RAMA UNIVERSITY

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FACULTY OF ENGINEERING AND TECHNOLOGY

MEMS-035

Lecture -10

BULK MICROMACHINING

Bulk micromachining is a process used to produce micromachinery or microelectromechanical systems (MEMS).
Unlike surface micromachining, which uses a succession of thin film deposition and selective etching, bulk micromachining defines structures by selectively etching inside a substrate. Whereas surface micromachining creates structures on top of a substrate, bulk micromachining produces structures inside a substrate

BULK MICROMACHINING

Bulk micromachining starts with a silicon wafer or other substrates which is selectively etched, using photolithography to transfer a pattern from a mask to the surface. Like surface micromachining, bulk micromachining can be performed with wet or dry etches, although the most common etch in silicon is the anisotropic wet etch.

This etch takes advantage of the fact that silicon has a crystal structure, which means its atoms are all arranged periodically in lines and planes. Certain planes have weaker bonds and are more susceptible to etching. The etch results in pits that have angled walls, with the angle being a function of the crystal orientation of the substrate.

This type of etching is inexpensive and is generally used in early, low-budget research.

SILICON SURFACE MICROMACHINING

Bulk micromachining where a silicon substrate wafer is selectively etched to produce structures, **surface micromachining** builds microstructures by deposition and etching of different structural layers on top of the substrate. Generally polysilicon is commonly used as one of the layers and silicon dioxide is used as a sacrificial layer which is removed or etched out to create the necessary void in the thickness direction. Added layers are generally very thin with their size varying from 2-5 Micro metres.

The main advantage of this machining process is the possibility of realizing monolithic microsystems in which the electronic and the mechanical components (functions) are built in on the same substrate. The surface micromachined components are smaller compared to their counterparts, the bulk micromachined ones

Fabrication Process

Micromachining starts with a silicon wafer or other substrate and grows layers on top. These layers are selectively etched by photolithography and either a wet etch involving an acid or a dry etch involving an ionized gas, or plasma. Dry etching can combine chemical etching with physical etching, or ion bombardment of the material. Surface micromachining can involve as many layers as is needed with a different mask (producing a different pattern) on each layer.

Modern integrated circuit fabrication uses this technique and can use dozens of layers, approaching 100. Micromachining is a younger technology and usually uses no more than 5 or 6 layers. Surface micromachining uses developed technology (although sometimes not enough for demanding applications) which is very repeatable for volume production.