

Technology innovation, reshaping the microelectronics industry

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The age of fast-moving information and computer technology is driven by the silicon CMOS technology, which has been delivering faster and more efficient computers and memories at a remarkably consistent pace. The number of transistors on a chip has doubled every 18 months mainly thanks to dimensional scaling. There is no fundamental limit to scale down to several nanometers through new device architectures even though concerns on manufacturability due to process complexities arise for the 10 nm and beyond.

One of the current technology directions is characterized by functional diversification of Si based CMOS. This would contribute to the equivalent miniaturization of the Si technology by providing additional analog functions such as imaging, RF, as well as by providing optical components to Si circuits to improve their speed. There are a few device concepts that could add more functionality to volatile as well as nonvolatile, memories, such as ReRAM, MRAM and PRAM. Nonvolatile devices, such as ReRAM, can be used to support important analog memory and processing elements, much like the functions performed by the brain and reconfigurable functions in Si circuits. ReRAM as synapses in neuromorphic circuits can potentially offer high connectivity and high density required for efficient computing.

Additionally, advances in material technology will soon allow spintronic, III-V and even graphene-based devices to be integrated on Si. III-V devices in combination with silicon technologies is finding important roles in energy-conscious devices, such as solid-state lighting and power electronics.

Both III-V compounds and graphene hold the key for adding more functions to Si circuits by utilizing light. These materials, integrated with Si electro-photonics ICs (EPICs), can provide a cornerstone for light processing combined with electronics' support, which will eventually enable on-chip optical interconnects for future computing and ultrawide-bandwidth data communications.

In recent years, silicon technology is also providing the platform for the advancement of bio, health and medical diagnostics, such as DNA sequencing, integrated polymerized chain reaction (iPCR), medical imaging and others.

In the workshop, these and other prospects, as well as the future microelectronics landscape will be presented.