PLASMAQUEST STANDARD OPERATING PROCEDURE

CORAL Name: Plasmaquest

Model Number: 145

Location: TRL Ballroom

What it does: Reactive Ion Etcher/Plasma Enhanced Chemical Vapor Deposition (RIE/PECVD)

INTRODUCTION:

The Plasmaquest is an Electron Cyclotron Resonance Reactive Ion Etcher (ECR/RIE) and Plasma Enhanced Chemical Vapor Deposition (PECVD) system for 4" wafers. Smaller substrates must be placed on a "handler" wafer. The system is ("Red") as it is gold-contaminated. The Plasmaquest can be used to etch Silicon Nitride, Silicon Dioxide, Poly Silicon, many III/V materials and some metals. It can be used to deposit Silicon Dioxide, Silicon Nitride, and Amorphous Silicon. Typically, etch processes use both the ECR and the Radio Frequency (RF bias). Typically, deposition processes only use the ECR. The maximum powers are: ECR (source) 700 Watts, RF (bias) 50 Watts. The ECR does not have an automatic match network—you must manually tune it. The matching changes for every process. Read the tuning section (below) very carefully, to avoid damaging the tool**!!!**

There are 12 gases available for processing: Nitrogen (N2), Oxygen (O2), Helium (He), Ammonia (NH3), Boron Trichloride (BCl3), Hydrogen (H2) Silane (SiH4 10% : Ar 90%), Sulfur Hexafluoride (SF6), Chlorine (Cl2), Methane (CH4), Tetrafluoromethane (CF4), and Argon (Ar)

Note to BCl3 Users: This gas gets little usage, so it is only opened on an as-needed basis. Please coordinate this with the Specialist in charge, (or the backup) in advance of your reservation, as it does take some time. While it is not being used, the line will be filled with Nitrogen. The Specialist will open the BCl3 bottle and remove the N2 from the line. Then the user must run the BCL3PURG.rcp to introduce pure BCl3 to the tool. When you're finished with the BCL3, you notify the Specialist again. This time so the tank can be shut and the BCL3 removed from the line. Then the user must run the BCL3PURG.rcp again, in order to introduce pure N2 to the tool.

SAFETY:

Note the location of the red, **EMO** button near the monitor. Pushing this button disables the power to the entire system (but not the vacuum pumps). Use this button in emergency situations**!!!** This button should also be pressed if a wafer falls off the load arm and is going to be broken**!!!** In either case, notify the Staff immediately so the system can be checked**!!!**

Due to the toxic nature of the processing gases, only qualified technical staff is allowed to perform the tasks of turning gases on and off and changing of gas cylinders. Keep your hands away from all moving parts. Do not try to defeat any of the system interlocks.

If, while operating this machine you encounter any problems, report them immediately by sending e-mail to plasmaquest@fab.mit.edu. The staff in charge will address them in a timely fashion.

PROCEDURE:

Check reservations in CORAL to insure that you reserved the correct machine in the correct facility for the correct date. Another user may have reservations; it is your responsibility to honor them, if this is the case.

'Engage' the machine in CORAL for the equipment that you are about to use; use this command BEFORE you start the operation. Insure that the correct facility is set (ICL, TRL, etc.) and that your lot name is entered correctly."

The CORAL switchbox must indicate "ON" in order to vent the loadlock**!!!**

Before you begin, check the water level in the heat exchanger (located to the left of the tool). If water is needed, the display reads "ADD." Please fill it with DI water using the beaker. Next, verify the heat exchanger temperature setting. For etching standard materials (oxide, nitride, silicon, polysilicon), it should be set to 25 degrees C. For etch processes using Chlorine (Cl2) or Boron Trichloride (BCl3); or for depositions, the temperature should be set to 80 degrees C. To change the temperature of the heat exchanger, press the SET TEMPERATURE button. Then use the UP and DOWN Arrows to set the temperature. Press the SET TEMPERATURE button again to exit the programming mode.

NOTE: It takes about 1 hour to the heat exchanger to reach 80 C.

Log on to the system by clicking on OPERATOR GUEST with the light pen; then click on LOGIN. Using the keyboard, enter your name and password. The STATUS of the machine will always be displayed when you first login. The functions an operator has access to are: STATUS, EDIT, and RUN.

Click on the RUN icon, then SELECT RECIPE. A list of recipes will appear. Scroll to the desired recipe. Click on your selection with the light pen; then click EDIT. The recipe you selected will appear on the screen. You will need to verify/set the process time. At the bottom of the recipe parameters, click on the arrows. These arrows will scroll the parameters to the << left and >> right. Only the step adjacent to the parameters column can be changed. To change a parameter, you must move the parameters column adjacent

to the desired step, and then click on the parameter you wish to change. In the center of the screen, a window will appear. Type in the desired numerical value and press ENTER.

PLEASE DO NOT CHANGE ANY OTHER PARAMETERS IN THE STANDARD RECIPES**!!!** Click on the CLOSE EDIT icon. The changes you entered will be automatically saved**!!!** This is why it is so important that you record all process parameters. There is no "write-protection."

ECR (Source) TUNING:
Under the column that supports the ECR meter, there are 3, ten-turn microwave tuning stubs. The tuning stubs are labeled from front to back as follows: MAX, MID, MIN. After the plasma lights, start with the coarse MAX stub and adjust it until the reflective power hit a minimum. Then adjust the MID tuning stub in the same way. Then adjust the MIN tuning stub to achieve as low reflected power as possible. Repeat this process as many times as necessary to achieve a reflected power less than 15 Watts.

RF (Bias) TUNING:
The bias system is equipped with an auto tune circuit; reflected power should read less than 10 Watts. Remember to record the bias voltage for the process.

Select the RUN icon located at the top of the screen. This is the Operation mode. Click START RECIPE and a window with 3 options will appear: 1) Run wafer already in the chamber, 2) Run the wafer on the load arm (if applicable), or 3) Vent the load lock and load a new wafer.

Normally, you run a 10 minute ETCHCLN using the dummy wafer already on the arm (option #2). After that, a window will appear and asks *DO YOU WANT TO UNLOAD THE WAFER*; click NO. Then you condition the chamber using the same dummy wafer with the process of your choice (click SELECT RECIPE then EDIT then START RECIPE, option #1). This time, click YES when the window appears and asks: *DO YOU WANT TO UNLOAD THE WAFER.*

After the load lock has come to atmosphere, (a prompt will appear on the screen saying *LL AT ATMOSPHERE*) open the cover. Remove and store the dummy wafer. Load your wafer onto the load arm. Ensure the major flat of the wafer matches the major wafer flat of the arm, otherwise the wafer may fall and break during transfer.

Close the cover. With the light pen, click on START RECIPE, and select "*WAFER ALREADY ON THR LOAD ARM*." By clicking the START icon, the process will run in the automatic mode; from load lock pump down to process completion. It will not automatically unload your wafer.

To unload your wafer from the chamber after process completion, click on yes when the prompt appears on the screen *DO YOU WANT TO UNLOAD THE WAFER.*

After your wafer is in the load lock, another prompt will appear: *DO YOU WANT TO VENT THE LOAD LOCK* click on the yes and the load lock will go into the vent cycle. Remove your wafer from the load lock. Repeat this routine until all your samples are processed.

To End an Etching Process:
When you are finished with your processing, the load lock must be pumped down to vacuum. To do this, place a dummy wafer onto the load arm. Click the LOAD icon and wait until the wafer is loaded into the chamber. After the wafer is loaded into the chamber, select the UNLOAD icon. This will bring the wafer back into the load lock. Click NO, when the prompt appears: *DO YOU WANT TO VENT THE LOAD LOCK*.

To End a Deposition Process:
When you are finished with your processing, remove your wafer and load a dummy wafer. The system must be cleaned after each use to remove particulate deposits from the chamber. To clean the chamber, click on SELECT RECIPE. Select the ETCHCLN recipe (cleaning should be performed for a minimum of 10 minutes). The recipe should be run10 minutes/micron of deposition. Click on START RECIPE, and select "*WAFER ALREADY ON THR LOAD ARM*." The process will run in the automatic mode; from load lock pump down to process completion. It will not automatically unload the dummy wafer. After the cleaning is finished, click on yes when the prompt appears on the screen: *DO YOU WANT TO UNLOAD THE WAFER*... Click NO, when the prompt appears: *DO YOU WANT TO VENT THE LOAD LOCK*. The load lock must be left under vacuum to keep the system dry. NOTE: DO NOT LEAVE THE WAFER IN THE CHAMBER.

Remember to reset the heat exchanger temperature to 25 degrees C (if applicable). Select the OPERATOR NAME at the top and click on LOGOUT located on the upper left corner of the screen.

Go to the CORAL terminal. In the comments field, please write in the number of wafers you processed, the total etching time, and the gases used.

Remember to "Disengage" the machine in CORAL.

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