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DENSITY OF CONFINED STATES IN FINITE-BARRIER QUANTUM WELLS

Marek OSIŃSKI and Mohammad MOJAHEDIE

Center for High Technology Materials, University of New Mexico, Albuquerque, New Mexico 87131-6081

Density of states (DOS) is one of the most important characteristics of quantum-well materials, significantly impacting their electronic and optical properties. For example, gain characteristics and lasing threshold of quantum-well semiconductor lasers are largely dependent upon the DOS. Yet, surprisingly little attention has been paid to the effects of finite-barrier height on the density of confined states in quantum wells. In spite of its weak foundation, the standard approach is to use an expression derived in a strictly 2D case which has been shown to apply also to quantum wells with infinitely high barriers. In an attempt to account for a more realistic case of finite-height potential barriers, a modified 2D DOS with the effective mass averaged between the well and the barrier materials was used occasionally. Here, we propose a new expression for the DOS in finite-barrier quantum wells based on the correspondence principle and on calculation of the quantized wave vectors.

Our results indicate that the DOS in finite-barrier quantum wells may differ substantially from the conventional 2D DOS calculated for infinite-barrier quantum wells. In view of the paramount importance of the DOS for quantum-well semiconductor lasers and other devices, a more rigorous first-principle analysis is necessary in order to verify our predictions.