

Semiconductor Lasers: from Homojunctions to Quantum Dots

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The presentation is devoted to the memory of outstanding Russian scientist, one of founders of the Quantum Electronics, Prof. N. G. Basov.

Abstract

A review is given on development of semiconductor lasers beginning from ideas and realization of first laser diodes to quantum-well and quantum-dot lasers. The progress in room-temperature threshold current density (improvement by 4-5 decades) is discussed. Role of electron and optical confinement is commented. A contemporary approach to the evolution of semiconductor laser devices is presented. Recent results on ultra-low current density laser structures on the base of quantum dots and quantum dashes are discussed. The energy spectra of QD ensembles are presented and analyzed from the point of view of influence of the confinement potential shape on the spectral peak positions. Data are given on anisotropy of quantum-dash structures, on gain cross-section and gain saturation in InAs/InGaAs quantum-dot lasers, on migration of carriers in structures with QDs. High overall efficiency of laser diodes (up to ~70%) is also discussed.

Biography

Peter G. Eliseev was graduated from Moscow State University (Russia) in 1959. Since 1963 he is a scientific coworker at P. N. Lebedev Physics Institute (Moscow, Russia), last time as a Principal Researcher. Since 1995, he is Research Professor at the Center for High Technology Materials, University of New Mexico. He is engaged in semiconductor laser technology and physics since 1962, developed several types of lasers starting from homojunction structures, then continued development of a number of heterostructures (introducing for the first time InGaAsP/InP and InGaAsSb/GaSb laser diodes), and then developing quantum-size heterostructure including ultra-low threshold quantum dot laser. He demonstrated and interpreted several phenomena in semiconductor lasers: voltage saturation, coherent collapse, asymmetrical nonlinear interaction of spectral modes, bistability in the external cavity, "optoelectronic signal", frequency chirping, etc. He had awarded with the State Prize in Science and Technology of the USSR in 1984 and with the N. Holonyak OSA Award in 2004. Senior member of IEEE, member of OSA and Russian Academy of Natural Sciences.