

Xetch Xenon difluoride Etching system

Lab procedure

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Purpose: Silicon isotropic etch primarily for release of structures

Note:

1. Please ensure that gloves, goggles and lab coat are worn at all while using the equipment
2. Please read the MSDS sheet for XeF₂
3. The nitrogen valve on cylinder located behind the machine is always on

System information:

The Xetch system basically comprises of the following components:

1. Gases :XeF₂ source bottle is located in the lower cabinet and N₂ cylinder located at the back of the system used for purging the chambers
2. Expansion Chamber: XeF₂ and N₂ are pumped into the expansion chamber as per the set pressure (specified during process recipe) and later allowed into the main process chamber for etch
3. Process Chamber: This is main chamber where isotropic etching takes place (chamber with glass lid where we load our samples). The etch time is entered by the user.
4. Front panel: Information regarding main chamber pressure and temperature is displayed on the front panel.

Instructions:

1. Select Load/unload icon on the screen. The chamber now purges and vents the main process chamber with nitrogen (automated venting sequence which consists of three nitrogen purges and a nitrogen flush). Wait for dialogue window instruction to load sample.
2. Once the chamber is at atmospheric pressure, lift the cover and load your sample on the sample holder. The front side of the holder can hold 2 /3 wafers (however it doesnot have clips to clamp the wafer, hence the wafer could vibrate during etching). The sample holder also has slots for holding chips on the backside. If one needs to etch on both sides, directly place the chip on the holder pins.
3. Close the cover, click load button which will now pump down the chamber.
4. Turn on the microscope light source using the dial on the EKE microscope illuminator control box. Position the microscope above the chamber and check to see if sample can be observed. Reposition microscope or sample if necessary.
5. After returning back to the main menu, press the "Perform etch" button. Enter the etch recipe (# of cycles, etch time/cycle, XeF₂ pressure and N₂ pressure).

Default recipe:

# of cycles	Etch time (sec)	XeF ₂ pressure (Torr)	N ₂ pressure (Torr)
20	60	3	0.0

Press the green start etch button. Each etch cycle consists of the following sequence: based on the desired pressures of XeF₂ and N₂, the system fills the expansion chamber and subsequently opens the valve to the main process chamber for etch as per the set etch time. This is followed by purging of the 2 chamber.

6. Observe etch under a microscope. The etch can be stopped at any time by pressing the stop button. The valve status with chamber pressure display can be observed by clicking the "View Diagram" button.
7. After the etch step, follow step 1, 2, 3 and pump down the chamber.

Application notes:

1. Xenon Fluoride in contact with moisture form traces of HF gas
2. XeF₂ is combustible with alcohol, scotch tape and paper products
3. Increasing XeF₂ pressure will increase the silicon etch rate, while increasing N₂ pressure will decrease the silicon etch rate.
4. Etch rate pointers:

Material	Etch rate comments
Si, Mo and Ge	Good etch rates Si: ~2#m/min, Mo: ~1#m/min
SiO ₂	Selectivity- 2000:1
Photoresist	Selectivity- \$:1
Silicon Nitride	Selectivity~100-200 (Stoichometric nitride has less etch rate as compared to nitride rich)
Au, Cu	Good masking layer However may exhibit discoloration at times
Ti, Ta, W	Unpredictable etch rates
Dicing tape/kapton tape	Good masking layers

5. One may observe differential etching on the wafer (for etch depths >25#m).
6. If one gets fatal error (due to invalid gas proportion),go to the maintenance menu, clear the fatal error and pump down the chamber
7. In case the system seems to run out of XeF₂, contact staff
8. Needle valve for adjusting the XeF₂ pressure is located on the left side on the left side of the system. Don't change the valve position during normal use.