Simulation of Field-Effect Transistors Based on Bilayer Graphene and Resonant-Tunneling Heterostructures Based on 2D Materials with Vertical Transport

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Abstract: The two-dimensional (2D) materials such as bilayer graphene and transition metal dichalcogenides (TMD) represent a prospect for the development of new micro- and nanoelectronics devices. Bilayer graphene can be used as channel of two-gate field-effect transistor (FET). Particularity of the FET based on bilayer graphene is that it is possibility to operate of graphene channel conductivity changed band gap. In this case electric field perpendicular to the channel of the FET is applied. Calculation of a band gap depends on material and thickness of top-gate and back-gate dielectrics, applied voltages. In laboratory "Physics of devices of micro- and nanoelectronics" at BSUIR we develop a quantum drift-diffusion model [1] of the FET based on bilayer graphene taking into account changing band gap [2, 3]. The model allows to calculate output and transfer characteristics of the FET based on bilayer graphene. In the paper the comparison of transfer characteristics of the FET based on bilayer graphene with different dielectrics of top and back gates has been carried out. Similar researches of transfer characteristics of the FET based on monolayer graphene was considered in paper [4]. The two-dimensional materials are also TMD such as MoS_2, WSe_2, WS_2. The paper [5] was devoted of investigation

of properties of the material systems accenting difference of material properties which depend on number of layers. Taking into account the particularities simulation of resonant-tunneling heterostructures with vertical transport was carried out. In particular heterostructures based on material systems MoS_2/WSe_2 and MoS_2/WS_2 were simulated. Investigation was fulfilled with the use of developed combined model of resonant-tunneling structures proposed for heterostructures with vertical transport [2]. Influence of spacer regions on *IV* characteristics of the heterostructures was demonstrated. Simulation of heterostructures with vertical transport including GaN, SiC and graphene also was considered.

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