

University of Minnesota Nano Fabrication Center

Standard Operating Procedure

Equipment Name: STS Etcher Recipe Writing
Coral Name: STS **Revision Number:** 2
Model: 320 **Revisionist:** Tony Whipple
Location: Bay 3 **Date:** 29 June 2010

1 Description

The Model 320 is a manually loaded batch plasma etching system.

2 Safety

If there is dangerous activity from the etcher, the system can be powered down in an emergency manner by pressing the Emergency off button. It is the large red switch on the upper right side of cabinet. Any other emergencies call 911 on any phone and also inform NFC staff of the emergency.

3 Restrictions/Requirements

- a Must be a qualified user.
- b Enable/Disable equipment using the CORAL system when in use.
- c Limitations on substrate materials are normal semiconductor materials such as oxides, Silicon, Nitride, resists, and polyimide type of products. Etching down to a metal layer below is fine.
- d What is NOT allowed is the use of a metal mask, non normal material such as bonding wax, rubber cement, oil and materials that could damage the system or other users' samples. Contact NFC staff if there are any questions

4 Required Facilities

5 Definitions

6 Operating Instructions

Log In to Recipe Editor

Press F6 to go to the Main Menu display.

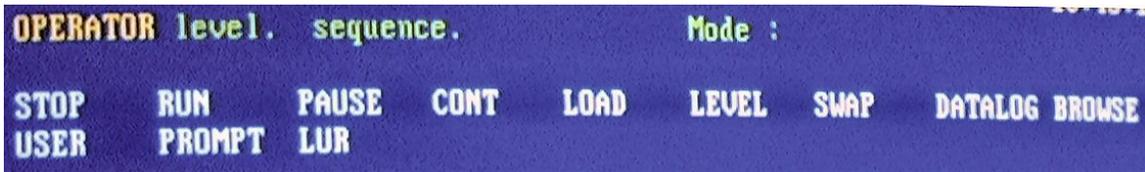


Pressing F8 will return back to the Text display. Do not press F7 the Mimic display option, as this will cause the software to fail.

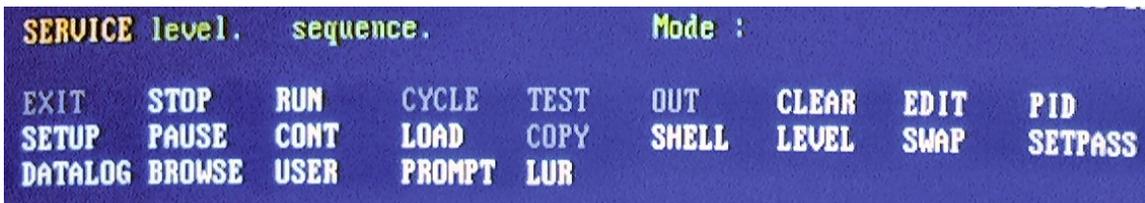
To write or edit a recipe you must be in the right level of software. The picture below does NOT have the SETUP option so you must type LEVEL first to log in.

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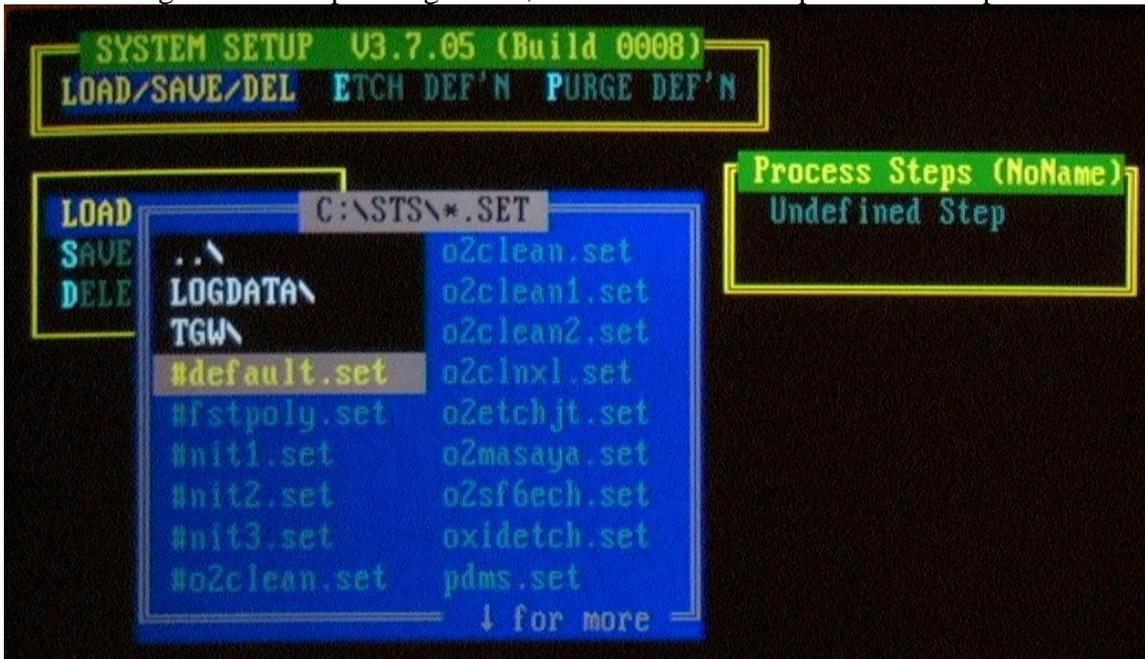


Type in LEVEL as access the recipe editor. Type in **Mtce** for the password. The computer will now display the SETUP option. Notice that is upper case M and the rest of the characters are lower case.



If you see the **SETUP** command listed, then type **SETUP** and press return.

This new display will have 3 boxes near the top and another box to the right side. The box to the right is the recipe being edited, it is labeled at the top "Process Steps"



You can move around the edit screen by using the arrow keys, making a selection with the return key, and jump back up menu layers by pressing the Esc key.

Select the recipe to edit by having the Load/Save/Del set and press enter or return. Choose Load and find the recipe to be edited. You can even select one recipe and edit it and then save it as a new name. Once the new name is selected you will see it in the box

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on the right side. A recipe can have several steps in it and they would be listed with a number in front. There also should be an **end step** also which is labeled “undefined step”, do not remove this step.



The recipe has been loaded and has only one step.

Now go to the **Etch Def'n** and from this select modify option. If you are going to be adding or deleting steps, select the other options. Once the **modify step** is selected you need to select which step from the box on the right side. Use the arrow keys up and down to select the etch step if more than one etch is listed and then press return.

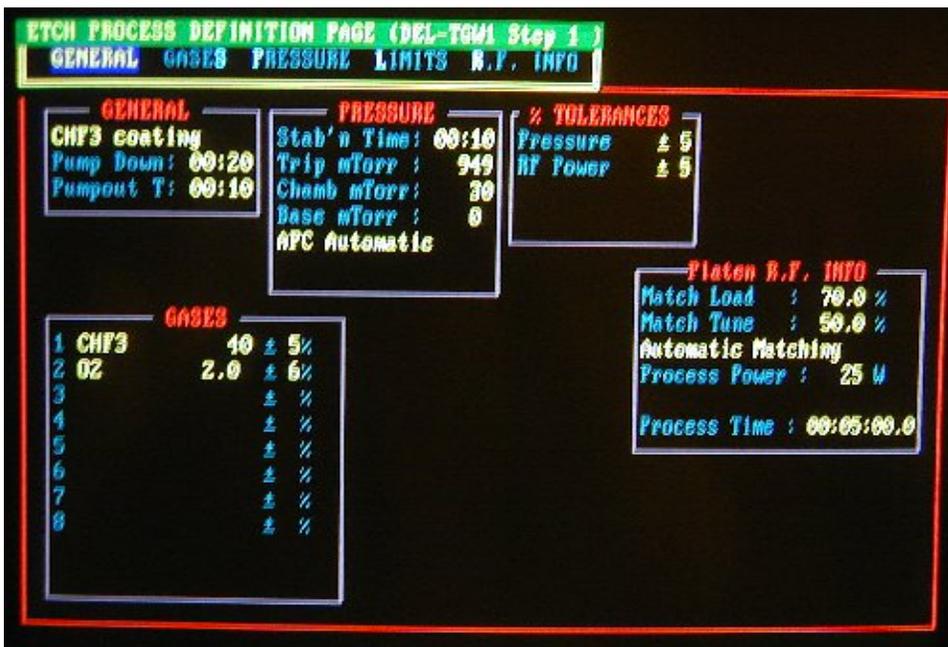


The Modify Step option is the normal one to edit, use others to add step.

A new screen is displayed listing all the variables for that one step. There are several options that are at the top menu of the editing area. Each word will allow editing to just that one item. The GASES menu will allow changes to the gas section which is the box in the lower left of the display. You can go through each of these items at the top and complete each one. When you are done editing each item and want to return to the top menu, just press the Esc key to move back.

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The recipe step being edited.

General – This has the item **DESCRIPTION** that can be edited, which is just info about the recipe step, DO NOT edit these.

Gases – This allows you to select which gases to use and at which flow values. The Gas Channel 1 is just the first gas you select, there is no order that must be followed in selecting which gas to use. Select the gas, the flow value, and tolerance which should be 5 % or less. The minimum flow values should be around 1 to 3 sccm and up to the maximum. But running at the maximum flow rate is not suggested since this will only waste the gas and it makes it harder to control the chamber pressure. Keep selecting gases as needed for the process, once done press the Esc key.

Pressure- The pressure of the process chamber is controlled as well as several other items. **Pressure is the only thing that should be adjusted here.** The min and max values for chamber pressure is around 30 mtorr to 300 mtorr and the tolerance may need to be set to higher value, but do not go over 15 % value. If your process is still having problems and is not controlling with a 15 % tolerance, then the angle valve should be set to a fixed number. Also know that to achieve the lower pressure values you might need to limit the amount of gas entering the system, reducing the total gas amount can help this.

R.F. Info - This sections sets the R.F. power level and also sets the process runtime. Most people have the process run time set for a longer than needed value and just abort the run once the time is reached. If you have many runs to do that a exact time then have the needed time set here. The **Process Power** level is limited to a min of 20 watts but you can try lower values, just make sure the plasma starts. A max limit for this system is set for 300 watts. If a higher value is thought to be needed contact the staff person for the

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system. The other item is the run time which is labeled as **HIGH RF Time** and this is in the form of **00:00:00.0** so it is **hours : min : seconds**

Add another step or save and exit the editor.

Once everything is completed press the Esc key to get back on level and select the Save key and it will allow you to press the **SAVE PROCESS** option. If you are making a new recipe and want to make a new name, you can type the new name in when it asks to write over the old recipe, and save the name of the new recipe name.



Exiting the recipe editor section. **Yes**, Quit now.

Press the Esc key until it asks if you and to exit, press the **Y** key. Sometimes the computer does not handle the exit correctly and it ends up at a DOS prompt. If this occurs, type this command to start the system software to get it running, which is **PROCESS** and press enter.

Designing an etch program:

The design of a etch recipe might be simple single step or a long multi-set sequence. Here are some of the items an etch recipe should be able to handle.

The first step is for one of two things, some times both is the **descum step** or the **breakthrough step**. The film might have resist scum on it from the photo process step, and this resist scum will prevent any etching in the area it is covering. The pattern of resist scum is strange and will only result in a very bad looking pattern after the etch step. The breakthrough etch step is for etching through the top layer of an unknown film that might slow the etching of the top. As it is etch through it might not happen at the same time resulting in a bad etch profile again. The first step is to etch through anything and have the main part of the film opened for the main part of the etch. This first step is only for a few seconds, and etches all films which is okay since it is so short. Once the top layer is cleared, the next step can be done.

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The **main etch** is the part which the bulk of the film is removed. This is where the etch recipe should be set to have the correct etching and selectivity along with any etch profile. From the etch rate testing or other testing the main etch step will need to be stopped after a given amount of time. If the main etch is allowed to etch too long then the layer below might be etched into, causing process problems. Knowing how fast the main etch step will etch in the layer below will help in deciding the level of risk the process can handle.

A **final etch** step is sometimes done which is the overetch step which is done to help remove any thing that still needs to be removed while the selectivity is to the lower level is much higher than the main etch step would be. This most likely is a lower power or a change of gases that limits the amount of etching to the lower film while still being able to etch any of the top film that was not yet removed.

Other etch steps might be needed and can be added after the main etch, as in if another type of film is needed to be etched. This can help in improving selectivity or etching several types of films. Keep in mind the previous layers might be affected by this next etch step. Another issue is that during the etching there can be polymer build up in the chamber or on the wafer surface which will alter the etching results.