Xactix Xetch XeF_2 etcher Operating Procedure

BioMEMS Laboratory Cleanroom

Rutgers University Department of Biomedical Engineering

Description

The Xactix Xetch XeF_2 etcher is a gas phase etching system capable of isotropic etching silicon and other materials (Si, Mo, Ge, Nb, polysilicon, Ti and W) with high selectivity to other materials (SiO_2, polymers, most metals). Xenon difluoride (XeF_2) is a white crystalline substance resembling rock salt. At room temperature, the vapor pressure of XeF_2 is 3.9 torr. XeF_2 shows very high selectivity vs. silicon to photoresist, SiO2, Si_3N_4, and aluminum. Selectivity of silicon nitride is better than 100:1 and the selectivity to silicon dioxide is better than 1000:1. I The system can etch silicon on small parts or up to 100 mm (4 inch) wafers. The etch rate is dependent on the surface area of the silicon and decreases with increasing area. The Xetch X2C contains two XeF_2 expansion chambers (Where sublimated XeF_2 and nitrogen collect before entering the process chamber) and gas introduction is controlled by computer controlled interface.

Safety

XeF_2 gas will form gaseous hydrofluoric acid (HF) in the presence of water vapor therefore proper ventilation and standard acid precautions are required when handling the bottle exchanges (this is a maintenance task). Samples must be dry and free of moisture. Baking of samples prior to loading in the etch chamber is recommended to reduce moisture.

Startup

When first initializing the system the Xetch, computer and pump should be off with the chamber under vacuum. The two gas wall supplies valves (Compressed Dry Air (CDA) and N_2) should be closed and the CDA valve into the Xetch closed. Once finished with use the system should be returned to this state.

When starting up the systems you should complete the following in this order.

1) Open the wall Nitrogen and CDA line.
2) Open the quarter turn plug CDA valve on the back of the Xetch (when facing the machine, the CDA valve on the right side halfway down the back of the machine.The valve will be perpendicular to the line in the closed position and parallel to the line in the open position.
3) Turn on the XDS dry pump using the toggle switch on the bottom right side of the pump

4) Turn on the power to the Xetch pushing the power switch on the front right of the Xetch. The computer should come on with the machine power.
5) If the computer does not start (or needs to be restarted) open the bottom front panel of the Xetch. Turn on the computer by pressing the power switch on the front of the computer module.

Computer control

The Xetch is controlled by a computer interface written in Labview.

Once the computer is started

1) The Xetch control program will start automatically. It will initial devicenet communication with hardware and sensors and verify communication
2) After initialization, a dialog box will appear. Press NORMAL startup and allow routine initialization to complete The system will begin a cycle of pumps and purges which takes about 10 minutes.
3) Log in. Enter admin for the user name and xetch as password. Click the login button
4) Load your sample. Press Load/Unload button. Verify by pressing yes. The system will purge and flush the chamber to prevent XeF_2 from escaping the chamber.
5) When purging is complete open the chamber lid and load your sample. There are three pins for supporting a 4 inch wafer. If using other sized samples it is recommended that you support your substrate on a 4 inch glass wafer loaded on the pins.
6) When sample is loaded press done on the screen. The process chamber will pump down.
7) Once the chamber is pumped down press Etch menu on the main menu.
8) Enter the lot # of the sample being etched. Press done.
9) Select a recipe from the drop down menu. A couple sample recipes are shown below

Recipe	# of cycles	Etch Time (Seconds)	Total Etch time (Minutes)	XeF_2 Pressure (Torr)	N_2 Pressure (Torr)	Expected Etch Depth* (μm)
Test	5	11	0.9167	1.0	10	1.83
JDZ1	25	11	4.35	1.0	10	8.7

* Etch depth based on 4" Si wafer with <10% exposed area at an etch rate of 2 μm/min. The etch rate drops to about 120nm/min for 50% exposed Si masked with SiO_2 on a 4-inch wafer.

10) Modify the recipe as needed to account for wafer size, exposed area, and/or desired etch depth. Change the number of cycles on the Etch Menu to increase/decrease total etch time

11) Press the Start Etch button to begin the etch. The system will automatically start and finish the etch process. Use the optical microscope to view your sample during the etch process
12) The Change Cycles button may be used at any time during an etch to add/delete cycles to/from the etch in-progress. The Stop button may be used to end an etch prematurely.
13) When the etch is complete, press the Load/Unload button. Verify by pressing yes.to vent the chamber and unload the sample
14) When finished etching start shut down procedures.

System Shut Down

When finished the system should be left in the base state as found. To shutdown follow these instructions in order

1) Make sure chamber is closed. Press done on the screen. The process chamber will pump down.
2) Click Log out of Xetch Program. Click Yes to Verify.
3) Shutdown Windows. Computer will tell you it is safe to turn off computer.
4) Turn of Main Power.
5) Turn of XDS Dry Pump
6) Close CDA line on back of Xetch. Close CDA and N_2 Gas lines on the wall.

Creating or Changing a Recipe

1) Creating or changing recipes is done from the ETCH MENU screen.
2) Make the appropriate recipe changes
3) Save the recipe by clicking on the save button located near the top of the “perform etch screen”.
4) The save new recipe screen will appear.
5) Global Recipes are starting recipe templates available to all users.
6) Using the toggle switch in the middle of the screen users can save the new recipe to their Personal Directory or the accessible Global Recipes.
7) Type in the name of your new recipe and Click on the SAVE button.