Simulating Nanowires and Ultra-Thin Body Transistors using NEMO5 on nanoHUB.org

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ABSTRACT

During the past twenty years, the most important aspects of semiconductor electronics have advanced into the nanometer range, resulting in exponential increases of microprocessor computing performance. As the size of electrical components continues to shrink, the cost of experimental research and industrial fabrication in this field has increased dramatically. Thus, the development of accurate nanoscale model simulations becomes necessary as a measure to decrease the high financial expenses of advancing semiconductor technology. This simulator supports atomistic modeling in order to provide an accurate description of the nanoscale devices, as current electrical components operate in the quantum regime and are affected by atomistic fluctuations in real world devices. Using the fifth edition of the Nanoelectronics Modeling engine, or NEMO5, developed in the iNEMO group of Purdue’s Network for Computational Nanotechnology department, the tool is capable of computing strain, phonon spectra, electronic band structures, and many other properties of semiconductor devices. The simulator utilizes effective mass approximations to calculate a device’s internal quantities, such as charge distribution and current densities. Real-space Schrödinger and Poisson equations are solved self-consistently using a 2-D finite difference grid to provide an electric potential map of the device or material being tested. This user-friendly simulation tool will allow students, teachers, and researchers to explore the properties of nanoscale transistors in a graphical manner. The simulator will be able to provide information such as quantum states, transport characteristics, and self-consistent potential densities in an aesthetic manner so that these concepts can be understood intuitively.

KEYWORDS

NEMO5, UTB, nanowire, simulation, transistor