XENON DIFLUORIDE ETCHING SYSTEM

LOCATION: Plasma Etch Area

PRIMARY TRAINER: Scott Munro (2-4826, smunro@ualberta.ca)

1. OVERVIEW

The Xenon Difluoride (XeF_2) etching system is available to users who require a dry, isotropic etch of silicon. XeF2 is a gas-phase etchant, and is typically used for MEMS dry release or silicon sacrificial layer removal. The etching process is relatively gentle and mask selectivity to silicon is generally very good.

2. SAFETY PRECAUTIONS

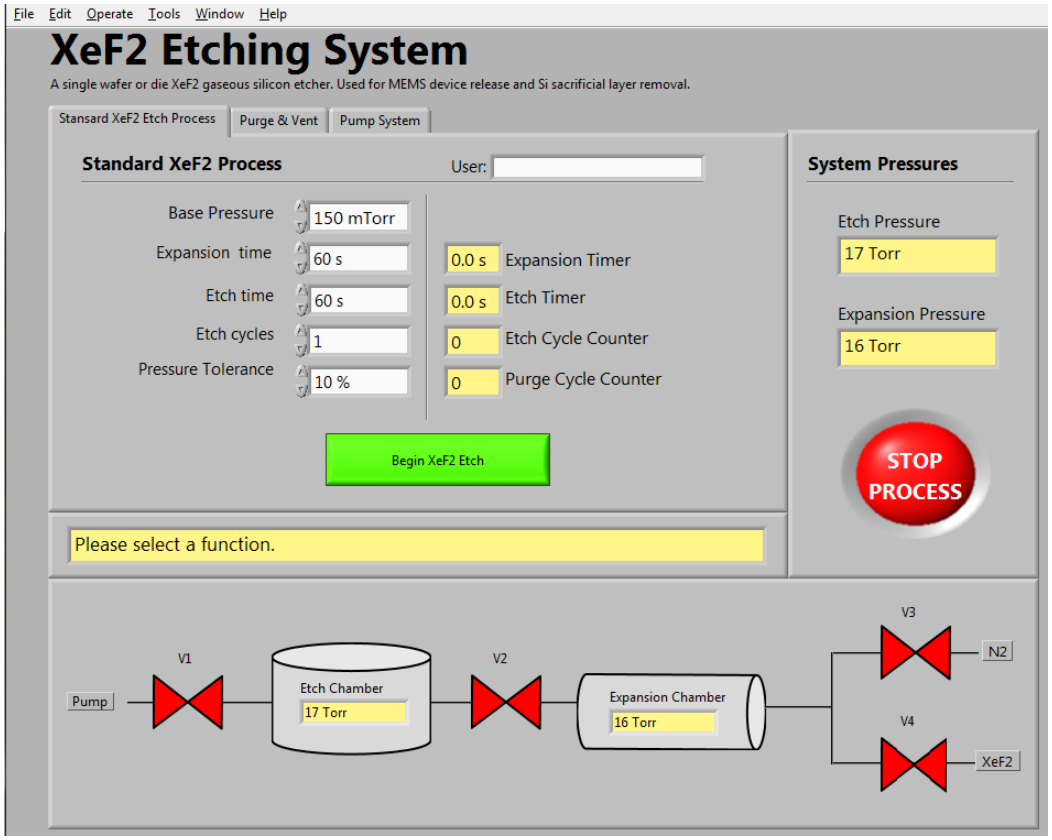
XeF2 is a solid at standard temperature and pressure, and sublimates at pressures <4T at room temperature. In this phase, the F will react with any exposed silicon, and etching occurs. If there is any moisture present, HF will be produced, and is a safety hazard. The sample should be clean and dry and chemical resistant and gloves must be worn during loading and unloading.

The software program must be running before the main power switch is turned on. If not, there is no control over the valves and the entire system will be left pumping which will quickly consume the XeF2 crystals and potentially damage the system.

If you are bringing any new materials into the NanoFab for use in your process, it is necessary to fill out a chemical import form (available on our website, http://www.nanofab.ualberta.ca) and supply an MSDS data sheet to Stephanie Bozic.

3. Operating Instructions

3.1. The system will likely be powered down. Before turning on the main power switch, ensure the software program is running. If it's not, double-click the **XeF2** icon to start. The following screen must be displayed before the power switch is turned on:



Standard XeF2 Etch Process Tab

3.2. With the software running, turn on the switch located on the front panel of the system. The system will likely be under vacuum. It is recommended that the system be "conditioned" by performing blank run on an empty chamber prior to running samples. A blank run of 5 cycles is typical.

3.3. To start the condition run, ensure the chamber is empty. Click the **Standard XeF Etch Process** tab, and edit the number of cycles in the **Etch Cycles** cell.

3.4. The default **Base Pressure** should be set to **150mT**, both the **Expansion Time** and **Etch Time** set to **60s**, and the **Pressure Tolerance** should be set to **0%**. These are the default etch parameters andmay be adjusted, but adjusting will affect the etch process. It is not recommended that these be changed unless you know what you are doing. Add a comment in the **User** cell for a log file name.

3.5. Press **Begin XeF2 Etch** to begin the conditioning run. The total time for each pulse if using the default 60s settings is ~3.5min.

3.6. Once the conditioning run is complete, the chamber will vent automatically. Put on chemical resistant gloves and undo the 6 locks to release the lid of the chamber. Remove the sample holder from the chamber.

3.7. Place the sample on the holder, and from underneath the holder, raise a spring loaded clip and slide the sample under one or more clips. Ensure the sample is secure as the chamber may be turbulent during the process. The holder and chamber can handle a maximum sample size of 100mm diameter.

3.8. Load the sample holder into the chamber and replace the chamber lid. Ensure the o-ring is properly seated between the lid and chamber. Do up the 6 locks to secure the lid.

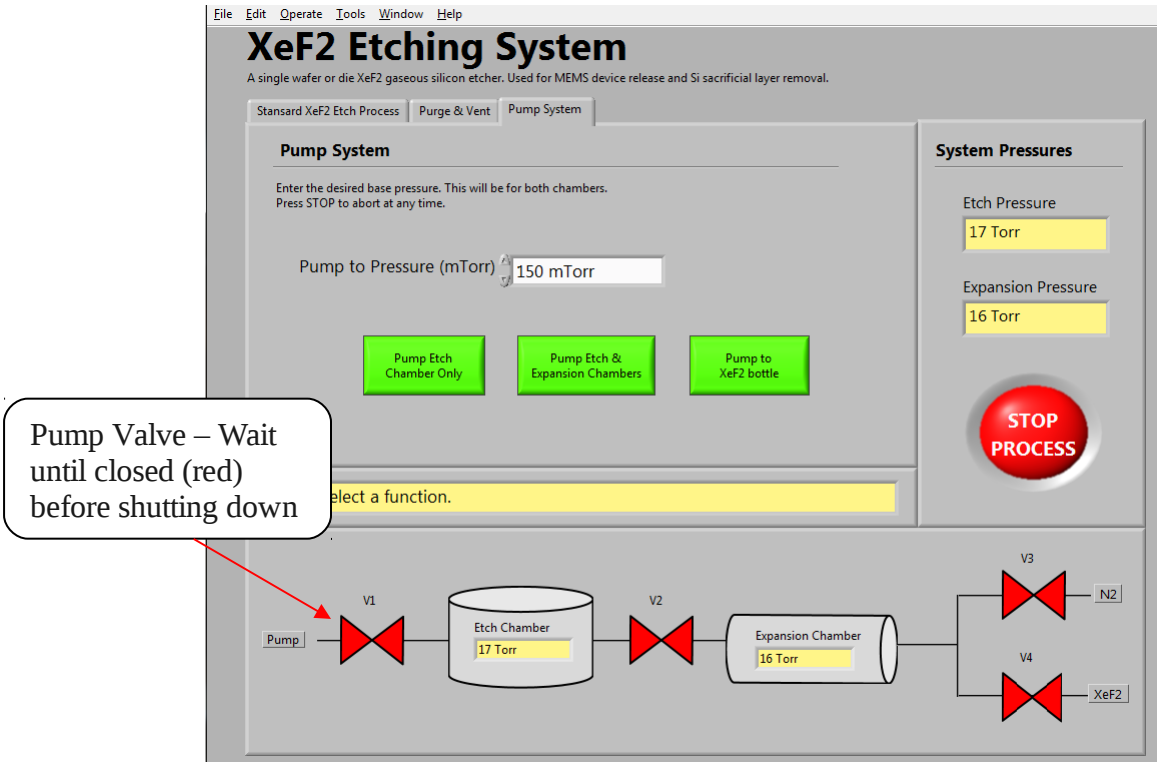
3.9. Return to the **Standard XeF2 Etch Process** tab, and again enter the number of cycles required. Adjust other parameters as required and edit the user cell as needed for data logging. Each cycle of each run is logged for reference. Refer to additional documentation for etch rate information and some parameter adjustment effects. It is recommended that a test device be etched to determine etch parameters (etch rates, undercut etc.) for your specific process as each process is different.

3.10. Press **Begin XeF2 Etch** to begin the etch process.

3.11. Once the number of cycles is complete, the system will vent. Put on the chemical resistant gloves before removing the sample

3.12. If the process needs to be stopped during the run, press the **Stop Process** button. The process will stop immediately and the the system will have to be manually vented. To do this, click the **Purge & Vent** tab and press **System Purge and Vent**. The system will go through the set number of pump and purge cycles before finally venting. It is recommended that at least 3 purge and vent cycles be performed prior to final venting. Do not open the chamber until the system is vented. Once vented, remove your sample.

3.13. If processing is complete, place the holder back in the chamber. Replace the lid and again ensure the o-ring is seated properly. Open the **Pump System** tab, press the **Pump Etch and Expansion Chambers** button. This will leave the system under vacuum. Wait until both chambers are under vacuum (<150mT), at which point the pump valve will close (turning red on the software). Once this is done, turn off the main power switch on the front panel of the system. The software program may be left running.



4. TROUBLESHOOTING

If there is a native oxide present, the silicon etch rate will slow down considerably due to the selectivity of the XeF2. Minimize the possibility of native oxide formation by minimizing process time between steps, or by doing a BOE dip to remove the oxide.

The presence of moisture may also inhibit silicon etching due to the formation of a silicon-fluorine film on the wafer surface. Again, ensure the sample is clean and dry before processing.

If you encounter an unexpected error or require assistance please contact the primary or secondary trainer listed above. Should they not be available, please contact any staff member for assistance.

5. APPROVAL

QUALIFIED TRAINER: Scott Munro
TRAINING COORDINATOR: Stephanie Bozic