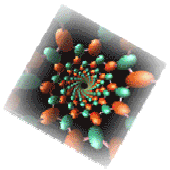

FIRST INTERNATIONAL NANOTECHNOLOGY CONFERENCE
ON COMMUNICATION AND COOPERATION

Abstract

Nanotechnology : Retrospect and Prospect

James D. Meindl

The predominant economic event of the 20th century was the information revolution. The most powerful engine driving this revolution was the silicon microchip. During the period from 1960 through 2000, the productivity of semiconductor or silicon microchip technology advanced by a factor of approximately 100 million. Concurrently, the performance of the technology advanced by a factor greater than 1000. These sustained simultaneous advances were fueled primarily by sequentially scaling down the minimum feature size of the transistors and interconnects of a microchip thereby both reducing cost and enhancing performance. In 2005 minimum feature sizes of 80 nanometers clearly indicate that microchip technology has entered the 1—100 nanometer domain of *nanotechnology* through use of a "top-down" approach. Moreover, it is revealing to recognize that the 300-millimeter diameter silicon wafers, which facilitate microchip manufacturing, are sliced from a 1—2 meter long single crystal ingot of hyper-pure silicon. This silicon ingot is produced by a "self—assembly" process that represents the essence of the "bottom-up" approach to nanotechnology. Consequently, modern silicon microchips containing over one billion transistors are enabled by a quintessential *fusion* of top-down and bottom-up nanotechnology.

Due to factors such as transistor leakage currents and short-channel effects, critical dimension control tolerances, increasing interconnect latency and switching energy dissipation relative to transistors, escalating chip power dissipation and heat removal demands as well as design, verification and testing complexity, it appears that the rate of advance of silicon microchip technology may decline drastically within the next 1—2 decades. Nanotechnology presents a generic opportunity to overcome the formidable barriers to maintaining the historical rapid rate of advance of microchip technology and consequently the information revolution itself. The breakthroughs that are needed are unlikely without a concerted global effort on the part of industries, universities and governments. Nurturing such an effort is profoundly motivated by the ensuing prospect of enhancing to unprecedented levels the quality of life of all people of the world.