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Research Article

Electrostatic Potential Distribution Analysis of Silicon Nanowire Field Effect Transistor with Various Channel Length

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Silicon nanowire FET plays a vital role in building of nanoscale electronic device applications. In this article, the silicon nanowire field effect model is designed with different channel lengths. By using the SiNW FET device model, various electrostatic potential distribution studies are done. This SiNW FET model is reducing the complexity in design. Two types of the device geometries are studied by changing the silicon nanowire channel length as 1000 nm and 200 nm. The 1000 nm channel provides high penetration to the active region of the nanowire FET than the 200 nm channel. This silicon nanowire FET model can apply to many nanoscale biochemical elements sensing applications.

1. Introduction

In nanomaterials, one-dimensional nanostructures play a great role in the detection of biochemical elements due to their excellent sensitivity at the nanoscale level. Nanowires provide high surface to volume ratio for getting great sensitivity with the conduction pathways being very small [1, 2]. So, it can cross the level of the detection limits of planar ISFETs. Due to their higher surface to volume ratio and the efficient gate filed penetration, the backgated nanowire FET shows the higher transconductance 4-10 times above the classical standard ISFETs [3]. When using ISFET for biological sensing applications, the liquid environment also works as a local gate electric field. These changes in the field vary the surface potential that produces conductance changes in the channel. Compared to the planar ISFETs, the surface potential highly influences the conduction channel of nanowires. In general, single crystalline silicon nanowires are used with p- or n-type doping in conduction channel that creates charge carriers attracted or repelled by the attached charged biological element.

In the present study, the undoped silicon nanowire is used [4, 5]. It works with the Schottky barrier FET [6, 7]. The dopant-free single crystalline silicon nanowire is free