CMOS post-processing for more-than-Moore

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The semiconductor industry is adjusting focus towards the so-called "more than Moore" innovation. By this is meant that microchip progress may not (or not only) follow from Moore's Law and its resulting dimensional scaling, but can also come from the addition of new components, new layers and new functions inside the microchip itself. Examples are the introduction of passive RF components, biosensors, and so-called 3D integration.

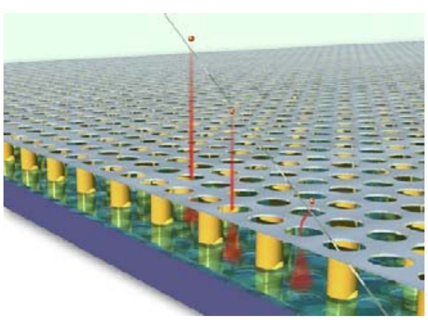
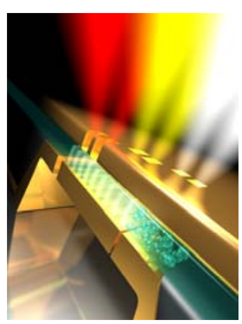
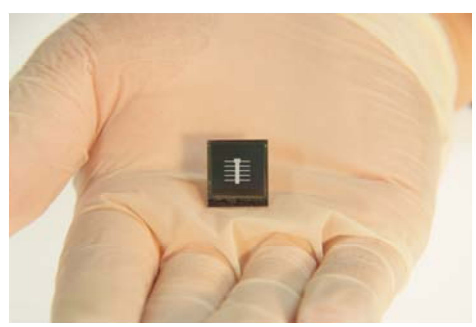
This new innovation paradigm offers great opportunities for the field of microelectronics. Rather than the unidirectional scaling improvements of CMOS and memory technologies, diversification will lead to entirely new microsystems. Recent examples are the CMOS active pixel sensor, now embedded in the cameras in many handheld consumer products, and human-implantable electronics for medical purposes.

In this work, we discuss several recent breakthroughs in this field, with a focus on technology. The first microsystem presented, fabricated by CMOS post-processing, is a miniaturized gaseous radiation detector working along the principle of a multiwire proportional chamber [1]. It consists of a CMOS microchip with an array of 256×256 bond pads at its surface, the so-called Timepix chip. Each bond pad is connected to a fast charge-sensitive preamplifier. On top, insulating pillars and an aluminum grid are fabricated, allowing for fast 3D radiation imaging with high position resolution.

The second presented device is an electrical surface plasmon polariton source, fabricated in the backend of standard CMOS [2]. Here, low-temperature CVD and ALD were essential to obtain functional devices at CMOS compatible process conditions. The device generates surface plasmons by an electrical stimulus, overcoming the need for an external light pump to integrate plasmonics on a chip.

The third CMOS-integrated device is a thin-film solar cell [3]. Envisaged as the ultimate means to power an autonomous sensor node ("smart dust"), a thin-film solar cell offers high power levels (even indoors) using very little material, with excellent long-term reliability. Experiments have shown that both a-Si and CIGS solar cell technology are compatible with CMOS. The key advance was to employ *existing* technologies, as thin-film solar cells are already optimized for low thermal budget and low stress.

Finally, we will share additional recent results on novel materials for CMOS post-processing, exhibiting fascinating new electronic and optical properties.

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3. J. Lu, W. Liu, C. Van Der Werf, *et al.*, *Tech. Dig. IEDM* (2010), art. no. 5703457.