Models of nanoelectronic devices based on graphene and other 2D-materials of system NANODEV

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Graphene and 2D-materials have some unique properties, therefore development of different devices based on these materials are attract the attention of researchers. In the paper models of different nanoelectronic devices, namely: quantum drift-diffusion model of field-effect transistor based on bilayer graphene, model of resonant tunneling structures based on 2D-materials with the vertical transport, and model of resonant tunneling diodes (RTDs) based on GaN/AlGaN with vertical transport are considered. The models are needed in order to develop new devices. With the using of the models the IV- characteristics are calculated.

First, algorithms and programs, realized model of field-effect transistor based on bilayer graphene are presented. The model is considered in details in the articles [1, 2], and it is based on equations of quantum drift-diffusion model. Opening of energy band gap is taking into account for calculation coefficient of quantum capacitance in graphene channel. Three cases of carrier transport, namely: holes, electrons and simultaneous electrons and holes are considered for calculation of the coefficient. Output and transfer characteristics have been calculated for field-effect transistor based on bilayer graphene at room temperature.

Secondly, validations of the program of calculation output IV-characteristics of resonant tunneling structures based on SiO_2/MoS_2 have been carried out. Parameters of investigated structure are presented in articles [3, 4]. Simulation of the multibarrier structures based on the material system is carried out with the using modified model.

Thirdly, simulation results of IV-characteristics of RTDs based on GaN/AlGaN with vertical transport using the proposed numerical combined model [5] are presented. The model is based on the self-consistent solution of the Schrödinger and Poisson equations. Cases with various parameters of the structures are considered.

The proposed models were included in the nanoelectronic devices simulation system NANODEV [6, 7], which developed at the BSUIR since 1995.

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