



Standard Operating Procedure (SOP)

XeF₂ SPTS/Xactix Isotropic Etcher

(DE-06)

In case of fire or injury please call 911 (511 from campus phones)

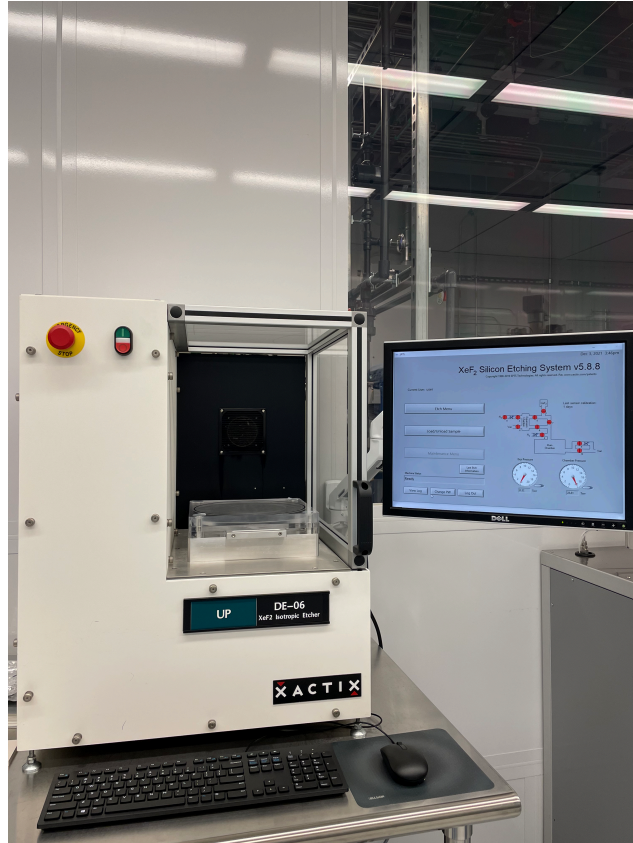
If there is an error on the system/tool please report it on IRIS, the staff will take care of it

Please *DO NOT* run diagnosis without a staff member's approval

General safety tips and common mistakes

- 1) If the system is not running, make sure you are logged into the tool on IRIS.
- 2) The XeF₂ pressure cannot get to 3 Torr fast. If you need to run at those pressures, cycles may take longer than expected.
- 3) Etch rate depends on the placement of sample inside the chamber, as well as the amount of surface available for etch.

XeF₂ SPTS/Xactix Isotropic Etcher



- Primary tool owner: Sam Azadi.
For questions regarding process development and characterization of etch rates contact Sam Azadi at: azadi@seas.upenn.edu
Problems with the tool **MUST** be reported on IRIS. Do not contact primary tool owner with tool issues directly.

Procedure Overview

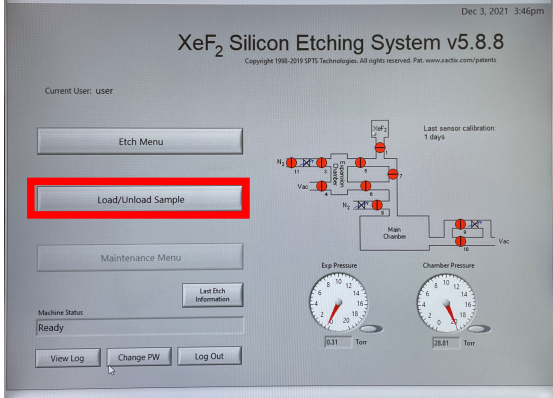
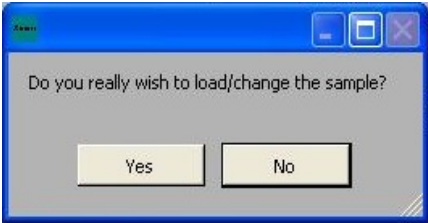
- 1) Vent the chamber, load sample(s) and pump the chamber
- 2) Set recipe parameters and run etch
- 3) Vent chamber, retrieve samples and pump the chamber

Tool Overview:

XeF₂ etch is a gas/chemistry isotropic etch that removes materials by chemical reaction from all directions. This method is ideal for etching Si. XeF₂ crystals sublime at room temperature with vapor pressure of ~ 3 - 4 Torr. The gas is introduced inside an expansion chamber and into the etch chamber. Given the reaction-based nature of the process, etch rate depends on the availability of gas on the etch surface, hence the rate is strongly dependent on the surface area available to etch, as well as placement of the samples inside the chamber. Given a constant gas pressure, the higher the surface area, the lower the etch rate. Nitrogen gas can be introduced in the chamber to increase selectivity and reduce surface roughness.

The gas does not etch photoresist, though it will be difficult to strip the resist after long etches.

Full procedure:

<p>Log into the tool via IRIS</p>	
<p>1. Vent the chamber, load sample(s) and pump the chamber.</p> <p>1.1. Click “Load/Unload Sample”, click “Yes” on the pop-up window.</p> <ul style="list-style-type: none">- The chamber gets purged and flushed with N₂ gas before venting to atmosphere. <p>1.2. When the chamber is vented, the following dialog box appears. The chamber is vented, and it must not be kept at atmospheric pressure for long!</p> <p>Attention! XeF₂ gas reacts with atmospheric moisture and produces hydrofluoric acid (HF) so it is absolutely critical to prevent moisture from building up inside the chamber.</p>	 

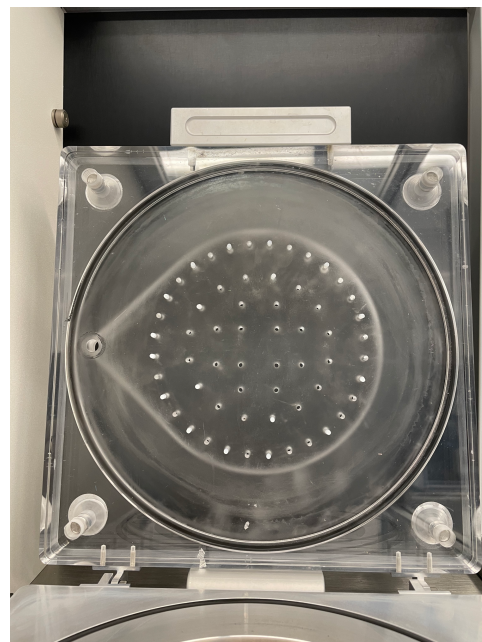
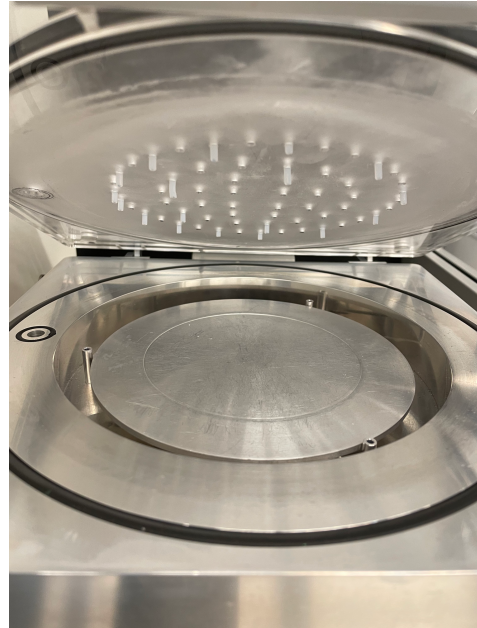
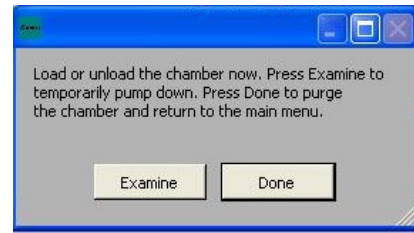
If you need to examine samples that are in the chamber, take them out and click “**Examine**”. If you need to load sample in the chamber, load them quickly sand click “**Done**”.

Note:

“Examine” only pumps the chamber down without purges so the system can be quickly vented to load samples. This is very helpful when examining a sample away from the system to prevent moisture from accumulating in the chamber. However, it is always necessary to press “Done” before etching samples.

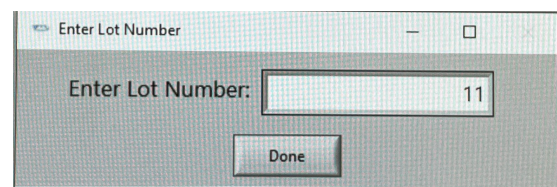
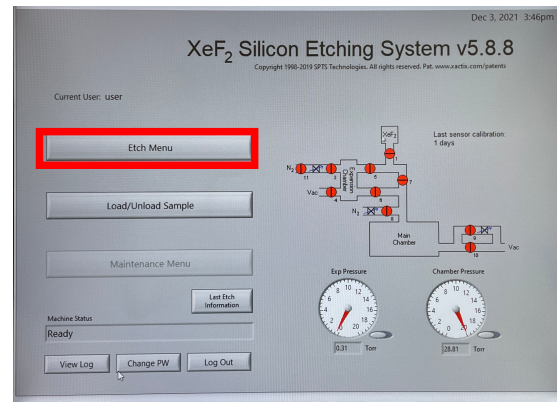
Attention! The gas inlet to the chamber are the open holes in the chamber lid, as shown in the picture. Some of the holes are blocked by plastic rods. This means the placement of your sample in the chamber affects etch rate. Keep this in mind when loading your samples.

Once you click “**Done**”, the chamber starts pump down sequence starts.



2. Set recipe parameters and run etch:

2.1. Click on “Etch menu” and give your run an etch lot number.



There are two types of etch recipe:

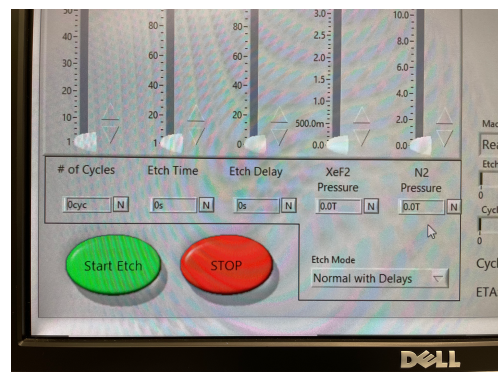
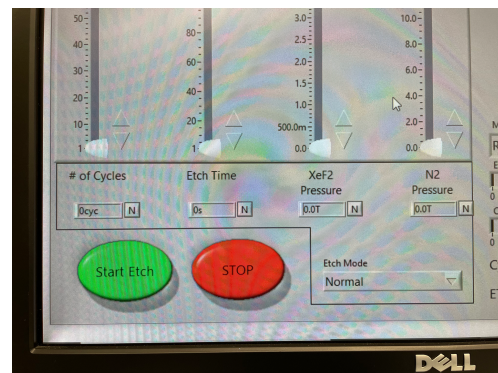
1. Normal
2. Normal with delay

The recipe with delay allows for the sample to cool down, resulting in a higher etch rate for the subsequent step.

It is recommended for long etches, a delay of 3 s to be applied.

Attention! The N2 Pressure can be kept at zero. N2 gas is used only when a smoother surface after etching is required, or a more selective etch is desired. For complete removal of Si, we recommend no N2 use.

2.2. Click “Start Etch” once you finish setting up your recipe



3. Vent chamber, retrieve samples and pump chamber:

3.1. Click “**Load/Unload Sample**”, click “**Yes**” on the pop-up window.

- The chamber gets purged and flushed with N₂ gas before venting to atmosphere.

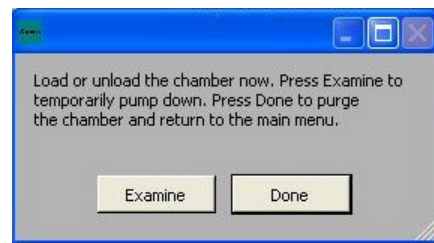
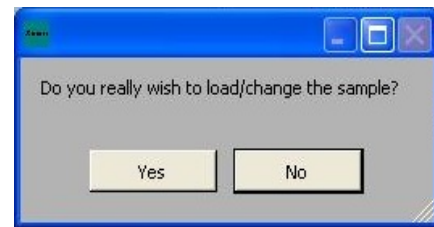
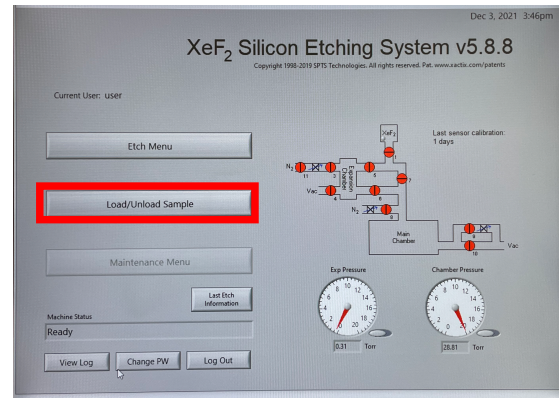
3.2. When the chamber is vented, the following dialog box appears.

The chamber is vented, and it must not be kept at atmospheric pressure for long! Retrieve your samples.

3.3. If you are done with etching, click “**Done**”. If you need to examine your samples, take them out, click “**Examine**”.

3.4. If after examining, you find out that samples need more etching, repeat the procedure to step 1.

Log out of the tool via IRIS once the pumping is done



Feel free to contact the staff members with any questions about your process and the tool.