

# University of MN, Minnesota Nano Center

## Standard Operating Procedure

**Equipment name:** STS Etcher                      **Badger name:** STS  
**Revision number:** 3                                      **Model:** 320  
**Revisionist:** Paul Kimani                      **Location:** Bay 3  
**Date:** 1 October 2013

### A. Description

The 320 is a manually loaded batch plasma etching system. The process chamber is configured for Reactive Ion Etching. Substrates reside on a powered electrode. Chamber wall is grounded. A higher DC bias is developed on the electrode. System control is done by a personal computer which provides full automatic operation. The system currently uses Fluorine based gases.



**Photo 1: The STS Etcher located in Bay3.**

### B. Safety

The only safety concern is that the system uses electrical power. The gases are NOT dangerous, except when in large quantities they can limit the amount of oxygen available. If there is dangerous activity from the etcher, the system can be powered down by pressing the **Emergency Off (EMO switch)** button. It is the large red switch on the upper right side of the cabinet. Any other emergencies call 911 on any phone and also inform MNC staff of the emergency. See Photo 2 for EMO location.

### C. Restrictions/Requirements

- a. Must be a qualified user.

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- b. Substrate materials are limited to normal semiconductor materials such as **Oxides, Silicon, Nitrides, Resists**, and **Polyimide** type of products. Etching down to a metal layer below is okay. However, what is **NOT** allowed is the use of **metal as a mask**, non-normal material such as **bonding wax, rubber cement, oil** and materials that could damage the system or other people's samples. Contact MNC staff if there are any questions

### **D. Required Facilities**

- a. Compressed air 80psi
- b. Nitrogen gas

### **E. Definitions**

#### **1. Process chamber:**

This is the top lid area where the wafers or samples are placed to be etched.

#### **2. Computer:**

This is the PC that controls the system. It has a 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.

#### **3. Blue Chamber Lift Buttons:**

These two buttons need to be pressed at the same time to open or close the chamber lid.

#### **4. EMO:**

Press this button if 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 an MNC staff about the problem.

#### **5. Pump Status Display:**

This display panel is only 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 MNC staff to resolve the problem.

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

**F. Operating Instructions**

The instructions to run the system are simple and involve loading, unloading and selecting a process to run. The sequence of operation is listed below

- a. VENT:** To VENT the system Press **F3** on the keyboard.

The screen will request; **OPEN VENT VALVE**. Press F1 key to confirm venting. The screen will now display, **Venting Chamber**. This takes about 30 seconds. The two buttons in front of the system light up with a blue color. Press and hold both buttons until the lid stops moving up and back.

- b. LOAD:**

Load your samples onto the center of the grey platen area. This will give you better uniformity for the etch. 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 away from the center. More than one sample or wafer can be loaded. The etch rate does decrease as you add more material to etch. This decrease could be anywhere from 5% to 25 %.

- c. CLOSE:**

Once the sample or wafers are loaded, the chamber lid needs to be closed. Press the **F1** key and press the two blue buttons holding them until the lid is closed all the way down.

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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 in its path when the chamber lid closes.

**d. 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 desired recipe. Once the desired recipe is highlighted, press the **ENTER** or the **RETURN** key to select the recipe. If you accidentally select the wrong recipe, use **NEW PROCESS** to reselect a recipe. While the recipe is loading, the chamber also 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 after closing the chamber lid and this will reload the previously run recipe.

**e. START ETCHING:**

Press **F1 (ETCH)** to start the etching recipe or **F2 (NEW PROCESS)** which brings up the list of recipes again, in case you want to choose a different recipe. After pressing **F1** to start the etching, run the recipe for the desired duration. When it is time to stop the etching, press the **F1** key now labeled **ABORT** to end the etching. This is the only time that you should use the **ABORT** function; any other time will result in the system having an error. The system goes through a sequence of purging the etch products.

**f. UNLOAD SYSTEM:**

After the etcher is done with the purge sequence the usual four options are displayed again: **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 your samples. Proceed as in previous vent instructions. If you do not need any more etching, select the recipe called **DEFAULT** from the recipe list and press **ENTER**. **WAIT** until the **F1**, **F2**, **F3**, **F4** options are displayed then you can now disable in Badger.

**g. SUMMARIZED SEQUENCE OF EVENTS**

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**.

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### G. Problems/Troubleshooting

#### a. 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 previously.

#### b. Blue buttons do not light up

A problem that happens occasionally 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.

#### c. 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 labeled retry, if it was only a Badger timing issue, the 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 take a minute to several hours. Contact an MNC staff and let them know of the problem, if it does not clear after a few minutes.

#### d. 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 and the front pump display will have a red box showing the error.

Contact MNC staff personnel to fix the problem. Pump status will have a red box on it.

#### e. Cannot find your recipe after saving it:

The maximum number of programs allowed with a \*.SET type of files is around 215 files. So if this number of files have already been created and saved, new programs will not be saved and you cannot run them. If you have some files that you wrote before that you no longer need, you can overwrite or delete them, or contact the MNC staff person in charge of 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 determine etch rates yourself.

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#### **H. 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 other types of films slower. 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 effects a 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.