Effect of reservoirs on transport properties of doped nanostructures

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Modern approach to description of transport properties of semiconductor nanostructures can be based on the quantum kinetic theory in which an ensemble of carriers is characterized by the non-equilibrium distribution function. One of the possible realizations of this approach is the formalism of the Wigner quasi-distribution function [1]. This formalism offers a number of advantages for use in modeling of electronic transport in nanosystems, but the most important of them is the conceptual simplicity of treatment of the nanosystems as open systems and inclusion of the dissipative processes in coherent dynamics of carriers [2].

The aim of this report is to investigate the influence of scattering processes in reservoirs on transport characteristics of doped nanosystems made of III-V compound semiconductor materials in CPP geometry. For this purpose the inflow boundary conditions given by the common supply function [3] are modified in accordance with the results presented in Ref. [4]. The influence of the reservoirs on the transport characteristics is investigated by solving the quantum kinetic equation for the Wigner function with the dissipative term which is modeled within the relaxation time approximation. The effect of the relaxation time for scattering processes in reservoirs on the electric current is shown in Fig. 1. The standard inflow boundary conditions are modified by using the Lorentz and the Voigt profiles.

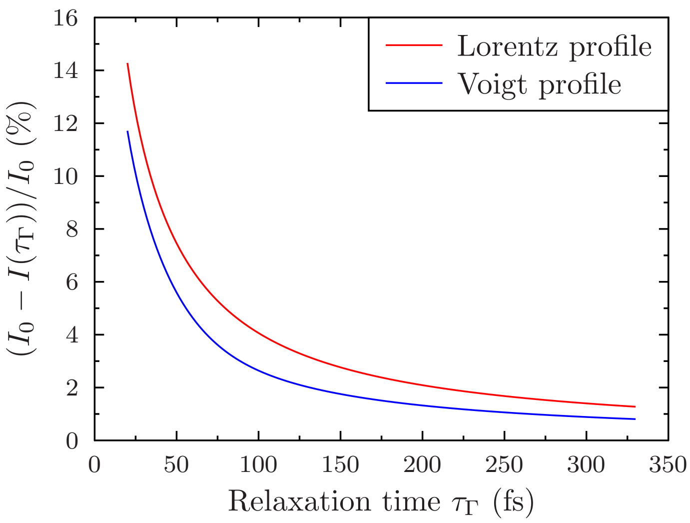

Figure 1: Relative change of the current due to the scattering processes in reservoirs described using Lorentz or Voigt profile.

K.K. is supported by the EU Project POWR.03.02.00-00-I004/16.

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