Modeling Carbon Nanotube FET Physics in COMSOL-Multiphysics

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Introduction

Carbon nanotube FETs are generating much interest in the nanoscale electronics area. Typically sub-threshold behavior in these devices has been modeled using the Laplace equation. Above threshold behavior uses self-consistent solutions to the Poisson and continuity equations. Accurate modeling of Carbon nanotube FETs needs to include quantum effects such as tunneling. This effect is captured via the inclusion of the Schrödinger equation. Finally, hot electron effects have been seen in fabricated devices, these effects are modeled by solving a coupled system consisting of the Boltzmann transport equation (for ballistic electron transport), Poisson equation (for the potential) and finally the heat equation to capture the energy balance. Owing to the coupled nature of modeling this device and the varied physics that need to be modeled, COMSOL-multiphysics is a tool that can be effectively used to model this device. In this paper we explore the ways in which we can model Carbon nanotube FET physics using COMSOL-multiphysics.

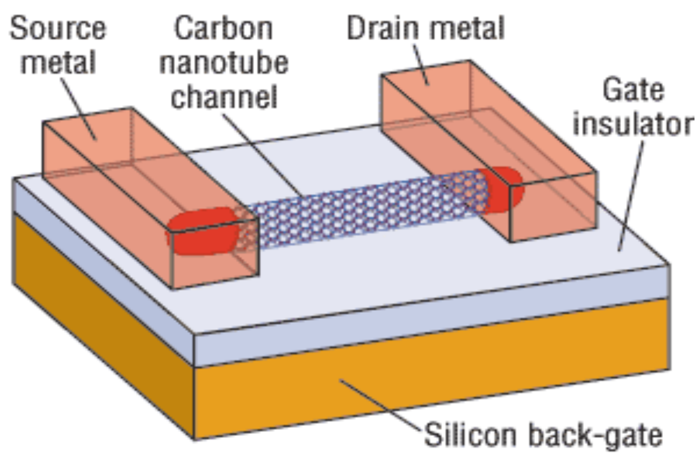

Figure 1: A schematic of a typical carbon nanotube FET

Reference:

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[2] J.P. Clifford, D.L. John, andD.L.John IEEE Trans. Nanotechnol., 2, 181, 2003.