Carbon Nanotubes – A Successor to Silicon Technology?

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Carbon nanotubes (CNTs) exhibit a number of interesting properties that make them viable candidates for applications in microelectronics. In particular, the availability of both metallic and semiconducting species for transistors and interconnects, respectively, means that the most important building blocks of microelectronics are accessible. However, silicon technology has set some definite conditions for large scale integration and manufacturing that have to be satisfied by any competing technology: Devices must be adequate for integration, a large number of devices must be fabricated at the same time, downscaling of lateral dimensions must be feasible, and modular processing must be possible at yields close to 100% for each individual processing step. In this paper state-of-the-art carbon nanotube production and placement procedures will be assessed with respect to these requirements. The first application result for interconnects will be presented that involves the replacement of metal via plugs between two conductive layers by carbon nanotubes. Likewise, semiconducting single-walled carbon nanotube field effect transistors will be compared to advanced silicon MOSFETs. The scaling of lateral dimensions is the most successful principle in microelectronics. We will also address the scalability of one dimensional CNT devices and show recent experimental results of very short CNTFETs. Finally, a stand alone CNT power device is presented that is produced with state-of-the-art deposition techniques and is capable of driving LEDs and small motors.