Arizona State University NanoFab

PLASMATHERM 790 RIE

Version A

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1. 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. Reference Documents

2.1. Chemical Safety & Hazardous Waste Management Rules & Procedures

2.2. CSSER Rules & Procedures Handbook

3. Equipment / Supplies / Material

3.1. Wafer or standard tweezers

3.2. Isopropyl Alcohol

3.3. Clean room wipes

4. 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, pyrophoric, 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. 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).

5.2. 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.

5.3. Click on the process tab click on to verify that the tool is in "idle" state and 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. Operation Procedures

6.1. System Start Up

6.1.1.   Create a run log on the iPad provided near the tool. Select your username from the drop down menu and note down the recipe to be run and the material etched.

6.1.2.   Log into the tool's software interface using your **username** and **password** by clicking on the user login button on the top right side of the screen.

6.1.3.   (Optional) Run a "Clean" Recipe to run a plasma clean and ready for processing.

6.1.4.   (Optional)Run a conditioning run (same recipe that you intend to use). This conditions the chamber and sets up the matching network.

6.2. Loading a Sample

6.2.1.   Click on **PROCESS** or **SERVICE** tab and click on **VENT.** The unit will go through vent operations. Wait till the chamber pressure reaches 760 T and the **STATE** changes to **VENTED**. The **INFO** will read **CHAMBER VENT COMPLETE**.

6.2.2.   To open the chamber lid, ensure that the computer monitor and keyboard are moved to the side so that the lid does not strike them while being raised. Following this, open the clam-shell lid of the chamber.

6.2.3.   The graphite plate of this tool cannot be changed. Clean the plate with a **dry** clean room wipe and place the sample in the center of the plate. (Do not use IPA to clean the surface of the plate)

6.2.4.   If the sample falls into any of the pumping ports do not attempt to take any part of the tool apart to retrieve it. **Do not start the pump down process**. Close the lid, put the tool "**DOWN**" and inform CSSER staff.

6.2.5.   Clean the O-ring and the upper surface of the seal with a **dry** clean room wipe. Do not touch the shower head on the bottom surface of the lid.

6.2.6.   Close the lid and hold it down with a small force when the chamber starts pumping down.

6.3. Chamber Pump Down

6.3.1.   To pump the chamber to base pressure press **PUMP CHAMBER/TURBO** from the **PROCESS** or **SERVICE** tab *while holding down the lid* with small pressure. Keep holding the lid down till the **INFO** reads **ROUGHING CHAMBER DOWN**. Subsequently the turbo pump will kick in and the **STATE** will read **PUMPING IDLE.**

6.4. Recipe Selection & Set Up

    6.4.1. To view a standard recipe click on the **RECIPES** tab and click on **LOAD RECIPE** to display a given recipe's run parameters.

    6.4.2. In the **PROCESS** tab select the required standard recipe from the list on the page and click on **START JOB**. The only aspect of these standard recipes that can be altered is the run time. The run time can be changed in step 4 of the recipe selection 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. After the run time is specified and the **START JOB** button is clicked the recipe starts to run. The process generally consists of a pump step, followed by a gas and pressure stabilization step, followed by a plasma ignition step, followed by the etch step and finally a pump out step. Note down the **Process Pressure, Forward Power, Reflected Power, and DC bias** in the run log system on the iPad.

    6.5.2. The top right of the screen shows the current step, recipe time for the step, and actual elapsed time. On the left 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 iPad run log.**

    6.5.3.After completing the entire process, including the post etch pump step, the system will go into **IDLE** mode.

6.6. Chamber Vent/Pump Down

    6.6.1. When the **STATUS** reads **PROCESSING COMPLETE**, click on the **VENT** button to start the chamber vent process.

    6.6.2. Wait till the chamber pressure reaches 760 Torr and the **STATE** changes to **VENTED**. The **INFO** will read **CHAMBER VENT COMPLETE**. Open the lid and take out your sample.

    6.6.3. Close the chamber lid and hold the lid down with a small amount of pressure.

    6.6.4. Pump the chamber to base pressure press by clicking on **PUMP CHAMBER/TURBO** buttons on the **PROCESS/ SEVICE** tabs. Ensure that the chamber has indeed pumped down before leaving the tool. This will take about 1-2 minutes.

6.7. Line Pump Down and Chamber Clean

    6.7.1. It is not mandatory to run a plasma clean recipe on this tool after a user has finished processing.

    6.7.2. Log out of the user interface on the tool.

    6.7.3. Go to the Tool-in-Use page on the run log interface on the iPad and click on run completed.

7. Tables

7.1. Standard Recipes

	Si Trench Etch	SiO$_2$ Etch Isotropic	BCB Etch	Polyimide Etch Isotropic
SF$_6$ (sccm)	25	-	25	10
CF$_4$	-	45	-	-
CHF$_3$	-	-	-	-
O$_2$ (sccm)	25	5	25	40
He	-	-	-	
Pressure (mTorr)	100	900	60	200
Power (W)	180	200	350	200
DC Bias (V)	150	-	500	-
Etch Rate (Å/min) Typical	5000-7500	350-500	2700	2000+
Notes	Process is load dependent. SiO$_2$ mask selectivity 10:1. Etch factor of 5:1 achievable	Process will etch thermal and PECVD oxide.	-	Etch rate increases with increasing flow.

7.2 Standard Recipes

	Silicon Nitride Etch (High Rate)	Silicon Nitride Etch (Passivation Removal)	Silicon Nitride Etch (Selective to Si)	Photo-Resist/Polyimide Etch (Anisotropic)	Photoresist Descum
SF_6 (sccm)	-	33	-	-	-
CF_4	45	-	-	-	-
CHF_3	-	-	45	-	-
O_2 (sccm)	5	7	5	10	18
He				10	-
Pressure (mTorr)	40	75	40	10	10
Power (W)	200	85	200	200	100
DC Bias (V)	425	-	440	500	-
Etch Rate (Å/min) Typical	1000-2000	1000	400-500	1000	600
Notes	Can be used if underlying layer is not attacked by Fluorine.	-	Selective to Al, Si and materials that etch in Fluorine.	Optimum performance obtained with SiO_2 mask.	30 sec Etch sufficient to clean up.

8. Revision History

Effective Date	Originator	DESCRIPTION OF REVISION	Issue
8/5/2016	Rohit Sarkar/Kevin Hilgers	Initial Release	A