Simulation of Graphene Field Effect Transistors by directly solving the semiclassical Boltzmann equation

Vittorio Romano
Università degli Studi di Catania
viale A. Doria 6, 95125 - Catania Italy
romano@dmi.unict.it

Giovanni Nastasi
Università degli Studi di Catania
viale A. Doria 6, 95125 - Catania Italy
g.nastasi@unict.it

In the last years an increasing interest has been devoted to graphene field effect transistors (GFETs) as potential candidates for high-speed analog electronics, where transistor current gain is more important than ratio current ON/current OFF. Several types of GFETs have been considered in the literature [7]: top-gated graphene based transistors, obtained synthesizing graphene on silicon dioxide wafer, and double gate GFETs. The current-voltage curves present a behaviour different from that of devices made of semiconductors, like Si or GaAs. Because of the zero gap in monolayer graphene, the current is no longer a monotone function of the gate voltage but there exists an inversion gate voltage [7].

Lately, some attempts to simulate Graphene Field Effects transistors (GFETs) have been performed (see for example [1, 6, 2, 3, 5]) with simplified models like drift-diffusion. The latter contains several functions to be fitted by experimental data such as mobilities and generation-recombination terms. Often adaptations of the expressions used for standard semiconductors are adopted and a reduced 1D Poisson equation is coupled to the equations for the charge transport. It is therefore warranted to have a confirmation of the obtained results by a direct solution of the semiclassical Boltzmann equation for charge transport in graphene. Here a discontinuous Galerkin method, already developed in ([4]), is used to simulate some challenging geometries for future GFETs by numerically solving the Boltzmann equations for electrons and holes in graphene.

References

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