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Direct current modulation effects on the photons density in InAs/InGaAs quantum dot semiconductor laser

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Abstract :

Different dynamics ranging from period 1 to chaos are produced in the photon density PD of InAs/InGaAs quantum dot laser QDL under the effect of injection current modulation using a theoretical model. Death phenomena in the PD of the QDL was registered too . Weak and strong modulations of the injection current led to chaotic states. Bifurcation route appears to be the main route leading to chaos .

Keywords: Quantum dot semiconductor laser , Direct current modulation, Periodic and chaotic dynamics .

Introduction

The discrete energy levels structure in semiconductor quantum dots(QDs) offers several advantages over higher –dimensional systems for the application to high-performance semiconductor laser technology ,including the potential for lower threshold current ,reduced thermal sensitivity ,and higher modulation speed [1]. QD lasers have attracted lots of attention as next –generation laser sources for fiber telecommunication networks ,because of the promising properties mentioned together with low chirp [1] .Particularly ,directly modulated lasers (DML) have been expected to play a major role in the next –generation telecommunication links for cool-less and isolator –free applications[1]. However ,one of the major drawbacks of QD lasers concerns the modulation bandwidth, which remains still limited at room temperature [2].

In principle ,direct modulation at a gigabit rate is expected to be feasible. However ,the practical rate of pulse modulation has been limited to below several hundred megahertz ,owing to the serious distortion of the output waveform caused by the relaxation oscillation of the light intensity .

The optical gain varies with the carrier density causing the number of lasing modes and the width of the spectral