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The Hall Coefficient and Magnetoresistance in Rectangular Quantum Wires with Infinitely High Potential under the Influence of a Laser Radiation

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Abstract : The Hall Coefficient (HC) and the Magnetoresistance (MR) have been studied in two-dimensional systems. The HC and the MR in Rectangular Quantum Wire (RQW) subjected to a crossed DC electric field and magnetic field in the presence of a Strong Electromagnetic Wave (EMW) characterized by electric field are studied in this work. Using the quantum kinetic equation for electrons interacting with optical phonons, we obtain the analytic expressions for the HC and the MR with a dependence on magnetic field, EMW frequency, temperatures of systems and the length characteristic parameters of RQW. These expressions are different from those obtained for bulk semiconductors and cylindrical quantum wires. The analytical results are applied to GaAs/GaAs/Al. For this material, MR depends on the ratio of the EMW frequency to the cyclotron frequency. Indeed, MR reaches a minimum at the ratio 5/4, and when this ratio increases, it tends towards a saturation value. The HC can take negative or positive values. Each curve has one maximum and one minimum. When magnetic field increases, the HC is negative, achieves a minimum value and then increases suddenly to a maximum with a positive value. This phenomenon differs from the one observed in cylindrical quantum wire, which does not have maximum and minimum values.

Keywords : hall coefficient, rectangular quantum wires, electron-optical phonon interaction, quantum kinetic equation
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