

NanoCMOS and Tunnel FETs for the end of the Roadmap

Francis Balestra

CNRS/Grenoble Institute of Technology, IMEP-LAHC, 3 Parvis Louis Neel, Grenoble, France

Many innovative technologies are needed for future More Moore and More than Moore applications in order to overcome the following limits: substantial increase of energy consumption and heating which can jeopardize future IC integration and performance, reduced performance due to limitation in traditional high conductivity metal/low k dielectric interconnects, limit of optical lithography, heterogeneous 3D integration of new functionalities for future sustainable, secure, ubiquitous and pervasive nanosystems, etc. [1-5].

With respect to the substantial reduction of the static and dynamic power consumption of future high performance/ultra low power terascale integration logic and autonomous nanosystems, new materials and novel device architectures are mandatory for NanoCMOS and Steep Slope Switch Nanoelectronics Devices, as well as new circuit design techniques, architectures and embedded softwares.

The presentation will focus on the main trends, challenges, limits and possible solutions for ultralow power and high performance nanoscale devices. It will particularly covers the most promising solutions for the end of the roadmap in the More Moore and Beyond-CMOS fields, including innovative nanomaterials such as ultra-thin Si-Ge-III-V/OI, 2D layers (phosphorene, various transition-metal dichalcogenides, etc.), 1D semimetals, heterostructures using strained Si, Ge, III-V (InAs, GaSb, AlGaSb, graded layers, quantum wells, etc.), combined with advanced nanodevice architectures, especially ultimate multigate NanoCMOS, Nanowire FETs, Tunnel FETs and hybrid Nanoscale Transistors.

[1] F. Balestra, *Nanoscale CMOS: Innovative Materials, Modeling and Characterization*, ISTE-Wiley (2010)

[2] F. Balestra, *Beyond CMOS Nanodevices (Vol. 1 and 2)*, ISTE-Wiley (2014)

[3] F. Balestra, *Challenges to ultra-low-power operation*, Chapter in “Future Trends in Microelectronics, Journey into the Unknown”, S. Luryi et al Eds, Wiley (2015)

[4] F. Balestra, E. Sangiorgi, M. Östling, P.E. Hellström, *Nanowires for very low power ICs and new functionalities*, Chapter, in “CRC Concise Encyclopedia of Nanotechnology”, CRC Press, 2014

[5] F. Balestra, *Silicon-On-Insulator Devices*, Chapter in the « Wiley Encyclopedia of Electrical and Electronics Engineering”, 2014.