

LECTURE-16

Purpose of Etch

- To remove material from areas identified by the lithography process
 - Areas of photoresist exposed to light
 - Developing leaves only these areas open
 - Etching removes substrate areas not masked
- To create structures for functional use
- To remove oxide layers below features to allow for motion

What is Etched and Why?

- Silicon
 - Pure silicon is highly reactive and forms SiO_2 from reaction with atmospheric oxygen
 - Patterning and removal of bulk structures
 - Sacrificial layer below moving features in MEMS
- Silicon Dioxide
 - A hard coating layer used as an insulator or a doping barrier
 - A critical layer in the construction of MOSFET devices

What is etched and Why?

- Silicon Nitride
 - Hard, impervious protective layer
 - Remove areas for connections
- Aluminum
 - Conductor used for wiring
 - Removed for patterning wires
- Tungsten
 - Contact barrier/Interconnect/Via plug

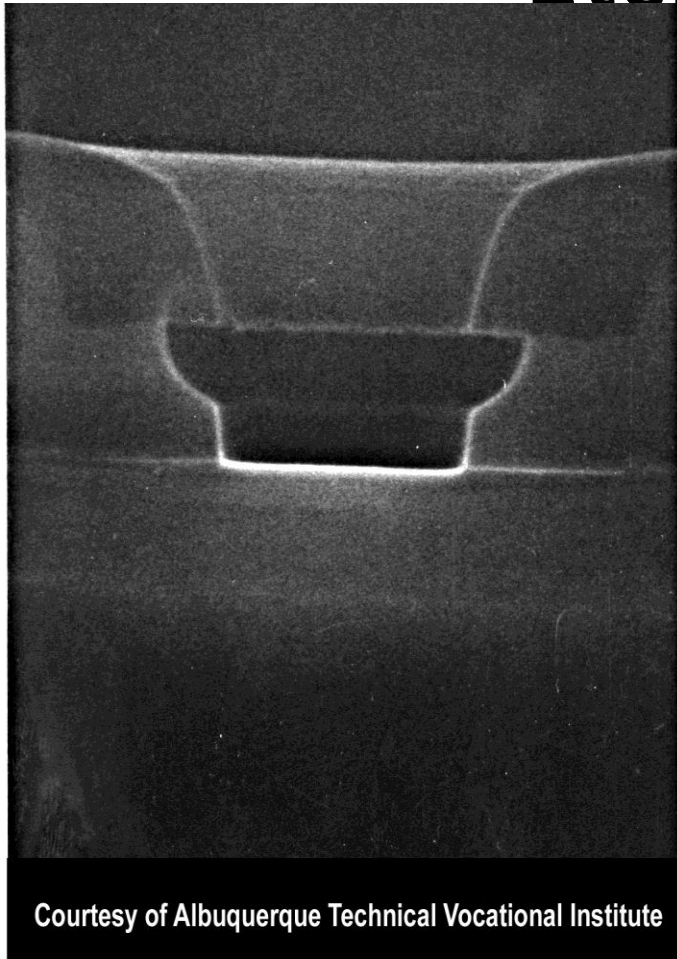
Etch Process Properties

- Any etch process is characterized by certain properties
 - **Etch Rate**
 - The amount of material removed from the wafer over a defined period of time
 - **Uniformity**
 - The evenness of the removal over the entire surface of the wafer

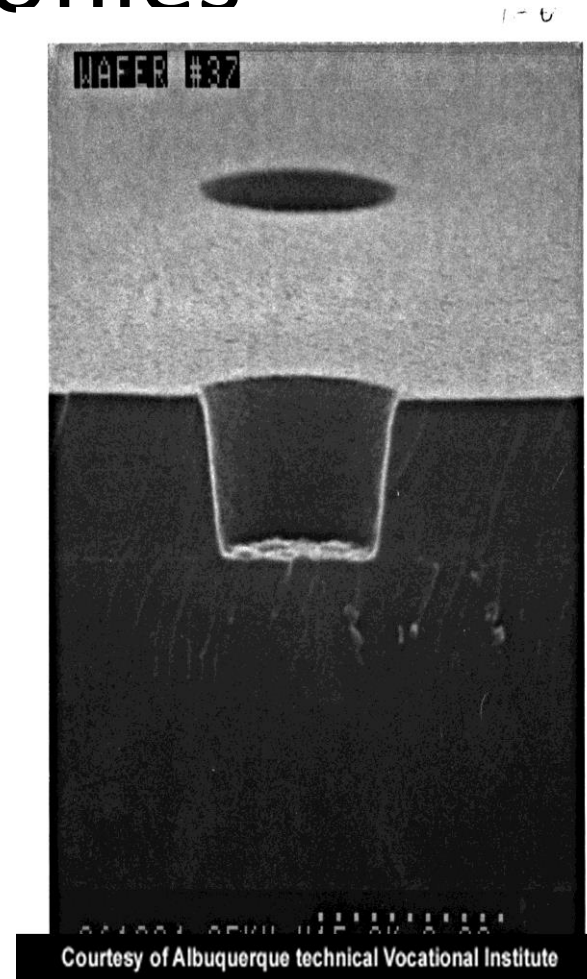
Etch Process Properties

- Any etch process is characterized by certain properties
 - **Profile**
 - **Isotropic** – Etching proceeds at equal rates in both horizontal and vertical direction
 - **Anisotropic** – Etching proceeds faster in one plane than in another
 - **Selectivity**
 - The ability of the etch process to distinguish between the layer to be etched and the material not to be etched

Etch Profiles



Isotropic Etch Profile



Anisotropic Etch Profile

Etching – Wet and Dry

- Wet Etch is performed by immersing entire wafers in liquid etchant solutions.
 - Reaction is between surface layer exposed and etchant
 - Purely a chemical process
- Dry etching is performed by placing the wafer in a chamber and pumping in chemical vapors or using plasma
- Dry etching can be chemical, physical, or both in its etch.