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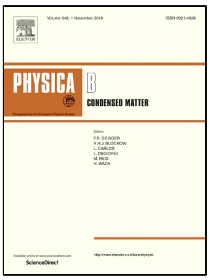

Energy loss rate of hot electrons due to polar-optical phonon modes in a semiconductor nanowire under transverse electric field

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Energy loss rate of hot electrons due to polar-optical phonon modes in a semiconductor nanowire under transverse electric field

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Abstract

Within the frame of electron-temperature model we calculate the average energy loss rate due to interface and confined longitudinal optical (LO) phonon emission from a hot-electron gas to a cold lattice in polar semiconductor nanowire surrounded by non-polar material. The system both with and without hot-phonon effect is investigated. The impact of a perpendicular electric field on average energy loss rate is explored. The energy loss rate dependences on electric field strength, wire radius and electron temperature are obtained. It has been shown that the energy loss rate is more sensitive to the electric field when the wire radius is larger. The presented results indicate that the electric field applied perpendicularly to the wire axis can serve as a means to control the energy loss rate. There is an experimental evidence concerning to the increase of energy loss rate with increasing electron temperature as we have obtained.

1. Introduction

To explain the basic properties of low-dimensional semiconductor structures, the knowledge of the hot carrier dynamics is of fundamental importance not only for exploring new electrical and thermal transport phenomena in condensed matter systems, but also for their importance in wide range of technological applications. When an electron system in semiconductor nanostructures is subjected to uniform heating, the temperature of the electron subsystem rises above that of the

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