University of Minnesota Nano Fabrication Center
Standard Operating Procedure

Equipment Name:	STS Etcher		
Badger Name:	K3 Etcher STS	**Revision Number:**	4
Model:	320	**Revisionist**:	Tony Whipple
Location:	Bay 3	**Date:**	26 March 2020

1 Description

The 320 is a manually loaded batch plasma etching system. The process chamber is configured for Reactive Ion Etching. System control is done by a personal computer which provides fully automatic operation. The system currently uses Fluorine based gases along with Oxygen and Argon. This is located in Bay 3.

Photo 1: The STS Etcher located in Bay3.

2 Safety

The system does not have any large safety items to watch for; the only safety concern is that the system does use electrical power. The gases are NOT dangerous, except in large amounts they could limit the amount of Oxygen a person gets. If there is dangerous activity from the etcher, the system can be powered down in an emergency manner by pressing the Emergency off button. This is some times referred to as the EMO button or EMO switch. It is the large red switch on the upper right side of cabinet. Any other emergencies call 911 on any phone and also inform MNC staff of the emergency. See Photo 2 for EMO location.

3 Restrictions/Requirements

a Must be a qualified user.

b 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. 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 people's samples. Contact me if there are any questions

4 Required Facilities

a Compressed air 80psi

b Nitrogen gas

5 Definitions

Process chamber: is the top lid area that contains the gases and where the wafers or samples are placed to be etched.

Computer: is the normal PC that controls the system. It has a normal keyboard and display monitor. This is where the system is controlled from. The chamber opening and closing, recipe selection, and etch starting and stopping is controlled from here.

Blue Chamber Lift Buttons: These buttons need to be pressed both at the same time to operate the lid to open and close.

EMO: Press this if there the system is acting in a dangerous manner, as in liquid is spraying out of the system or if there is electrical sparks or smoke coming from the system. Press the button inward and contact a MNC person about the problem.

Pump Status Display: This display panel only is used to note if the pump has stopped working. The LCD display should have a green box in the lower right corner, if not contact a MNC person to solve the problem.

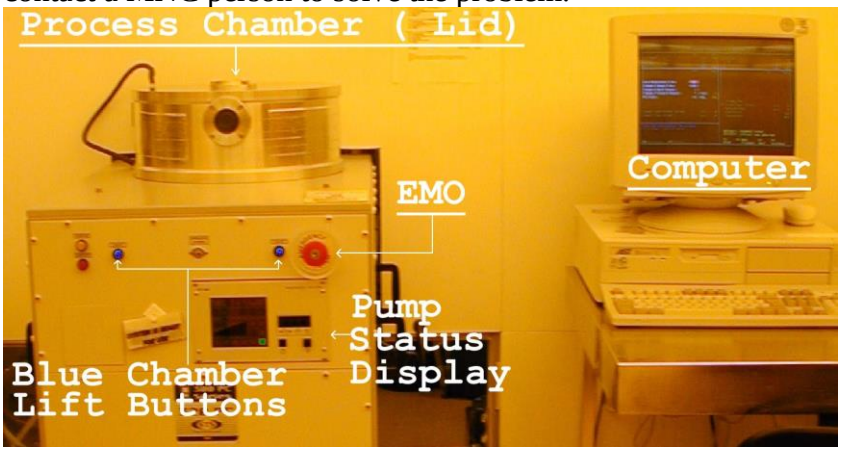

Photo 2: Location of key items of the STS etcher.

6 Operating Instructions

The instruction to run the system is easy; it only involves loading, unloading and selecting a process to run. The sequence for operation is listed below.

VENT:
To VENT the system Press **F3** on the keyboard.
The screen will ask**, OPEN VENT VALVE ?** Press F1 key to confirm venting.
The screen will now display, **Venting Chamber** this is take about 30 Seconds.
The two buttons in front of the system light up with blue color, press and hold until the lid stops moving up and back.

LOAD:
Load your samples into the center of the gray platen area. This will give you better uniformity for the etching. The etch rate on the edge might not be as good as the center, but this depends on the etch recipe and the material being etched. Putting a clean glass slide next or several around your sample might help it from moving from the center.

CLOSE:
More than one sample or wafer can be loaded during the run, the etch rate does decrease as you add more material to etch, this could be from 5 to 25 % if a decrease. Once the sample, or wafers are loaded the chamber needs to be closed, press the **F1** key again and press the two blue buttons and hold them until the lid is closed all the way down. It is best to HOLD the buttons two or three seconds longer after the chamber lid has stopped moving. This will make sure the lid is completely closed. Also make sure there is nothing that the chamber lid will close on top of when closed.

SELECT RECIPE:
The display on the screen will change and a list of recipes will appear. You can use the arrow keys or the Page Up or Page Down keys to scan for the correct recipe. Once the correct recipe is hi-lighted press the **ENTER** or the **RETURN** key to select the recipe. This list of recipes can be brought up to re-select a recipe at a later time, it is called **NEW PROCESS**. While the recipe is being loaded from the computer the chamber pumps down. After the chamber is pumped down the display will change to the normal **TEXT** display screen. Need to run the same recipe again?, just press the Escape key and this will reload the previous recipe.

START ETCHING:
At this time you can press **F1** to **ETCH** to start the etching recipe. Or **F2** to **NEW PROCESS** which will bring up the list of recipes that can be selected again, incase you wanted to select a different recipe. While pressing **F3** would allow you to **VENT** and remove your sample. The normal thing to do is to press **F1** to start the etching and have it run for a while. When it is time to stop the etching, press the **F1** key

labeled **ABORT** to end the etching. This is the only time that pressing something to **ABORT** is allowed, any other time will result in the system having an error.

UNLOAD SYSTEM:

After the etcher does the purge sequence the normal four options are displayed: **F1 ETCH**, **F2 NEW PROCESS**, **F3 VENT**, **F4 EXIT**. The **F4** option is never used. The normal step is to press the **F3** key to **VENT** the system to remove the samples. Do the same steps as before, and if the etcher is not to be used any more select the recipe called **DEFAULT** from the recipe list. The system can be left that with that recipe loaded. WAIT until the F1,F2,F3,F4 options are displayed then you can now log off of the system.

Below is a shorter sequence of events.
Log in
Vent system
Open lid
Load samples
Close lid
Select recipe
Etch samples
Press Abort key to end recipe from running.
Vent system
Open lid
Unload samples and load in more if another run is to be done.
Close lid and select new recipe, or select DEFAULT recipe if done using the system.
Log off

7 Problems/Troubleshooting

Program drops to DOS prompt.

If the system happens to exit the program and ends at the **DOS prompt**, type the word **PROCESS** at the prompt and press enter and the system should return back to running the system software. You will have to reload in the recipe that you were using.

A problem that happens from time to time is that the two blues buttons do not light up after the **F3 VENT** option was selected. After about 2 minutes press the **F1** key and select the default recipe. This will have the system pumping down. Try again to VENT the system by pressing the **F3** key, doing this a second time seems to work.

A +24 VOLT error:

There might be one of two reasons for this to happen. Most likely the cause would be that a user did not wait long enough before they are logged out of Badger. Log into Badger and press the button to retry, if it was only a Badger timing issue, error will

go away. The other reason might be that the pressure to the etcher is TOO low and it will not run until the supply pressure of the Clean Dry Air is high enough. This might a minutes to several hours. Contact a MNC person and let them know of the problem, if it does not change after a few minutes.

Turbo pump turns off, Red box on LCD display:
Another problem is that IF a person aborted an action while the timer was counting the system will error, the front pump display will have a red box showing the error. Contact a MNC personal to fix the problem. Pump status will have a red box on it.

Can not find your recipe after saving it:
The maximum number of programs allowed with a _____.SET type of files is around 215 files. So if there too many files the new ones will not be displayed and you can not run them. If you have some files that you wrote before you can delete them, or contact the MNC staff person for the STS. DO NOT delete other users programs.

Could not find a recipe that works; check the Appendix on how to write a recipe? Check the Appendix for the etch rate data sheet, and how to do etch rates yourself.

Extra hints:

The STS etcher is not the complete answer to all etch problems. It can do etching of some materials at a high rate while etching slower on other types of films. The choice of films that a person uses for a given process must be thought about and this includes what etch recipes will be used. Using the correct mixture of films and recipes can result in a good process that is useful and functional. Not taking in to account the give and take affect the recipes might have on the films used results in a process that has poor quality or parts that do not work.

So plan ahead, check the etch rate table of materials to plan for the desired process results. You may have to do several etch tests to confirm the results you want.