A Perspective in Nanoelectronics

Mark Lundstrom
Electrical and Computer Engineering and Network for Computational Nanotechnology
Birck Nanotechnology Center
Purdue University, West Lafayette, Indiana USA

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Ten years ago, there was great concern that Moore's Law was about to end because it would be difficult to scale channel lengths below 100 nm. At the same time, there was great excitement about new research advances in molecular electronics, carbon nanotubes, semiconductor nanowires, spintronics, and more recently graphene electronics. In the intervening decade there have been remarkable scientific advances in this unconventional nanoelectronics, but at the same time, the traditional silicon MOSFET continues to shrink in size. Moore's Law proceeds, and a decade later the challenge is to achieve good performance with channel lengths below 10nm. What have we accomplished, what lessons have we learned, and what is in store for us in the next decade? In this talk I will argue that the insights, understanding, and computational tools developed in the course of research on unconventional nanoelectronics have played an important role in the continued evolution of silicon technology, which continues to have transformative impact. (Similar arguments could be made for research advances in metrology at the nanoscale, new techniques for the synthesis of nanostructures, etc.). The National Nanotechnology Initiative (NNI) has also captured the imagination of young people and attracted them to careers in the physical sciences. The NNI has fostered multidisciplinary research, strengthened connections between disciplines in science, engineering, and the physical and life sciences. NNI research has also generated numerous opportunities for novel technology development. These trends will continue during the next decade, and should be strengthened, but in the next decade we must place more emphasis on turning nanoscience into nanotechnologies. Success will require a strong nanoscale science base, but we must also get better at identifying the appropriate applications and at better understanding a very competitive and fast moving technology landscape.