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Title:Transverse wave-vector-dependent electron transport in terahertz quantum cascade lasers
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Abstract:We use the effective-barrier-height method to investigate the coupling effect between components of the motion of an electron in directions parallel and perpendicular to the interface on an electrically pumped, intersubband three-level THz emitter using multiple quantum wells heterostructures. It is shown that the coupling effect leads not only to a shift of all resonant peaks toward the low-energy region, but also causes broadening of resonant peaks and reduction of the peak-to-valley ratio in the transmission spectrum. Moreover, three lowest levels of one triple-quantum-well module decrease monotonically with increasing the transverse wave vector. Under a proper bias, the first excited level falls much faster than the second excited level, and the separation between the first excited level and the ground level becomes much smaller than 36 meV with the transverse wave vector increasing. This means that for a quantum laser which corresponds to the intersubband three-level THz emitter, a fast depopulation of the first excited level can not be achieved through scattering, and the removal of electrons may become difficult. Furthermore, the impact of the transverse wave vector on the squared magnitude of the wavefunctions of the three lowest levels is also discussed in this work. Copyright © 2012 Inderscience Enterprises Ltd.
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