State of art of MEMS technology

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***Abstract*-MEMS is a Micro electro mechanical system. This paper deals with the field of micro-electromechanical system process-based technologies used to fabricate tiny integrated devices or system that integrate functionalities from different physical domains into one device. The product range in size from a few micrometers to millimeters. Such devices are fabricated using a wide range of technologies, having in common the ability to create structure with micro-and even nanometer accuracies. This system have the ability tosense, control andactual on the micro scale, and generate effects on the macro scale. This fieldiscalled by awide variety of names in different parts oftheworld; micro electromechanical system (MEMS), micromechanics, Microsystem technology (MST), micro machine.**

MEMS is a relatively new technology which exploits the existing microelectronics infrastructure to create complex machines with micron features sizes. These machine scan have many functions, including sensing, actuation and communication. Extensive application of these devices existsin both commercial and defense system.MEMS combine conventional semiconductor electronics with beams, gears, levers, switches, accelerometers, diaphragms, micro fluidic thrusters, and heat controllers, all of them microscopic in size.

***Key Words*-MEMS, Micromachining, Inject printer head.**

I. INTRODUCTION

MEMS devices are very small, their components are usually microscopic. Pumps, gears, valves, pistons, as well as motors and even steam engines have all been fabricated by the used of MEMS. However, two points are worth consideration. MEMS are not just about the miniaturization of mechanical components or making things out of silicon.

MEMS isan enabling technology and current applications include pressure, flowsensors, accelerometer, chemical and flow sensors, micro optics, optical scanners, and fluid pumps. Generally a satellite consists of battery, internal communication system, state sensors and control units. All these can be made of MEMS so that size and costcan be considerably reduced. Also small satellite can be constructed by stacking wafers covered with MEMS and electronics components. The real power of this technology is that many machines can built at the same time across the surface of the wafer, with no assembly required. Since it is just as easy to build a million machines on the wafer as it would be to build just one.

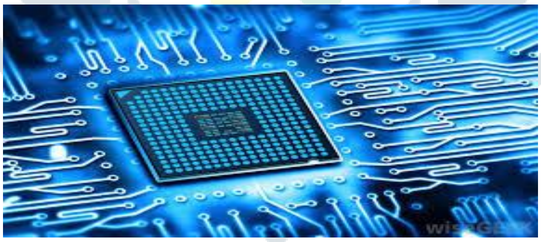

Fig1: Mems Sensor

There are several different micro categories of MEMS technology:

A. *Bulk micromachining*

Bulk Micromachining is a fabrication technique which bulks mechanical elements by starting with a silicon wafer, and then etching away unwanted parts, and being left with useful mechanical devices. Typically, the wafer isphoto patterned, leaving protective layer on the parts of thewafer that you want to keep. The wafer is then submersed into a etchant liquid, like potassium hydroxide, which eat away any exposed silicon. This is a relatively simple and inexpensive fabrication technology, andiswell suited for application which does not require much complexity andwhich are price sensitive.Almost all pressure sensors are built with Bulk Micromachining. Bulk Micro machined pressure sensors offer several advantages over traditional pressure sensors. They cost less, are highly manufacturable, reliable and there is very good repeatability between devices.All new cars on the market today have several micromachined pressuresensors, typically used to measure manifold pressure in the engine.The small size and high reliability of micro machined pressure sensors make them ideal for a variety of medical applications as well.

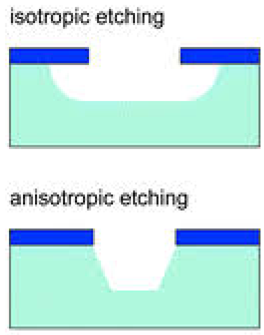

Fig2: Bulk micromachining

B. *Surface micro machining*

While Bulk micro machining creates devices by etching into a wafer, Surface Micro machining builds devices up from the wafer are layer-by-layer.

A typical Surface Micromachining process is repetitive sequenceofdepositing thin filmon awafer, photo patterning the film, and the etching the patterns into the film of structural materials (typical silicon) and sacrificial material (typical silicon dioxide). The structural material will form the mechanical elements, and thesacrificialmaterial createsthe spaces andgaps betweenthemechanical elements.At the end of this process, the sacrificial material is removed and the structural element is left free to move and function.

For thecase of the structural level being silicon andsacrificial material being silicondioxide, the end release process is performed by placing the wafer in Hydrofluoric Acid. The Hydrofluoric Acid rapidly etches away the silicon dioxide, while leaving the silicon undisturbed.

The wafer is typically then sawn into individual chips and the chips packaged in an appropriated manner for the given application.

Bulk Micromachining requires less fabrication steps than SurfaceMicromachining and hence is more expensive. It is able to create much more complicated devices, competent of sophisticated functionality. Surface Micromachining is prepable for applications requiring more sophisticated mechanical element.

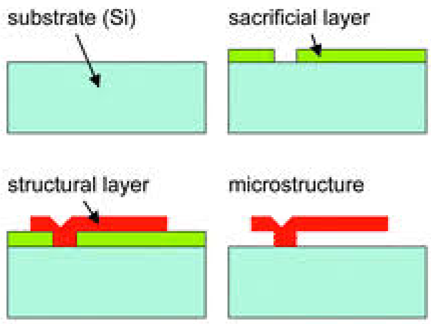

Fig3: Surface Micromachining

II. LITERATURE SURVEY

MEMS, an acronym that originated in the United States, is also referred to as Micromachining in Japan and Micro System Technology in Europe, is probably not a fully appropriate term as not all the current so called MEMS, MST or Micro machined devices are electromechanical module or system MEMS device are made by different micro devices. MEMS device electronics are fabricated using computer chip IC technology, the micromechanical component are fabricated by sophisticated manipulations of silicon and other substrate using micromachining process. Such as bulk micromachining, surface machining, and High-aspect-ratio micromachining. In the early 1950 MEMS has gradually made its way out of research laboratories and into everyday products. In the mid 1990 MEMS component began appearing in numerous commercial products and application including accelerometer used to control airbag deployment in vehicles, pressure sensors for medical application, and inkjet printer head. Later also other products were developed like display, oscillators, lab on chip and microphones.

The origins of MEMS technologies can be traced back to 1954s when a paper Piezoresistive effects in silicon and germanium was published in the international journal Physical Review. It described for the first time, stress sensitive effects in silicon and germanium termed piezoresistive. This paper was followed in 1955 by the first publication that assessed the possibility to replace bulky electromechanical sensors with small device. After in 1960's different manuscripts from the Honeywell Research Center and the Bell Labs reported and described the first silicon diaphragm pressure sensor and strain gauge. In 1970 developments in micromachining and improvement of silicon processing brought to pressure sensor with nonpolar diaphragm geometries, showing superior performance these were arguably the first proper MEMS sensor. Now MEMS technologies have progressively established a wide range small, high performance and often inexpensive sensor able to sense and thus responds to many physical variables such examples position, pressure, strain, motion, flow and radiation. From low volume high cost products in industry and aerospace in 1970 to 1980 to ultrahigh volume very low cost products in consumers electronic in 2000 onwards. Nowadays MEMS based devices range from simple arrangement with no moving parts to complex electromechanical system with several moving elements under the control of integrated micro-electronics.

III. WORLD SURVEY

NEW YORK, NOV.2015/PRNewswire/. The BCC research report looks at MEMS market and gives map to technologies and application that is successfully commercialized in the next five year includes forecast though 2020.

Thisreport gives information about various MEMS technologies and applications. We can get the idea of segments of MEMS market with greatest commercial potential in the near to midterm from the year 2014 to 2020. It receives information from the profiles of major players in the industry.Evaluate the challenge that must be overcome for a segment to realized its potential to estimate the probability of successful commercialization. The global market for MEMS device and production equipment wasworth $11.7 billion in 2014.ndit's expected to reach$121.8 billion in 2015. And $ 21.9 billion in 2020.nd its compound annual growth rate (CAGR) of 11.5 % between 2015 and 2020 .micro-fluidic MEMS , the largest segment of this market.

IV. INDIAN SURVEY

Indiasupported the international conference on MEMS and sensors (ICMEMSS 2014) organized by Indian Institute of Technology, madras (IIT) in Chennai. The purpose of this conference to provide a forum for researcher to interact and exchange the information about their activitiesin the area of MEMS. The main aim of the conference is on application and devices. MEMS is thriving area of research in India. They had organized an internal conference on MEMS in Chennai, India from 18-20 December 2014.

V. CONCLUSION

MEMS industry in many aspect is still a young industry MEMS has undoubtedly invalid more and more consumer's products. MENS are more and more reliable and their sensitivity better every day. Size of MEMS is getting smaller, frequency response and since range is getting wider. Prices of MEMSdevice aren't excessive, but they still have to drop a lot if we want to expand massive consumption. Standardization of production, testing and packaging MEMS would do certainly a big part at it. We can say that the future of MEMS is bright the relatively long expensive development cycle for MEMS component is a hurdle that need to be lowered and also less expensive micro-fabrication method than photolithography has to be pursued.

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