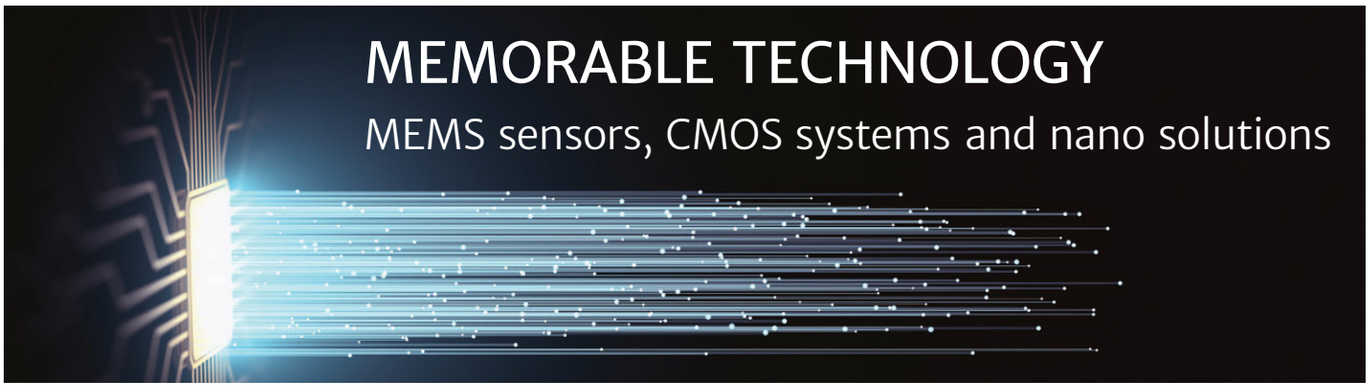


MEMORABLE TECHNOLOGY

MEMS sensors, CMOS systems and nano solutions

Scientists and engineers have struggled to exploit the potential of nanotechnology. Sensor specialist, Nanusens, aims to end that with its latest developments: NEMS, Nano Electro Mechanical Systems, for embedded CMOS technology

A revolution was unleashed upon the electronics market, with CMOS technology being used to shrink almost everything onto a printed circuit board (PCB), on a single chip, then manufactured and copied to make millions of those chips. No longer a bespoke manufacturing process for each board, products can now be made at any volume, in any semiconductor fab, as a result of the versatility of the CMOS technique.

Nanusens, a British company, is about to kickstart a similar revolution: this time, it's for MEMS sensors. Again, the constraint is that of bespoke manufacturing. Every MEMS sensor chip has taken 5 to 7 years to design, with a custom manufacturing line crafted for its production.The only way to significantly increase production is to build a duplicate line: the MEMS industry is struggling to reward demand with supply. Considering the resourcefulness of MEMS sensors within a plethora of applications, this will persist as a major concern.

Why are MEMS sensors so complex to make? MEMS stands for Micro Electro Mechanical Systems. To the naked eye, components are still and simple. But under a microscope, the MEMS reveals tiny moving parts, like springs, load masses and even sometimes gears, formed by etching on the surface of a slice of silicon. As every design needs its own set of manufacturing processes, the only economies of scale are being able to make a high number of the same device, on one production line.

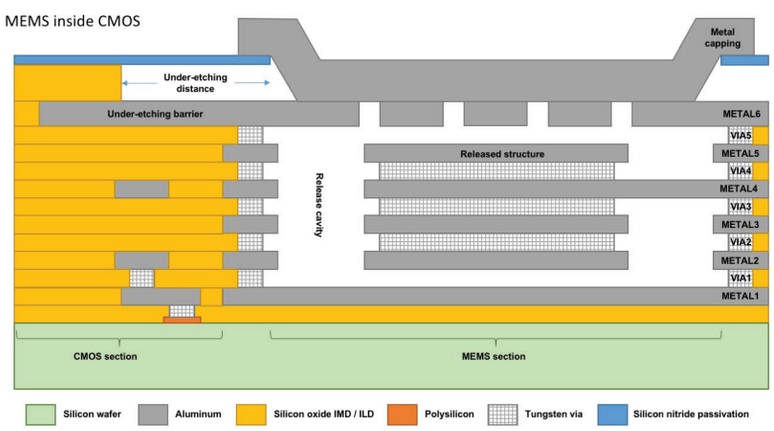
Nanusens has inverted the manufacturing and design. Instead of starting with a MEMS design and then processing the production, Nanusens has started with the standard CMOS manufacturing process, exploiting this knowledge to construct MEMS within the layers of CMOS on the backend of a chip, only using standard CMOS methods.

Effectively, the tiny metal structures that form the MEMS are created, and then the dialectric is etched away to create voids for them to move freely. Typically, this is a movable load mass suspended by springs, and its movement causes a detectable change in capacitance. The problem is that the released metal structures distort, due to stresses to the CMOS as it was never designed for this purpose.

Why is this a revolution? The MEMS sensors made by this new process are ten times smaller, bringing nanotechnology into the electronics ring, back under the spotlight. These NEMS – Nano Electro Mechanical Systems – take up very little real estate on the chip. As it is made in the same fab as standard CMOS ICs, this presents the possibility to implement the control electronics onto the chip simultaneously. Moreover, several different types of NEMS can be built at the same time, on the same chip, to create a single multi-sensor solution. For comparison, to build an equivalent, one requires a separate chip with each different type of sensor, plus a separate control chip, all assembled together in a multi-chip package that is many times larger than the NEMS solution presented by Nanusens.

For many device designs, space is at a premium. The best example is the earbud, where designers face two challenges that the NEMS technology solves. The first is battery life: it demands augmentation, to function at its absolute limits. Each packaged Nanusens sensor is a quarter of the size of its current packaged equivalent, which frees up space for larger batteries – even more with a multi-sensor NEMS package. These packages also overcome the second issue: the lack of space preventing the additional integration of new sensors to increase functionality. Adding sensors to earbuds increases awareness: when they are or should be in the ear, rather than on a table or in a pocket, they should automatically turn themselves off.

The biggest part of the revolution is that the manufacturing bottleneck is now removed, just like CMOS did to PCBs. Because these NEMS are made with standard CMOS techniques, they can be made in any fab so there is no limit to the numbers, enabling the MEMS market to grow: with the value rising beyond the billions, into the trillions, every device can accumulate as many sensors as designers desire.



The cross sectional structure of NEMS: the MEMS within the CMOS technology