

MEMS and MEMS Microfabrication



What are MEMS?

Micro Electro-Mechanical Systems (MEMS) are a technology field that can be defined as microscopic implementations of mechanical and electro-mechanical elements (ie devices and structures) that are made using the techniques of Microfabrication. These devices are widely used in everyday products such as **Smartphones** (microphones, gyroscope, magnetometer), **Wearable devices** (accelerometers, heart rate sensors), **Automotive** (pressure, flow, acceleration sensors) and many other applications.



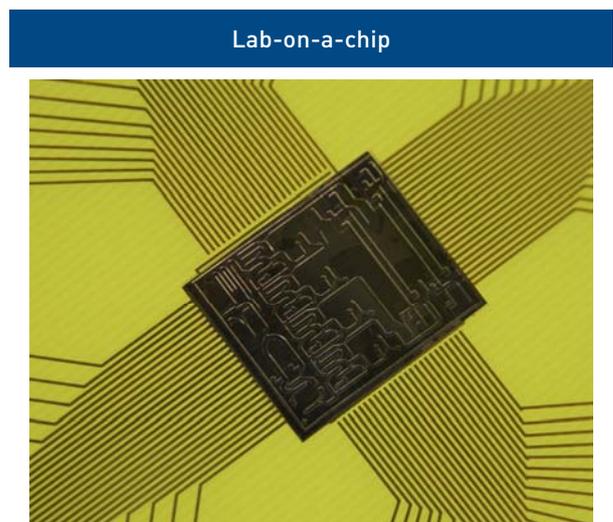
What are the differences between MEMS and Semiconductors?

MEMS and Semiconductors are completely different technologies. Semiconductor devices make use of the electronic properties of materials such as Silicon. These properties have meant semiconductors now are the basis of most advanced electronics. Semiconductors have progressed since the 1960's to the sophisticated microprocessors, memory chips, and wireless components that enable our Laptops, Tablets, and Smartphones, and the Internet of Things.

Synergistically combined with Semiconductors, MEMS are essential in allowing devices to sense and physically interact with the world. MEMS devices can vary from a relatively simple structure to extremely complex electromechanical systems with multiple moving elements under the control of integrated microelectronics.

MEMS can capture physical data such as measuring temperature, air pressure, magnetic fields and radiation. MEMS may use semiconductor material for its electronic qualities, but also utilize its mechanical properties. Silicon can be flexed with almost no energy dissipation, thereby providing highly repeatable motion and very little fatigue. Silicon based MEMS devices can have service lifetimes in the range trillions of cycles without failure. MEMS can also be made from ceramics or glass as a substitute for silicon for applications requiring particular optical properties, chemical resistance, or bio-compatibility.

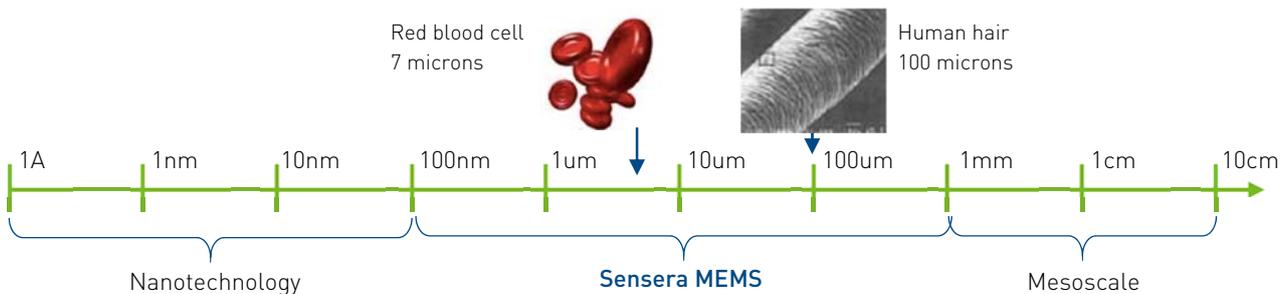
When we look to the future of technology and the host of possibilities of functionality such as 'lab-on-a-chip' or even 'organ-on-a chip', MEMS and Microfabrication processes are essential.



How small are MEMS?

MEMS are manufactured with typical materials thickness and component feature size ranging from less than 1 to 100 microns. MEMS can also be sub-micron size and begins to enter nanotechnology territory. MEMS chip size is generally about 1 square millimeter.

MEMS are manufactured with the same process as semiconductor integrated circuits, meaning they are made by combining together extremely thin layers of engineering materials (metals and insulators in combination with silicon) and patterned with micron or sub-micron size features. As a frame of reference, a human hair is about 100 microns in diameter and a red blood cell has a size of about 7 microns.



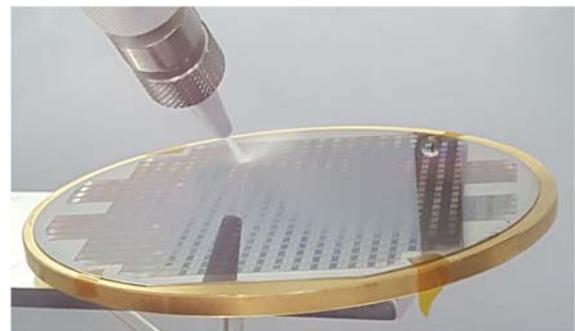
How does MEMS microfabrication work?

Unlike other types of “micromachining”, the MEMS microfabrication process offers significant cost benefit, high reliability and performance. Similar to semiconductor integrated circuit manufacturing, MEMS devices are manufactured on a silicon or glass “wafer”. This platform provides an economy of scale as hundreds or thousands of devices are manufactured at once in a batch process. Further, many wafers can be processed simultaneously using automated or semi-automated equipment.

MEMS fabrication has building block processes including successive iterations of material deposition, patterning using photolithography, and both wet and dry etching to create the final three dimensional MEMS device structure.

As the purpose of MEMS fabrication is to make micro-machines, mechanical properties are crucial, especially for material forming the structures. Properties such as yield strength, density, residual stress and long term stability require optimisation. Sophisticated measurement tools are used throughout the microfabrication manufacturing process as part of a quality system.

Sensera Microfabrication



How do these properties open new markets?

MEMS are versatile to enable a wide range of designs, and resilient leading to long, consistent service lifetimes.

The unique properties offered by microfabricated devices offers new and constantly improving products for motion, pressure, and chemical sensing, miniature and biocompatible medical devices, and life science organ-on-a-chip platforms.

The production and availability of devices with features comparably sized to human cells, and the ability to move fluids and chemicals at the same scale, is poised to revolutionize both drug discovery, drug delivery, diagnostics, and treatment.

Sensera operates at this forefront.

