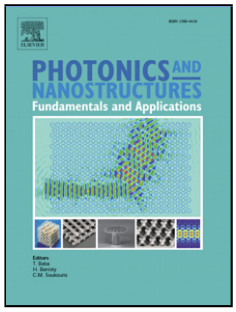

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Investigation of Dynamical Characteristics and Modulation Response Function of InAs/InP (311)B Quantum Dot Lasers with Different QD Size

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Highlights

- Increase in transition energy with reduction of size and the effect of diameter on separation of levels.
- The preferred size for 1.55 μm emission from GS level and ES level.
- For smaller diameter threshold gain is at lower current and saturation gain is higher.
- Resonance frequency and modulation bandwidth of GS level is larger for more height QDs but for ES level is larger for less height QDs.
- Diameter decrement leads to larger modulation bandwidth while threshold injection current is smaller.

Abstract

We have investigated the effect of size of InAS/InP (311)B quantum dot (QD), both height an diameter, on electronic levels and hence transition energies through k.p model, with focus on application in QD lasers. Therefore the results have been included in dynamic analysis based on coupled differential rate equations, to obtain variation of laser properties such as gain, photon number and modulation bandwidth in accordance to different experimental outcomes. This demonstrates that larger modulation bandwidth of ground state is given by QDs with smaller diameter but larger height however for excited state larger modulation bandwidth is given by smaller diameter and smaller height.

Keywords: Quantum Dot; Quantum Dot lasers; k.p; Band Structure; Rate Equations; Modulation Bandwidth.

1. Introduction

The growth of Quantum Dot (QD) semiconductors with Stranski-Krastanow method attracts many attentions due to producing spatial confinements which results in separation of electronic levels of electrons and holes [1]. These artificial atoms have many applications in semiconductor based devices like QD lasers with special characteristic such as lower threshold current [2], less sensitive to temperature [3] and zero-chirped modulation bandwidth [4, 5] than Quantum Wells, in view of quantum confinement. Accordingly, QD laser is a good choice for high-speed light