Simulation of Carrier Transport and Hot Phonon Effects in Quantum Well Laser Diodes

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We have developed a two dimensional quantum well laser diode simulator (MINILASE II). In this presentation a review is given on how the simulator deals with hot electron effects, hot phonon effects and in general with electron and hole transport over and capture into the quantum wells. It is demonstrated that laser diode operation requires the solution of Boltzmann type equations at least within the quantum wells to describe important effects such as nonlinear gain and degradation of the modulation response. This together with the necessity to solve Maxwell's equations for the optical field makes the laser diode a device of unmatched complexity as far as simulation is concerned.

Both simulation of edge- and surface-emitting lasers will be discussed. It will be shown that surface emitting lasers present additional challenges for the self-consistent solution for electrical properties and optical field intensity. First attempts of such solutions will be presented.