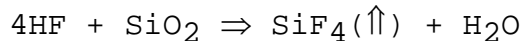


## OP-P: Hydrofluoric Acid Etching

filename: HFETCH

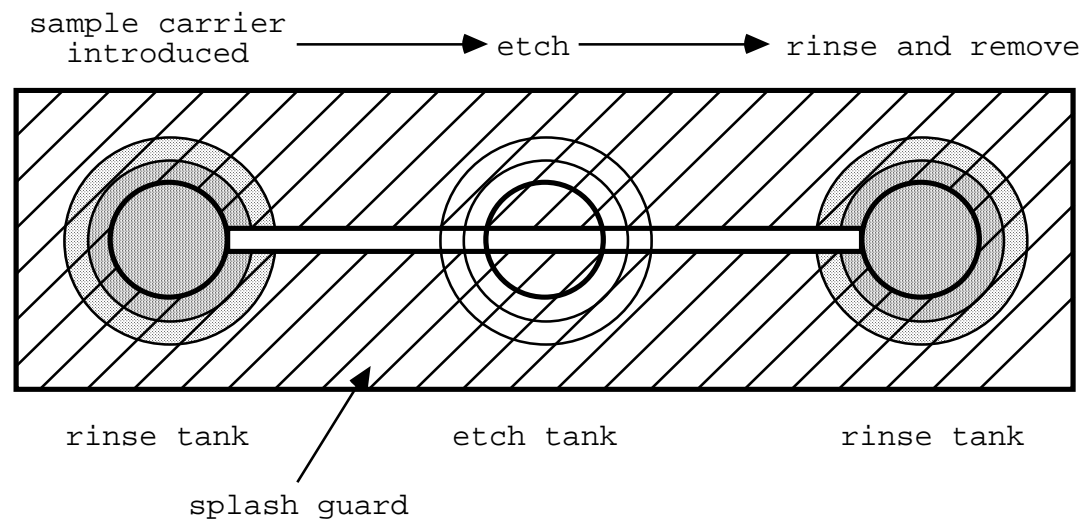
As discussed in the Safety section of the Lab Manual Introduction (p. 10), hydrofluoric (HF) acid can be very dangerous if mishandled. It is, however, a very useful etch for silicon dioxide, SiO<sub>2</sub>. It has a number of advantages over other techniques when patterning SiO<sub>2</sub> over silicon: it has very high selectivity over silicon, i.e. the etch rate of SiO<sub>2</sub> in HF is much greater than the etch rate of Si; HF can easily be masked by photoresist; the etch rate is quite repeatable, and remains constant even after a large number of samples have been etched; and the equipment required to etch with HF is relatively simple and inexpensive.

The actual etchant we use is a solution of concentrated HF (49%), water, and a buffering salt, NH<sub>4</sub>F, in about the ratio 1:6:4. This solution is referred to as buffered HF, or BHF. The buffering agent is added to maintain a constant pH as the HF is consumed in its reaction with SiO<sub>2</sub>:

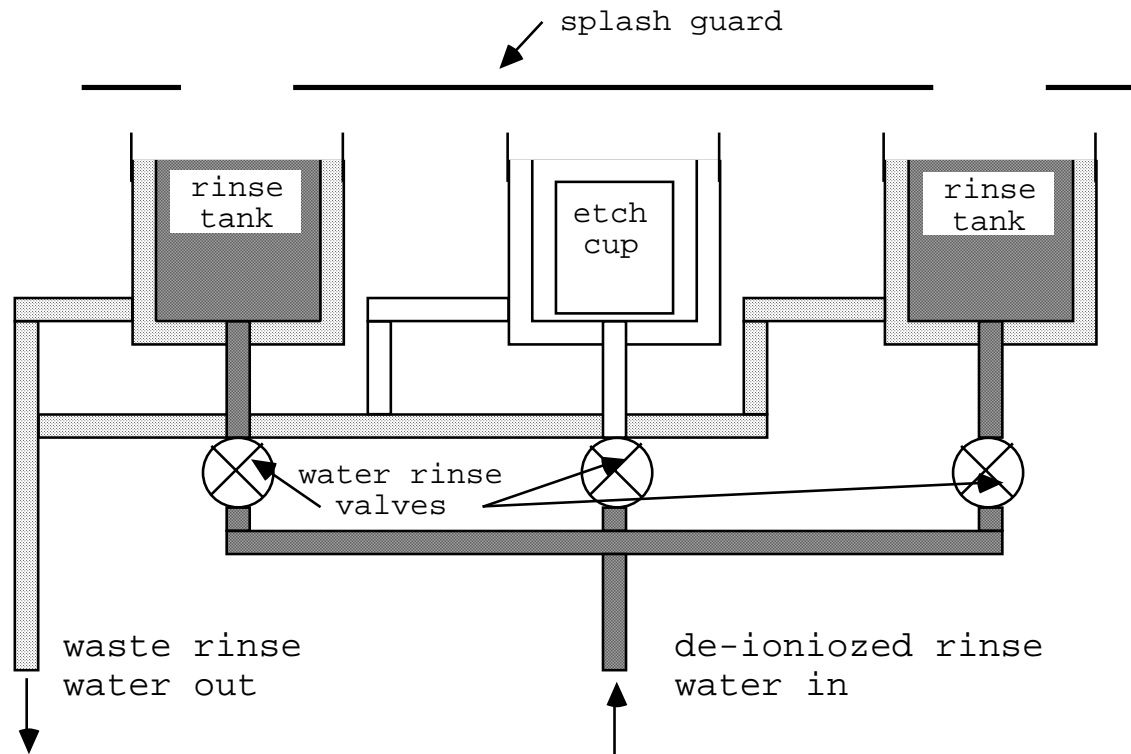


Since the etch rate is a function of the solution pH, BHF has a much more controlled etch rate (about 1000Å/min at room temperature) over the life of the etchant.

In order to safely handle our BHF etching a special etch station has been designed for our lab. Figure 39 shows a top view of our station, and Figure 1b shows the plumbing arrangement for the station.



**Figure 39: top view of BHF etch station.**



**Figure 40: Plumbing diagram for BHF etch station.**

Our system consists of three dump-type rinse tanks installed in the work top of a fume hood. Each tank has a DI water supply, controlled by a water valve in front of the station. The tanks are made up of an inner cup to which the water is supplied; this cup fills until it overflows into the outer portion of the dump tank, which is connected to an acid drain. We use the first tank on the left for an introduction rinse to wet the samples to be etched; the middle tank holds a teflon etchant cup, which actually contains the BHF; the last tank on the right is used for a water rinse to remove the BHF.

In addition to the dump tanks we use a special splash guard to prevent accidental acid spills. This consists of a plexiglass cover with large openings above the two end rinse tanks. These openings are connected by a narrow slot which passes over the etch cup (see Fig. 1a). To begin an etch step, the substrates to be etched are placed in a teflon chip carrier with a long handle attached. This carrier is then lowered into DI water through the opening over the first rinse tank. After wetting the samples the carrier is raised and transferred to the etch cup. The slot in the splash guard is large enough to allow the handle to pass through, but is not large enough to allow the chip carrier to be removed. When the etch is finished, the carrier is raised clear of the etch cup, and is transferred to the final rinse tank. After a suitable rinse time the chip carrier can be removed through the large hole in the splash guard over this tank. We have found this system will prevent HF splashing in almost all circumstances.

## BHF ETCH PROCEDURE

1. Place samples to be etched in the teflon carriers located on the bench to the left of the etch station. Make sure a long teflon handle is inserted into the carrier.
2. Turn on the water supply to the two end dump tanks; make sure the two regular water faucets are on and running into the sink.
3. **Put on a pair of acid resistant gloves (the green gloves next to the hood) and a pair of protective eye glasses. DO NOT LEAVE THE HOOD AREA ONCE YOU START THIS PROCEDURE!**
4. Carefully lower the sample carrier through the splash guard into the left-most rinse tank. Leave immersed for approximately 15 sec.
5. Lift the carrier out of the rinse water, and carefully shake off any excess water. Now slide the handle down the slot to position the wafer carrier over the BHF cup. **Very carefully lower the carrier into the cup.** Be sure not to splash any HF out of the cup.
6. Use the running water in the sink to thoroughly rinse your gloves. **DO NOT REMOVE YOUR GLOVED HANDS FROM THE HOOD DURING THE ETCH TIME: REMAIN AT THE ETCH STATION UNTIL THE PROCESS IS COMPLETE.**
7. At the end of the desired etch time carefully lift the carrier out of the etch cup, and gently shake any drops of BHF off the carrier back into the cup. Now transfer to and immerse the carrier in the right side rinse tank. **RINSE FOR AT LEAST 1 MIN.**
8. Use the HP H<sub>2</sub>O dispenser to rinse the handle of the carrier, as well as your gloves. **MAKE SURE ANY SURFACES THAT MAY HAVE BEEN CONTAMINATED WITH HF ARE RINSED IN WATER.**
9. Remove the carrier from the rinse tank, and finish with at least two HP H<sub>2</sub>O rinses in the teflon beaker in front of the etch station.
10. After completing the rinse remove the carrier from the hood, and transfer to the wafer spinner. Go back to the hood and thoroughly rinse your gloves in running water in the sink. Remove acid gloves, leaving them at the hood.
11. Remove your clean gloves, throw them away, and go to the large sink in the Litho Room for final wash up. Be careful to rinse your hands and arms thoroughly, especially under the fingernails.