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标题: Performance optimization for terahertz quantum cascade laser at higher temperature using genetic algorithm
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摘要: The aim of this work is to establish an approach for obtaining improved design parameters for high temperature operation of terahertz quantum cascade lasers using a multi-objective evolutionary algorithm. For studying the lasing conditions of a quantum cascade laser, a self-consistent model is adopted. This model uses standard wave function approximation and effective mass approximation with relevant scattering mechanisms to solve Schrodinger's equation for the cascaded quantum wells. Fermi's Golden Rule is then used to calculate the corresponding lifetime of each eigen states. To describe the coherent evolution of wave functions and phase breaking, density matrix formalism is employed. Subsequently, laser rate equations are used for calculating the parameters related to electronic transport in the device. These parameters are then utilized for investigating the temperature dependence of existing terahertz quantum cascade lasers. Finally, using an optimization technique based on Genetic algorithm, design parameters for resonant-phonon quantum cascade laser are obtained within the terahertz frequency range. The results illustrate that this optimization process can offer improvement in the performance of quantum cascade lasers in terahertz region at an elevated temperature. Moreover, the results also reveal that significant increase in operating temperature of a resonant phonon terahertz QCL is unlikely and hence novel design approaches should be considered for operating THz QCLs at room temperature.
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