STANDARD OPERATING PROCEDURE for XeF2 Etcher

Coral Name: XeF2
Model #: SE Tech ES-2000XM
Location: TRL
What it does: Isotropic Silicon etcher

INTRODUCTION:

This tool is an isotropic Silicon etcher. It is highly selective to Oxide, Photoresist, Nitride, and Aluminum (see Appendix below). It is a Gold-contaminated tool and accepts any size or piece up to a 6" wafer. This system has three chambers: Source, Expansion, and Etch. The Source chamber is where the bulk of the Xenon Difluoride is stored. At the beginning of the etch process, a valve opens between the Expansion and Etch chambers. When the etch pressure rises to 2000 mTorr the valve closes and the etching of the sample begins. Finally, the etch chamber is evacuated and the entire process is repeated, as necessary. There are four programmable timers that control these operations. Use the up and down arrow keys to modify these timers.

During training you will learn to write a recipe, and run a process. You must receive training before using the XeF2 etcher.

Before operating this system you must RESERVE the equipment in CORAL.

It is mandatory to ENGAGE the machine before you start processing. Please enter etch rate data in CORAL and the logbook by the tool

If you encounter any problems while operating this machine, report them immediately by sending e-mail to XeF2@fab.mit.edu. The staff in charge will address them in a timely fashion.

SAFETY:

Xenon Difluoride is a solid compound and is both toxic and a strong oxidizer. During the etch process, it sublimates and forms Fluorine gas, (both toxic and corrosive.) Do not attempt to change the XeF2 source! Keep your hands away from all moving parts. Do not remove any machine panels or go behind the machine. Do not try to defeat any of the system interlocks.

Note: Before using this machine, you should learn the location of the EMO button on the front panel of the tool.

PROCEDURE:

Log into CORAL and use the ENGAGE MACHINE command. The CORAL switchbox should indicate "ON". This is necessary in order to open the Chamber.

Note: If the pressure of the source chamber is under a 1000 mTorr, then the source may need to be refilled. If so, then notify the Staff immediately by sending e-mail to: XeF2@fab.mit.edu.

I) STARTING UP:

1) **Turn the rotary switch on** (main power)
2) **Push the system power button.** It should light.
3) **Push the Vacuum Pump button**. It should light.

Note: If the source chamber pressure is out of range then an audible alarm will sound. Push (and hold) the reset **[RESET]** button for a second. If there is no problem, then the stand-by **[STBY**] lamp will be on.

II) CREATING THE PROCESS RECIPE:

1) Setting the Purge Time. The gas purging timer adjusts the time for the pulse of XeF2 to diffuse throughout the chamber Currently, the purging time is 3 seconds and should not need modification (see Note).
Note: The valve will shut before the programmed time expires when the pressure in the Etching chamber exceeds 2800 mTorr.

2) Setting the Hold Time. This is the actual etching time. Normally, it is between 10 and 180 seconds. The starting pressure should be about 2800 mTorr. You should see a gradual, fairly constant, increase in the Etch Chamber pressure during this time. This is due to the production of SiF4 gas as the XeF2 etches Silicon.
Note: The Etch chamber pressure must be below 25 mTorr to start the process in the AUTOMATIC mode.

3) Setting the Vacuum Time. Currently, the pumping time is 20 seconds and should not need modification. This step allows the byproducts of the reaction to be evacuated before another etch cycle starts.

4) Setting the Step. The number represents how many cycles (of purge, hold, and vacuum) will be repeated. It is dependent on the etch rate and total etch depth desired.
Note: If the cycle counter fails to count it is because the Vacuum Time is too long and it is exceeding the alarm setting of 25mTorr.

III) LOADING THE CHAMBER:

1) Vent the Etch Chamber. Press (and hold) the Etch Vent button **[EVENT],** until the light goes on. The Etch chamber will vent to atmospheric pressure. Then the **[EVENT]** light will go out to indicate the chamber has vented.

2) Open the Etch Chamber. Push both green buttons located on either side of the etching chamber, and the chamber will rise.

3) Place the sample on the chuck.

4) Close the Etch Chamber. Push both green buttons located on either side of the etching chamber, and the chamber will close.

IV) RUNNING THE PROGRAM:

1) Select the Automatic Mode. When the stand-by **[STBY]** lamp is on, you can change the mode (from Manual to Auto). Press the **[A/M]** button until it lights. Simultaneously, the **[STBY]** light will go off. The tool is now in the Automatic Mode.

2) Press the Start button. The process starts when you push the **[START]** button.

Note: The pressure in the Etch chamber must be below 30 mTorr before the actual processing begins. Please be patient, it may take a minute or so.

3) When the alarm sounds. Press the **[RESET]** button to stop the alarm. The process is complete. The Etch chamber has been pump/purged several times and left under vacuum.

V) UNLOADING THE CHAMBER:

1) Press the [A/M] button. The **[A/M]** light will go off, and the tool is back in manual mode. The **[STBY]** light will come on.

2) Vent the Etch Chamber. Press (and hold) the Etch Vent button **[EVENT],** until the light goes on. The Etch chamber will vent to atmospheric pressure. Then the **[EVENT]** light will go out to indicate the chamber has vented.

3) Open the Etch Chamber. Push both green buttons located on either side of the etching chamber, and the chamber will rise.

4) Remove the sample from the Etch Chamber.

5) Close the Etch Chamber. Push both green buttons located on either side of the etching chamber, and the chamber will close.

6) Pump the Etch Chamber. Press the **[V1**] button to open the valve to evacuate the Etch Chamber. Wait until the Etch Chamber pressure gets to 50 mTorr, and then press the **[V1**] button to close the valve to the chamber.

VI) SHUTTING DOWN:

1) Press the Vacuum Pump button on the panel.
2) Turn off the rotary power switch on the panel.
3) Disengage from CORAL
4) Record your results in the logbook

VII) APPENDIX

Material:	**Effect:**
Acrylic	Does not etch
Aluminum	Does not etch
Gallium	Does not etch
Molybdenum	Etches
Nickel	Does not etch
Nitride	Does not etch
Packaging metal	Discolors
Poly-Si	Etches
Photoresist	Does not etch. May be difficult to strip after long etches
Platinum	Does not etch
Silicon	Etches up to 10 μm/min
Silicon Carbide	Does not etch.
Silicon Germanium	Etches

Titanium	Etches
Tungsten	Etches very rapidly

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