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Vahideh KhademHosseini, Daryoosh Dideban, Mohammad Taghi Ahmadi, Razali Ismail

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An Analytical Approach to Model Capacitance and Resistance of Capped Carbon Nanotube Single Electron Transistor

Vahideh KhademHosseini[1], Daryoosh Dideban *[, 1, 2],Mohammad Taghi Ahmadi[3, 4, 5], Razali Ismail[3]

[1]Institute of Nanoscience and Nanotechnology, University of Kashan, Kashan, Iran

[2]Department of Electrical and Computer Engineering, University of Kashan, Kashan, Iran

[3]Faculty of Electrical Engineering, Universiti Teknologi Malaysia, 81310, UTM Johor Bahru, Johor, Malaysia

[4]Department of Electrical Engineering, Pardis of Urmia University, Urmia, Iran

[5] Nanotechnology Research Center, Nano electronic Research Group, Physics Department, Urmia University, Urmia, Iran

Corresponding author: dideban@kashanu.ac.ir

Abstract

The single electron transistor (SET) as a nanoscale transistor operates according to the electron tunneling via two tunnel junctions. Since selecting a suitable island material plays a key role in electron transfer through the tunnel junctions, in this research capped Carbon NanoTube (CNT) is utilized for the SET island which produces the quantum capacitance (C_Q). Its low value decreases the total capacitance (C_T). Subsequently the coulomb blockade (CB) energy and the critical temperature are reduced. Moreover the resistance of the capped CNT as a two dimensional material is very low thus its effect on the total resistance can be neglected. The result of an investigation on the capped CNT SET tunnel junction shows that the tunneling time of electron into or out of island decreases therefore the operation speed of capped CNT SET increases. Furthermore both the resistance and the quantum capacitance are modeled and analyzed. Comparison studies of proposed models indicate that the capped CNT