Table of Contents

1.0   Purpose/Scope

1.1   This document is intended to give the User an understanding of the proper procedure for the use of this tool. Should question arise that are not covered in the document it is requested that you ask a CSSER Staff member prior to continuing with any experiments as you might damage the tool, your sample or contaminate the chamber resulting in the possibility of causing harm to another person's project.

2.0   Reference Documents

2.1   Chemical Safety & Hazardous Waste Management Rules & Procedures

2.2   CSSER Rules & Procedures Handbook

3.0   Equipment/Supplies/Material

3.1   Wafer or standard tweezers

3.2   Isopropyl Alcohol

3.3   Clean room wipes

4.0   Safety

4.1   Follow all safety procedures outlined in the CSSER Handbook

4.2   Follow all Lock Out/ Tag Out procedures where they may apply.

4.3   Follow safety procedures for high voltage when working with high voltage or RF energy.

4.4   Follow safety and handling procedures when working with high pressure, pyroforic, or toxic gases.

4.5   In an emergency:

4.5.1   In an emergency, such as risk of personal injury, press the EMO (big red button) on the front of the tool. This will turn off all power to the machine, including the roughing pump in the sub-fab. Contact CSSER staff if this button is pressed.

5.0   Set Up Procedures

5.1   There are standard recipes on the tool. You will have access to change etch times only. **Any attempt to modify the recipes, pump parameters or purge cycles will result in loss of clean room privileges**. Contact CSSER Staff if you need to develop/modify an existing recipe (Additional charges may apply).

> **No III-V materials, metal or gold contaminated materials are to be run in this tool without proper CSSER approval. It is for Silicon based material processing only!**
>
> **CF4 Etch Recipes or Recipes with 20sccm of CF4 flow or larger must use the Graphite plate, failure to do so could result in loss of cleanroom privileges & possibly cost associated with replacement of the Quartz plate.**

5.2   Install the proper base plate in the chamber (Quartz or Graphite) located on the right hand side of the tool depending on your process needs. (Make sure unused unit is covered).

5.3   If using SF_6 chemistry the manual gas valve should be turned on at this point.

5.4   Check that the water flow meters are set to 0.4GPM for turbo & 0.6 GPM for electrode.

5.5   Check the temperature on the Turbo controller LCD display: ATP (Alcatel Turbo Pump) & ATC (Alcatel Turbo Controller) should not be above 30degrees centigrade.

5.6   Check UP/DOWN status of tool; DO NOT proceed if tool is DOWN. If you encounter any problems during your process contact a member of staff, place the tool sign to DOWN, and enter a service request at the CSSER Nanofab website at https://fultonapps.asu.edu/csser/sr.

5.7   At **Process** tab click on "**Chamber**" to verify a recipe is not running at present, if so wait till it has completed before continuing with any type of "Vent" or "pumping" cycle.

6.0   Procedure

6.1   System Start Up

6.1.1   From the on screen menu select **SYSTEM/PUMPING** to verify the status of the tool. All interlocks above the chamber diagram should be **GREEN.** Check that the chamber pressure is below 5.5×10^{-5} Torr before proceeding.

6.1.2   To log-on to the system select **SYSTEM/PASSWORD** from the menu and enter your username and password followed by selecting **OK.**

6.2   Loading a Sample

6.2.1   Select **SYSTEM/PUMPING** and press **STOP** followed by **VENT.** The unit will go through two vent operations, the first for 120 seconds, the second for 200 seconds. The chamber cannot be opened to atmosphere until the indicator reads **VENTING FINISHED**. Also be aware that the Pod interlock changes from green to red, indicating gas flow through the MFCs (Mass Flow Controllers) has been cut-off.

6.2.2   To open the chamber lid, rotate the switch on the chamber body to **CHAMBER UP** and press both blue buttons simultaneously. The lid will raise and rotate 90 degrees, ensure that the lid has come to a complete stop before proceeding.

6.2.3   Place your sample in the center of the quartz platen. When using whole 4" wafers orient them with the flat towards the operator, for etch repeatability.

6.2.4   To close the lid change the switch to **CHAMBER DOWN**, and hold down the two blue buttons until the lid returns to the closed position.

6.3   Chamber Pump Down

6.3.1   To pump the chamber to base pressure press **STOP** followed by **EVACUATE** on the PC. You will be immediately prompted for a wafer ID. You are required to input a unique wafer ID, this helps in troubleshooting and locating your run in the tool logs. Having entered your wafer ID click **OK.** There will be a short delay of approx 20 seconds before you will hear the chamber pump commence. Allow the chamber to pump below base pressure indicated by **BASE PRESSURE REACHED** before proceeding.

6.4   Recipe Selection & Set Up

6.4.1   Select **PROCESS\RECIPES**. The recipe window is split into two main areas, recipe creation and recipe edit. As a USER you only have access to recipe edit. To load your desired recipe select **LOAD**. You will be prompted to overwrite the previous recipe, select **YES** and select your recipe from the list shown.

6.4.2   The etch process generally consists of a pump step, followed by the etch step, followed by another pump step. To alter the etch time highlight the step denoted as **ETCH**, and left click on the mouse and select **EDIT** from the drop down screen. You will be able to change the etch time only. When you hit enter, the time will be saved for your process.

DO NOT ATTEMPT TO ALTER ANY OTHER PARAMETERS. THIS INCLUDES PUMP TIMES AND STANDARD RECIPES SUCH AS THE OXYGEN CLEAN AND LINE PUMP.

6.5   Etch Process

6.5.1   To run the etch process simply select **RUN** from the recipe window. The system will automatically switch to CHAMBER 1 view, which provides a schematic live display of the tool conditions. The following features are of note:

If you need to abort a running process:

While a recipe is running, you can ABORT the process by pressing the STOP ALL PROCESS button in the top right corner of the screen. This will turn off process gases, RF, and open the throttle valve. The turbo will still be pumping the chamber.

A screen will come up when you press the STOP button, asking if you wish to shut down the system. PRESS NO!!! A yes response will shut down the pumps. A full system restart is then required.

6.5.2   The top left of the screen shows the current step, recipe time for the step, and actual elapsed time. On the right are the MFCs set points and actual flows. On the bottom of the screen, the left side shows the vacuum set point and actual values. The right side displays forward and reflected RF power and bias voltage.

During the etch process make sure to enter the RF reflected power and the DC bias into the logbook.

6.5.3   After completing the entire process, including the post etch pump step, a yellow warning will pop up. Acknowledge the alarm by selecting **ACCEPT**.

6.6   Chamber Vent/Pump Down

6.6.1   This is automated by the manufacturer to perform several pump and purge cycles. When the chamber has reached atmosphere, open the chamber lid, remove your sample.

6.6.2   Close the chamber lid ensuring that it is fully closed.

6.6.3   Pump the chamber to base pressure press **STOP** followed by **EVACUATE** on the PC.

6.7   Line Pump Down and Chamber Clean

***Note: When you prepare to start the gas line/O2 clean select "evacuate" the tool will query for "wafer" or "no wafer" you need to press "Cancel" for no wafer.**

6.7.1   If you used SF_6 as a source gas the gas line needs to be pumped out to prevent corrosion of the system. Shut off the manual valve for SF6 on the gas stick, just before the regulator and run the recipe named **SF6 PUMP OUT/O2 Clean**.

6.7.2   When you are finished with your work, always run the O2 clean recipe for 10 minutes, do not attempt to alter the time of this process. Be sure to leave the tool under vacuum after the "OPT Plasma Clean" recipe has completed.

6.7.3   When processing is completed, log off the tool by selecting "Verify", no password is required. The tool will go into "View-Only" mode.

7.0   Forms

7.1   Oxford 80+ Run Sheets

USER:	DATE:	START TIME:	END TIME:
ETCHED MATERIAL:		**ETCHED MATERIAL DEPOSITION / GROWTH METHOD:** DVCEP MAEB-E)EBUT ETATS(ECANRUF NUPS)ETATS(REHTO	
SUBSTRATE:			
ETCH RECIPE:		**O2 CLEAN:**	
ETCH TIME:	mins	**REF POWER:**	W
DC BIAS:	V	**ETCH RATE:**	Å/min
COMMENTS:			

USER:	DATE:	START TIME:	END TIME:
ETCHED MATERIAL:		**ETCHED MATERIAL DEPOSITION / GROWTH METHOD:** DVCEP MAEB-E)EBUT ETATS(ECANRUF NUPS)ETATS(REHTO	
SUBSTRATE:			
ETCH RECIPE:		**O2 CLEAN:**	
ETCH TIME:	mins	**REF POWER:**	W
DC BIAS:	V	**ETCH RATE:**	Å/min
COMMENTS:			

USER:	DATE:	START TIME:	END TIME:
ETCHED MATERIAL:		**ETCHED MATERIAL DEPOSITION / GROWTH METHOD:** DVCEP MAEB-E)EBUT ETATS(ECANRUF NUPS)ETATS(REHTO	
SUBSTRATE:			
ETCH RECIPE:		**O2 CLEAN:**	
ETCH TIME:	mins	**REF POWER:**	W
DC BIAS:	V	**ETCH RATE:**	Å/min
COMMENTS:			

8.0   Tables

8.1   Standard Recipes

	SiO2 etch	Si3N4 etch	SF Si etch*	Fused Silica etch
Gas 1 (sccm)	CHF_3 - 25	CHF_3 - 50	SF_6 - 50	$CF_4 - 31.7$
Gas 2 (sccm)	Ar - 25	O_2 - 5	O_2 - 10	CHF3 – 31.7
Gas 3 (sccm)				Ar – 31.7
Pressure (mtorr)	30	50	150	200
Power (Watts)	200	150	100	250

* SF6 Recipe Note: This has a 20 second SiO2 punch through step!

8.2   Etch Rates (performed on standard patterned & blanket etch 4" wafers)

Recipe		Film		
	Oxide	Nitride	Silicon	Photo resist
Oxide (Quartz plate)				
Patterned 200W	350			203
Blanket 200W	407			
Oxide (Graphite plate)	405			670
Nitride(Quartz plate)				
Patterned150W		616		749
Blanket 150W		568		
Nitride(Graphite plate)		603		225
Silicon(Quartz plate)SF6			10342	694
Silicon(Graphite plate)SF6			1322	516
CF4/O2**		349	275	283

All Etch rates in A/Min

Effective Date	Originator	DESCRIPTION OF REVISION	Issue
1/18/05	Gez Laws		2
3/15/06	Tim Eschrich		3
8/15/08	Jon Martin	Documents format was changed to a uniform procedure.	A
11/5/10	Jon Martin	Change/Additions to Sections 5.3, 5.4 & 6.7	B
7/31/12	Jon Martin	Graphite Plate usage & Etch Rate Updates	C