CIRCUITRY NETWORK MODELING FOR PREDICTION OF A NANOFET SENSOR BEHAVIOR USING SCALING-LAW APPROACH

MANZOUROLAJDAD Ali, RAEISI Mostafa, HASHEMI MAHNEH Hamed, KALANTARINEJAD Reza, HOSSEINI Kiarash

Aerospace Research Institute, Ministry of Science, Research and Technology, Iran

Abstract

In this paper we computationally investigate a Nanobiosensors behavior based on field effect transistor (FET). The nanoFET sensor comprises Source, Drain, Channel, Insulator layer and aqueous medium that contain ions and target molecules and receptor that cover in channel that absorption target molecules. When receptors absorb target molecules, conductance of channel change. Changing in conductance is factor that we understand absorption occur. Simulations are tools that help us to predicted behavior of sensors. There are kind of computational tools such as quantum and classic methods. One of classic method is scaling-law. In this method the sensor is assumed to be a circuitry network that contains nodes covering sensory receptors. To investigate the sensor response, a number of target molecules are randomly adsorbed by the receptors. Randomization here is translated into the concentration of target molecules in the sensor. In this paper we study the impact of aspect ratio of the sensing channel upon the sensitivity of the sensor. We assume sensing channel is plenary with a length and width that respectively define the number of nodes in length and width of network. It is firstly assumed that all of nodes contain receptors and normalized conductance between each node (Δ) is 1. Then receptors are randomly covered with target molecules. Two kinds of sensor behavior are there studied as the first being depletion where the carriers are run out of the region while the second being accumulation where the carrier density increases there. In this study we conclusion that in depletion sensitivity isn`t function of width of sensors but is function of value of conductance between each node. This kind of sensor appropriate for low concentration of target molecules. Accumulation model appropriate for high concentration of target molecules and at this model in long length and wide width, by increasing length, there is not a major shift in sensitivity and increasing in value of conductance lead to increasing of sensitivity.

Keywords: Field effect transistor (FET), randomization, sensitivity, target molecules, receptors, accumulation, depletion, scaling law

Author did not supply full text of the paper.