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Comparing the turn–on dynamics of quantum well and quantum dot lasers

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Abstracts:

We investigate the turn –on dynamics of the quantum well and quantum dot lasers under the effect of many parameters on the transient region length up to the initiation of the dc part of the laser signal and the level of the power output at the steady state region . Our findings are based on two laser models related to the two lasers the first consists of two equations describing the temporal behavior density and photons and the second consists of three equations describing the temporal behavior of occupancies of carriers in the quantum dot QD and wetting layer and photons respectively.

Keywords : Quantum well laser, Quantum dot laser, Turn–on dynamics

1.Introduction

Compact and efficient infrared light sources are neededfor portable and small footprint sensing and communication.Semiconductor diode lasers are key components in modern optical communications, storage,printing,medicine, and informationprocessing.These types of devices were developed and evolved constantly in the direction of size and integration .

A quantum well (QW) laser is a structure in which the active region of the device is so narrow that quantum confinement occurs [1,4]. Quantum dot (QD) on the other hand is a new kind of semiconductor nanostructure that confines the movement of carriers in all three dimensions[5,8]. QW and QD lasers have the well-known advantage of increasing radiative recombination efficiency,making them of particular interest of optoelectronic applications. In addition, the small size of QWs or QDs makes them relatively insensitive to structural defects in the surrounding matrix, with the consequence of reducing nonradiative recombination rates[9,10].Following the recent workof Lee et al.[11],we present a detailed study of quantumwell and quantum dot lasers dynamics under the effects of various control parameters that appeared in the mathematical models that describes their dynamics