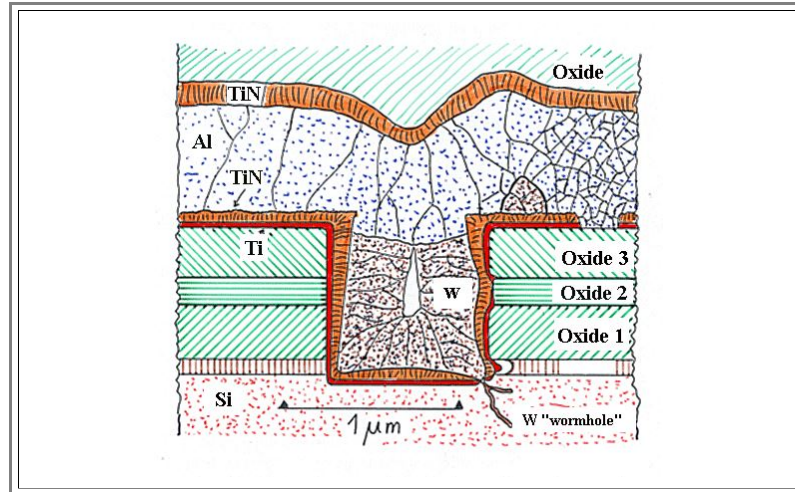


## 6.4 Etching Techniques

### 6.4.1 General Remarks

After we have produced all kinds of layer, we must now proceed to the [structure module](#) of our basic process cycle. First we discuss **etching techniques**.

- Lets see what it means to produce a structure by etching. Lets make, e.g., a contact hole in a somewhat advanced process (and do some of the follow-up processes for clarity).
- What the stucture contains may look like this:



Obviously, before you deposit the **Ti/TiN diffusion barrier layer** (and then the **W**, and so on), you must etch a hole through **3** oxide layers and an **Si<sub>3</sub>N<sub>4</sub>** - and here we don't care why we have all those layers. (The right hand side of the picture shows a few things that can go wrong in the contact making process, but that shall not concern us at present).

There are some obvious requirements for the etching of this contact hole that also come up for most other etching processes.

- You only want to etch **straight down** - not in the lateral direction. In other words, you want strongly **anisotropic etching** that only affects the bottom of the contact hole to be formed, but not the sidewalls (which are, after all, of the same material).
- You want to **stop** as soon as you reach the **Si** substrate. Ideally, whatever you do for etching will not affect **Si** (or whatever material you want not to be affected). In other words, you want a large **selectivity** (= ratio of etch rates).
- You also want reasonable **etching rates** (time is money), the ability to etch through several **different** layers in **one** process (as above), no **damage** of any kind (including rough surfaces) to the layer where you stop, and sometimes **extreme** geometries (e.g. when you etch a trench for a capacitor: **0,8 μm** in diameter and **8 μm** deep) - and you want perfect **homogeneity and reproducibility** all the time (e.g. all the about **200.000.000.000** trenches on **one 300 mm** wafer containg **256 Mbit DRAMs** must be identical to the ones on the other **500 - 1000** wafers you etch today, **and** to the **thousands** you etched before, or are going to etch in the future).

Lets face it: **This is tough!** There is no single technique that meets all the requirements for all situations.

- Structure etching thus is almost always a search for the best compromise, and new etching techniques are introduced all the time.
- Here we can only scratch at the surface and look at the two basic technologies in use: **Chemical or wet etching** and **plasma or dry etching**.