



FACULTY OF ENGINEERING AND
TECHNOLOGY
MEMS-035
Lecture -09

WET ETCHING

This is the simplest etching technology. All it requires is a container with a liquid solution that will dissolve the material in question. Unfortunately, there are complications since usually a mask is desired to selectively etch the material. One must find a mask that will not dissolve or at least etches much slower than the material to be patterned. Secondly, some single crystal materials, such as silicon, exhibit anisotropic etching in certain chemicals. Anisotropic etching in contrast to isotropic etching means different etch rates in different directions in the material. The classic example of this is the $\langle 111 \rangle$ crystal plane sidewalls that appear when etching a hole in a $\langle 100 \rangle$ silicon wafer in a chemical such as potassium hydroxide (KOH). The principle of anisotropic and isotropic wet etching is illustrated in the figure below.

Wet etching works very well for etching thin films on substrates, and can also be used to etch the substrate itself. The problem with substrate etching is that isotropic processes will cause undercutting of the mask layer by the same distance as the etch depth. Anisotropic processes allow the etching to stop on certain crystal planes in the substrate.

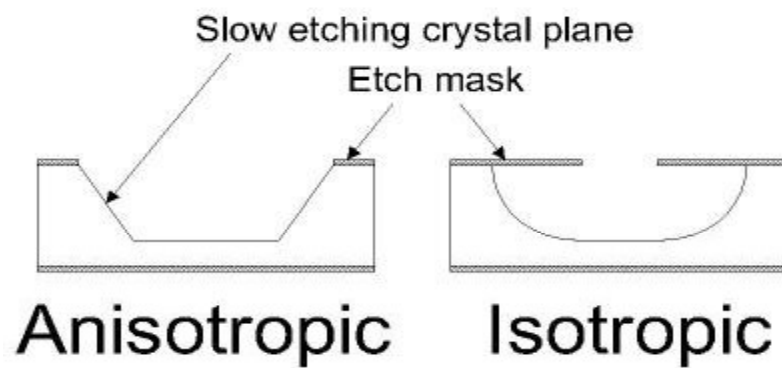


Figure 1: *Difference between anisotropic and isotropic wet etching*

DRY ETCHING

The dry etching technology can split in three separate classes called reactive ion etching (RIE), sputter etching, and vapor phase etching.

In RIE, the substrate is placed inside a reactor in which several gases are introduced. A plasma is struck in the gas mixture using an RF power source, breaking the gas molecules into ions. The ions are accelerated towards, and reacts at, the surface of the material being etched, forming another gaseous material. This is known as the chemical part of reactive ion etching. There is also a physical part which is similar in nature to the sputtering deposition process. If the ions have high enough energy, they can knock atoms out of the material to be etched without a chemical reaction. It is a very complex task to develop dry etch processes that balance chemical and physical etching, since there are many parameters to adjust. By changing the balance it is possible to influence the anisotropy of the etching, since the chemical part is isotropic and the physical part highly anisotropic the combination can form sidewalls that have shapes from rounded to vertical. A schematic of a typical reactive ion etching system is shown in the figure below.

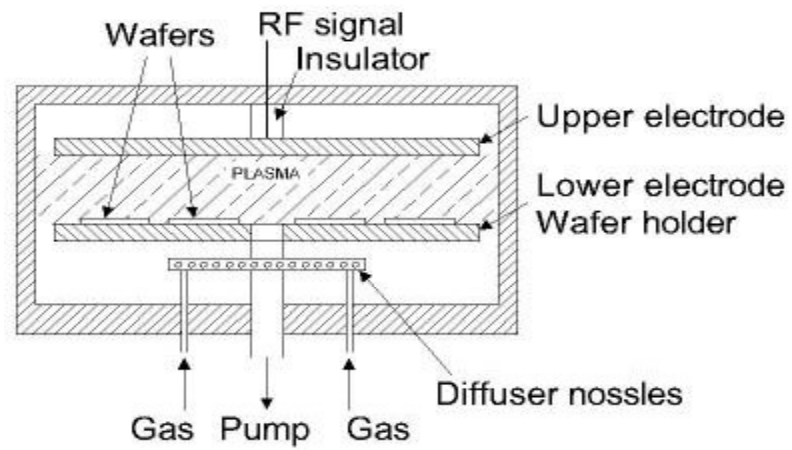


Figure 2: *Typical parallel-plate reactive ion etching system.*