University of Minnesota Nano Fabrication Center
Standard Operating Procedure

Equipment Name: PECVD

Coral Name: pecvd
Model: Plasmatherm 340
Location: Bay 3

Revision Number: 1
Revisionist: Tony Whipple
Date: 31 Nov 2003

1 Description

The Plasmatherm PECVD is primarily used for the deposition of Silicon Nitride, Silicon Dioxide, or Amorphous Silicon. The system has an RF electrode at the top of the chamber and a heated base plate. The base plate is heated by an embedded resistance heater with a range of 80-340 degrees Celsius. The programs used for the deposition of Silicon Nitride and Silicon Dioxide are already stored in memory. The parameter that will need to be monitored/changed for each run is the deposition time. Deposition time controls the thickness of the deposited material.

Fig 1. The PECVD system with the keyboard and monitor to the right of the system.

2 Safety

The safety item beyond the normal electrical hazards is to watch out for are the temperatures as the system can go to 340 degrees C. The gases that are used are, N_2, O_2, CF_4, N_2O, SiH_4, NH_3, and He. If there is anything that the system does that needs to be stop in an Emergency press the RED EMO button. Contact a NFC person about any problems.

3 Restrictions/Requirements

Must be a qualified user on the PECVD system.

To prevent wafers from contaminating the tubes and other user's wafers and large cost; READ THIS:

There are to be NO wafers that EVER had metal on them, was in the PECVD system, the RTA, or any metal or E-beam deposition systems, allowed into the oxidation or LPCVD tubes. Unless they are to be ran in the ALLOY tube. So if you run your wafers through the PECVD system, they **can not** go back into any oxide or LPCVD tube, except for the alloy tube. If you need to denisfy the film you can use the RTA. Contact a NFC staff person for options.

4 Required Facilities

The system needs electrical power, and gases.

5 Definitions

RECIPE = This is the program that controls the sequence of events while running the system.
PLATEN= The main bottom base plate that the wafers sit on.
LID = The top bell jar cover of the system that opens up.

6 Setup

No special setup is needed; just have your wafers ready.

7 Operating Instructions

Preparing to run wafers:

If the screen saver is on when you first approach the PECVD, touch any key on the keyboard or move the mouse.

1. The *Operator Login* window should now be in the middle of the screen. In the **Operator** box enter **MLRE** and press **TAB**. In the **Password** box enter **1234** and click with the mouse on the **OK** box. Notice the password is in uppercase.
(Use the top left mouse button, this is the only one used in operation).

2. The *System Monitor* window will now be on the screen. Move the mouse to the **Process** pulldown mode and click on it. Select **Load** and click on it. The *Process Files Right Chamber* window will now appear. Select the process you want to use by clicking on it with the mouse (sin250, sin340, sio2250, sio2340, etc.). The process you selected will now appear in the **File Name** box. Click on the **OK** box in the upper right hand corner of the window. Your program with a 1 hour run time is now loaded.

3. Move the mouse to the **Utilities** pulldown mode. Click on it. Move the mouse to **Vent** and click on it. The chamber will vent. When the chamber is vented the chamber cover will pop open. You can now lift it up by hand and load your wafer samples. **CAUTION: THE BASE PLATE IS VERY HOT - AVOID CONTACT**.

4. Once you have the wafers loaded move the mouse to the **Utilities** pulldown mode and click on it. Select **Pump Chamber (low vac)**. and click on it while holding the chamber lid closed. Hold down the chamber lid until the pressure screen turns from atmosphere (blue) to vacuum (red). You will notice that the gap from the top lid will get smaller as it pumps down.

5. After the chamber is pumped down the pressure box will turn white. Click on **READY** in the **System Status** cluster at the bottom of the screen. When the system has met all initial parameter requirements the entire **READY** button will turn yellow. Once the system is in the **READY** mode, click on **RUN** in the **System Status** cluster at the bottom of the screen. The deposition will now proceed automatically and go through six process steps:

   Step 1 Initial Pumpdoun
   Step 2 Prepurge
   Step 3 Gas stabilization
   Step 4 Process (this is the actual deposition)
   Step 5 Postpurge
   Step 6 End and vent

   Since most programs are written with a standard 1 hour actual deposition time (Step 4) you will have to time your deposition using the clock visible in the lower right side of the screen when Process Step 4 is reached. (Most depositions will be shorter than the one hour setpoint time. If you need a longer deposition time contact an NFC staff menber.) The **Time** box, as stated earlier, is on the lower right side of the screen. It has **Setpt**, **Elapse** and **Left** boxes in it. You will use the running time in the **Elapse** box to time your deposition. When the time in the **Elapse** box has reached the deposition time you desire click on the **END STEP** button in the **System Status** cluster at the bottom of the screen. This will end your deposition at the desired time but continue the remaining steps of the process.

6. After the run is done the chamber will vent automatically and the lid will pop open. Remove your samples at this time placing them on the ledge of the system or table until they cool down. **CAUTION: THE BASE PLATE AND THE SAMPLE BEING REMOVED ARE VERY HOT - USE CAUTION WHEN HANDLING.** The *Process Complete* window appears when the process is done and gives the time the automatic process was completed. Click on the **OK** box. If more samples are to be processsed, load them at this time, then continue. The lid might not open by itself after a long deposition time, as in over one hour, or Amorphous films, just lift up once it is at atmosphere.

7. Move the mouse to the **Utilities** pulldown mode and click on it. Select **Pump Chamber (low vac.)** and click on it while holding the chamber lid closed. Hold down the chamber lid until the pressure screen turns from atmosphere (blue) to vacuum (red). Measure the thickness and refractive index of your samples and record this information in the Log Book. If processing is complete proceed to step 8. To continue processing proceed to step 2 and **Load** another program.

8. After the system has pumped down, (the pressure box has turned white), click on the **STANDBY** box in the **System Status** cluster at the bottom of the page. This should put the system in the **STANDBY** mode. Click on the **Utilities** pulldown mode again and select **Log Out**. Click on it. The system should now be in the **STANDBY** mode and logged out.

8 Problems/Troubleshooting

Extra hits and tips.

Remember, anything that is ran through this system **<u>CAN NOT</u>** go into any equipment in bay 1 except the Alloy tube or the RTA.

It is a good idea to do a dummy run before the actual deposition to get that day's deposition rate of the process you are running, if you need the thickness to be very close to the target value. The time you choose for a dummy run will vary with the thickness you are trying to achieve. A 5 to 10 minute dummy run should usually be sufficient.

To get a close, rough estimate of the deposition rates check the Process Summary Sheets or Run Sheets next to the PECVD.

Check the system to see what the bottom platen temperature is set at, if you have selected a recipe that is a different temperature from the current set point, the system might need to heat up or cool down. You can have the temperature set point set before you load your wafers by selecting the recipe and pressing the **READY** option. And to confirm that the set point is controlling the system , open the front panel door below the chamber, and the top temperature displayed should be what is in the recipe. See Fig.2 for an example of this. In the photo the system is at 110 degrees and a 150 degree recipe was selected. The system will now heat up to the 150 degree set point value. Remember the system will only get to with in about 5 degrees of set point while in standby. So start the run, it will get closer while running. To help cool down the platen the chamber could be vented to help in cooling it down.

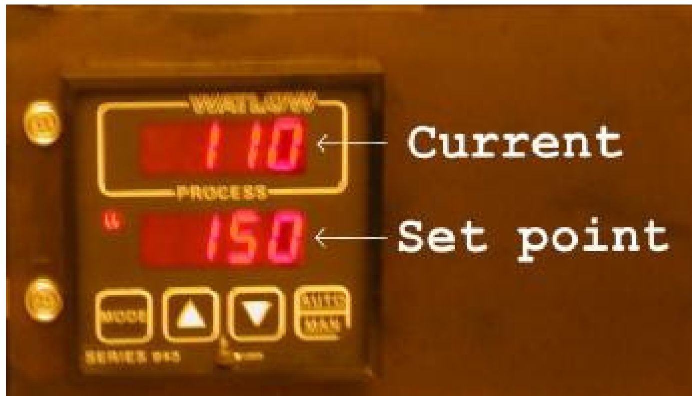

Fig.2 The CURRENT and SET POINT temperature values, this display can be seen if the door is opened.

The Nitride film is the cleanest film with the oxide film being the next cleanest, while the amorphous films are the dirtiest films. So the PECVD system should be cleaned when changing from an oxide deposition to a nitride deposition. If the last recipe ran was an amorphous recipe a clean must be done before doing anything. The nitride is clearer then the oxide so if an oxide was last ran, a clean should be done before the nitride dep. If the system needs to be cleaned run the recipe **CLEAN.RCP** to do the cleaning in the system. After the clean was done, run the planned recipe for 5 to 10 min to coat the inside chamber, this will help coat and seal any particles that might be left over from the cleaning.

Doing more than one deposition for the total thickness helps reduce the problem of film voids or pinholes. Doing several depositions, as in three layers have helped users in the past solve their film quality problems. So to take advantage of this, just run 1/3 of the total time needed and do this time 3 times. Some users even below the wafer with N2 between deposition steps.

Sometimes the system will not accept passwords, or just operate in a strange fashion, this is a clue that the software has stopped working correctly. Rebooting the system by pressing the Crtl-Alt-Del keys will reboot the system. Once the software is running, loggin, pump the chamber down and continue with selecting a recipe.

If you have any questions contact an NFC staff member.