **Manual**.

6.3.13 Go to **Service**, **Vacuum Service** and click on **Online for Process** for Chamber A. Select **Put Offline for Maintenance**.

6.3.14 If no one else will be using the chamber that day, turn off the chamber lamps. Go to **Chamber A**, **Chamber Service**, click on the temperature next to **Lamps** and select **Set to Standby**.

6.3.15 Wait until the chamber temperature goes below 200°C. Go to **System**, **Monitor Facilities** and turn off **Lamp/ Mag Contact** for **Chamber A**.

6.3.16 Go to **Service**, **Vacuum Service** and **Chamber A**. Turn the throttle off and then the pump.

6.4 Procedure for Nitride Depositions (Chamber B)

6.4.1 Nitride depositions use hazardous gases and may not be run after 5:00pm. All gas lines must be completely pumped out by that time. Please allow 1 hour to pump out gas lines and shut down the tool.

6.4.2 After verifying all items in the **Initial State Check,** pump down Chamber B. Go to **Service**, **Vacuum Service**, click on **Offline for Maintenance** for Chamber B and then select **Chamber pump down**.

6.4.3 Set the chamber temperature. Warning! Do not energize lamps before chamber is pumped down!

6.4.3.1 Go to **Chamber B** (on top of the screen), **Chamber Service** and view the **lamps** temperature. The 1st number is the set point and the 2nd number is the readout.

6.4.3.2 Set the lamp temperature to 400°C.

6.4.4 Now go to **Service**, **Vacuum Service**, **Chamber B**, click on **Offline for Maintenance** and then select **Put Online for Process**.

6.4.5 When using Chamber B, close all the covers on P-5000 to achieve good exhaust.

6.4.6 Turn on the burn box control located next to P-5000 with the breaker. If there is no readout, reset the breaker.
Zone 1 – 500 °C Zone 2 – 200 °C Zone 3 – 200 °C

6.4.7 Turn on the burn box air located next to the burn box and make sure that it is set to 10 LPM.

6.4.8 Wait until all temperatures (burn box and chamber) reach the proper setting to perform your run.

6.4.9 Hold down **black button** above switch for at least 20 seconds and turn on NH_3 and Silane gas switches in the red box located next to the LPCVD tool. If the black button is not held down for 20 seconds all gasses will be shut off. If someone else is using LPCVD, make sure to let them know which gasses you will be using so that they are not turned off while you still need them.

6.4.10 While holding down **black button**, turn on **extension gas switch** to P-5000 on red box.

6.4.11 Check the gas line pressure on the gauge near the ceiling between the LPCVD tool and the P5000. NH_3 should be 20 psi and silane should be near 0 psi.

6.4.12 Make sure that the system is in Automatic Mode. Go to **System**, **Control System**, **System State** and **Manual** and select **Automatic**.

6.4.13 Select the recipe to be run. Go to **System**, **Enter Wafer Lot Name**, Click the blank next to **Cassette A** or **Cassette B**, select **New Lot Name**, click the blue square, enter in the lot name and select **Enter**. Select the blank blue square and then select the sequence name for the lot.

6.4.14 Load the wafers with the flats up in the cassette. Make sure not to cross slot the wafers and make sure that the cassette is well seated.

6.4.15 When running a process on chamber B, make sure the temperature in **Zone 1** of the burn box does not increase dramatically.

6.4.16 Start the run with the **Run** button on the front of the tool.

6.4.17 Press **Unload** on the front of the tool after all of the wafers are done. (**Unload** will be flashing)

6.4.18 Go to **Service**, **Vacuum Service**, **Chamber B**, click on **Online for Process** and put **Offline for Maintenance**.

6.4.19 **Pumping out the gas lines**:

6.4.19.1 While you are pumping down the chamber, make sure the chamber pressure does not go above 0.4 Torr and the hot box temperature does not go above 550°C.

6.4.19.2 If gasses are not in use in LPCVD, turn off the main switches for silane and ammonia, pump out the gases and then shut off the extension switches.

6.4.19.3 If one of the gases is in use in LPCVD, just turn off the extension for that gas and pump down to the extension.

6.4.19.4 To pump down ammonia go to **System**, **Monitor Gas Panel**, **Chamber B** and set NH_3 set point (SP) to 200 sccm. When **IS** value reaches close or equal to 0, select **Stop AFC Flow.** Note that the line pressure will not go all the way to vacuum for ammonia.

6.4.19.5 To pump down silane go to **System**, **Monitor Gas Panel**, **Chamber B** and set Silane set point (SP) to 200 sccm. When **IS** value reaches close or equal to 0, select **Stop AFC Flow.** For Silane, the line pressure will read vacuum when the line is completely pumped out.

6.4.20 Wait 20 minutes and turn off the burn box, burn box air and any extension switches left on in the red box.

6.4.21 If no one else will be using the chamber that day, turn off the chamber lamps. Go to **Chamber B**, **Chamber Service**, click on the temperature next to **Lamps** and select **Set to Standby**.

6.4.22 Wait until the chamber temperature goes below 200°C. Go to **System**, **Monitor Facilities** and turn off **Lamp/ Mag Contact** for **Chamber B**.

6.4.23 Go to **Service**, **Vacuum Service** and **Chamber B**. Turn the throttle off and then the pump.

6.5 Procedure for Oxide/Nitride Etching (Chamber C)

6.5.1 To prevent arcing and possible damage, only 6 inch wafers with a single flat may be etched in this chamber, no secondary flats. Wafer backs must be clear of oxide and nitride. After verifying all items in the **Initial State Check**, pump down Chamber C. Go to **Service**, **Vacuum Service**, click on **Offline for Maintenance** for Chamber C and then select **Chamber pump down**.

6.5.2 Go to **Service**, **Vacuum Service**, **Chamber C**, click on **Offline for Maintenance** and then select **Put Online for Process**.

6.5.3 Make sure that the system is in Automatic Mode. Go to **System**, **Control System**, **System State** and **Manual** and select **Automatic**.

6.5.4 Select the recipe to be run. Go to **System**, **Enter Wafer Lot Name**, Click the blank next to **Cassette A** or **Cassette B**, select **New Lot Name**, click the blue square, enter in the lot name and select **Enter**. Select the blank blue square and then select the sequence name for the lot.

6.5.5 Load the wafers with the flats up in the cassette. Make sure not to cross-slot the wafers and make sure the cassette is well seated.

6.5.6 Start the run with the **Run** button.

6.5.7 Press **Unload** after all of the wafers are done. (**Unload** will be flashing)

6.5.8 Go to **Service**, **Vacuum Service** and click on **Online for Process** for Chamber C. Select **Put Offline for Maintenance**.

6.5.9 Turn off the pump by going to **Service**, **Vacuum Service** and **Chamber C**. Turn the throttle off and then the pump.

6.6 Procedure for Chamber D

6.6.1 Not currently available

6.7 Errors during Run

6.7.1 If the burn box temperature readout is wrong, cycle the breaker off and on.

7 APPROPRIATE USES OF THE TOOL

7.1 Nitride depositions use hazardous gases and may not be run after 5:00pm. All gas lines must be completely pumped out by that time. Because of the time needed to do the pump out, it is best not to start a new deposition after 4:00pm.

REVISION RECORD

Summary of Changes	Originator	Rev/Date
Original Issue	Sean O'Brien	A-11/22/2004
	Sean O'Brien	B- 05/02/2005
Modified 6.1.12, 6.3.1, 6.4.2, 6.5.1, clarified other areas	Sean O'Brien	C- 02/15/2006
Modified 5.2.1, 6.3.4, 6.3.13, 6.3.14, 6.3.9, 6.3.13-6.3.15, 6.4.21-6.4.23	Sean O'Brien	D- 12/03/2007

Added 6.3.10.1 Modified 6.3.15, clarified 6.4.9, 6.4.10, added 6.3.12	John Nash	E- 08/22/2008
Swapped 6.3.8 and 6.3.9	O'Brien	F-02/10/2009
Modified 6.1.9 and added 6.5.1	O'Brien	G–04/21/2009