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Carbon nanotube based field-effect transistors: merits and fundamental limits

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The development of even more powerful computer systems are made possible by scaling of CMOS transistors, and this simple process has afforded continuous improvement in both the device switch time and integration density. However, CMOS scaling has become very difficult at the 22-nm node and unlikely to be rewarding beyond the 14-nm node. Among other new approaches, carbon nanotube devices are emerging as the most promising technique with unique properties that are ideal for nanoelectronics. In particular, perfect n-type and p-type contacts are now available for controlled injection of electrons into the conduction band and holes into the valence band of the CNT, paving the way for a doping free fabrication of CNT based ballistic CMOS, high performance optoelectronic devices, and integrated circuits [1-3]. These results will be compared with data projected for Si CMOS toward the end of the roadmap at 2026, as well as with those thermodynamic and quantum limits. References: [1] L.-M. Peng, Z.Y. Zhang and S. Wang, Materials Today 17 (2014) 433 [2] L. Ding et al., Nature Communication Published 14 Feb 2012, DOI: 10.1038/ncomms1682; Tian Pei et al., Nano Letters 14 (2014) 3102 [3] S. Wang et al., Nano Letters 11 (2011) 23; L.J. Yang et al., Nature Photonics 5 (2011) 672; H. Xu et al., Nano Letters 14 (2014) 5382