

# University of Minnesota Nano Fabrication Center

## Standard Operating Procedure

**Equipment Name:** Oxford Etcher  
**Badger Name:** P2 Etcher Oxford  
**Model:** 180-ICP  
**Location:** Bay 2 PAN

**Revision Number:** 5  
**Revisionist:** Tony Whipple  
**Date:** 27 Mar 2020

### 1 Description

The Plasmalab System100 ICP180 is a loaded locked plasma etching system made by Oxford Ltd. The process chamber is configured for Reactive Ion Etching with a ICP ( inductively coupled plasma). The system control is done by computer which provides fully automatic operation. The system currently uses Fluorine and Chlorine based gases along with other support gasses. This is located in Bay 3.



Photo 1: The Oxford Etcher located in Bay2 of PAN.

### 2 Safety

The safety concerns are the chlorine gases and that the system uses electrical power. 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 NFC staff of the emergency.



See Photo 2 for EMO location.

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### 3 Restrictions/Requirements

- a Must be a qualified user.
- b Do not edit recipes.
- c Limitations on substrate materials are normal semiconductor materials such as oxides, Silicon, Nitride, resists, metals and polyimide type of products. What is NOT allowed are non-normal material such as bonding wax, rubber cement, oil and materials that could damage the system or other people's samples. Ask if you have a question if your film is allowed. Whole 4 "wafers (100 mm) are only allowed, for small samples they need to be mounted onto a whole wafer. Using photoresist or cool-grease to attach small samples. The resist MUST be baked before loading in to the system. Do mounting work on tables not the system.

### 4 Required Facilities

- a Compressed air 80psi
- b Nitrogen gas
- c compressed air
- d Supplied gasses BCl<sub>3</sub>, N<sub>2</sub>, CF<sub>4</sub>, O<sub>2</sub>, CHF<sub>3</sub>, SF<sub>6</sub>, Cl<sub>2</sub>, and Ar

### 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: This 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.

Load – lock Lid: 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 NFC person about the problem.

Screen Icons: The computer screen has several icons that can be clicked on to make several actions happen.

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### 6 Operating Instructions

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

#### **Logging in:**

If you need to log in, click on the SYSTEM tab the **user name** and **password** is **NFC** in upper case for both.

#### **VENTING Loadlock:**

To VENT the Loadlock - click on the System Tab and select the Pumping button to display the PUMP CONTROL page. The lower left is the loadlock controls. Press the STOP button, and then press the VENT button. After a short while a timer will be displayed counting down from 200 Sec. Once the timer reaches zero open the loadlock lid, do not try to open the lid before that time, it will not open.

#### **LOADING wafer:**

Load your wafer flat against the two small pins on the robot arm. The flat needs to be on the pins. If you are doing small parts of a wafer you will need to attach it to a whole 4 inch wafer. Using resist bonding or Cool grease are two accepted methods of bonding samples. Resist bonding does not transfer heat very well. Close the lid cover.

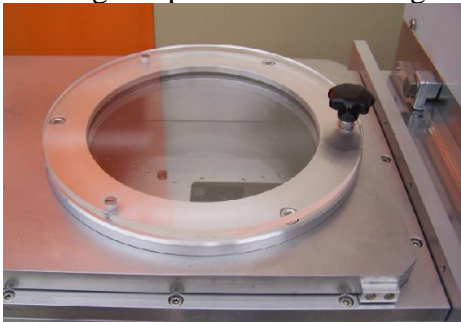
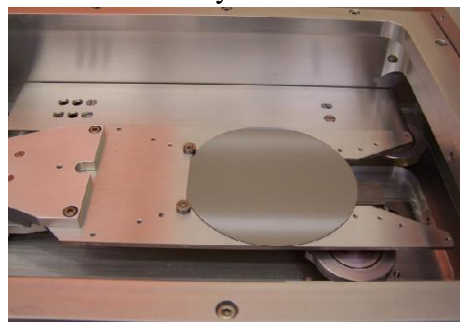


Photo 4: Loadlock lid closed



and wafer position on arm with the lid open.

Press the STOP button, and then press the EVACUTE button. The system will ask for a wafer name, enter what you like so it can be later found in the data log. ( The name is used by the software to keep track of the wafer if you try to etch it twice. ) You must wait until the Penning gauge displays a value, then go to the next step.

#### **SELECT RECIPE:**

Select the recipe - click on the Process Tab and select the Recipes button. The Recipe Page will appear, in the center click the Load button.

The software will ask if you want to **Overwrite current recipe** , it really means “ do you want to stop using this recipe? “ Click **YES** Select the recipe from the list.

#### **START ETCHING:**

At this time in the Recipe Page within the center section click the **Run** button.

You will be prompted for a wafer I.D. Enter a wafer name and press the OK button. The screen will change to the Process Control page see fig 5.

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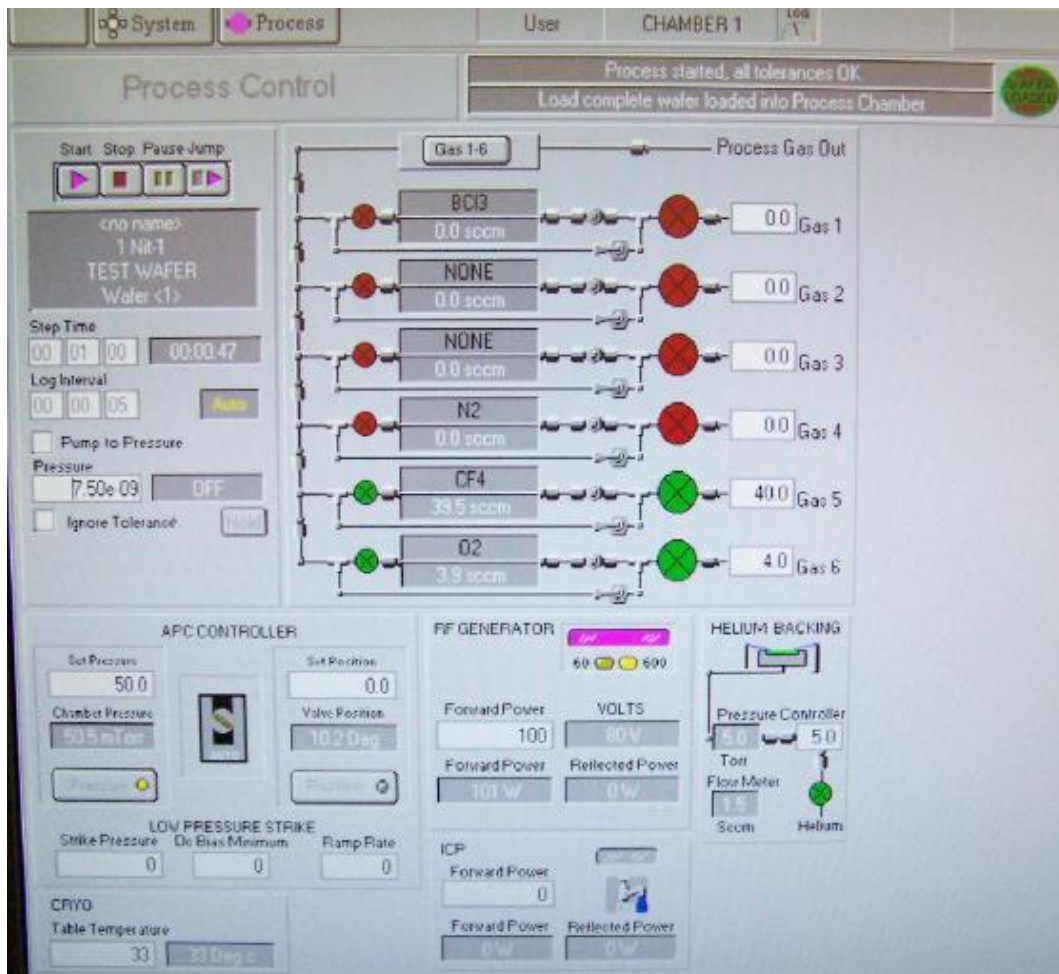


Fig 5 Process Control page

If the etch time is longer than needed it can be jumped to next step by clicking on the Jump button



Fig 6 Jump button

DO NOT JUMP out of the Purge or Pump process steps – or you may lose Coral access to the etcher, as this can cause the loadlock to be contaminated and corrode.

## UNLOAD WAFER:

Vent the loadlock to remove the wafer following the same procedure as listed above in the VENTING Loadlock section. Then load the next wafer or close lid if there are no other wafers to be etched.

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Below is a shorter sequence of events.

Log in  
Vent loadlock  
Open lid - Load wafer - Close lid  
Pump down loadlock - Enter wafer ID  
Select recipe – Yes over write  
Run recipe to etch sample - Enter wafer ID  
Press JUMP key to end recipe time from running.  
Vent system - Open lid  
Unload samples and load in more wafers if another run is to be done.  
Close lid and load in new wafer to be etched and start over again.  
If done using the system evacuate the loadlock – wafer ID press cancel  
Log off

### 7 Problems/Troubleshooting

#### **Program drops to windows display.**

If the system happens to exit the program, the software can be restarted by clicking on the PC2000 Icon. You will be prompted if there is a wafer in the loadlock, answer it correctly. You will have to log in again and reload in the recipe that you want to run.

If the software asks you if you want to stop the process and move wafer to the loadlock, answer / select YES. If you do not the wafer will be stuck in the chamber causing the system to stop working.

If there is a wafer in the chamber the software might handle this correctly, but if it does not display a wafer in the chamber, you will need to contact NFC staff to remove it. Sometimes by just pumping down the loadlock the wafer will be unloaded.

Sometimes a wafer will not be removed from the chamber when done etching, try pumping down the loadlock. This has happened a few times before and this solved it.

#### **Unknown error:**

There might be some unknown or new error that is has not been solved before. Contact a NFC person and let them know of the problem, if it does not change after a few minutes. Record the problem on Badgerl.

Check the Appendix for the etch rate data sheet.

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### Extra hints:

This 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 variables the recipes might have on the films etched might result 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. Having extra wafers with the correct film will help in doing this testing.

The Oxford etcher needs to have chamber cleans done regularly, run a recipe such as: N-Clean O2, N-Clean O2/CF4 Plasma, or O2/SF6 Plasma, run for 10 min.

Cool Grease can be used to mount small samples to be etched on a normal 4 inch carrier. While resist can be used, it does not have the thermal conductivity as cool grease does and the resist will not last as long. Make sure that there is no cool-grease sticking out from under the sample, as we do not want it exposed to the plasma.

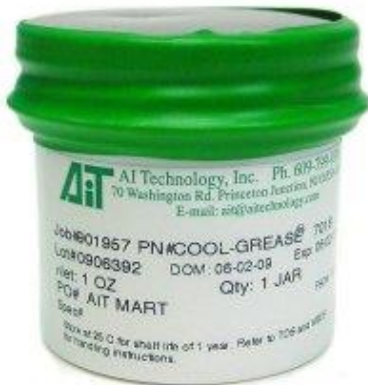


Fig 7 Cool Grease from [www.aitechnology.com](http://www.aitechnology.com)

Low temperature recipes keep the chamber at the low temperature when they are finished. The chamber needs to be raised to the normal idle temperature of 25 C and this can be done by running the **N\_Warm Up 25C** recipe.

### **Appendix:**

Recipe that start with N- xxxx are ones that have been made by NFC staff, Recipe that start with O-xxxx are Oxford company recipes they tend to have much higher etch rates.

If you need to have a recipe made or have etch rate questions contact the main NFC process staff person.

Recipe results will be listed near the system and online.