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Simulation of all-optical logic XNOR gate based on quantum-dot semiconductor optical amplifiers with amplified spontaneous emission

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Abstract The performance of all-optical logic XNOR gate has been simulated. XNOR operation is realized by using Mach–Zehnder interferometer utilizing semiconductor optical amplifiers (SOAs) with quantum-dot (QD) active region. The study is carried out when the amplified spontaneous emission (ASE) is included. Nonlinear dynamics including carrier heating and spectral hole-burning in the QD–SOA are taken into account together with the rate equations in order to realize the all-optical logic XNOR operation. Results show that the XNOR gate is capable of operating at data speed of 250 Gb/s with high output quality factor (Q-factor). The dependence of the output Q-factor on signals and QD–SOAs parameters is also investigated and discussed.

Keywords Optical logic · XNOR gate · Quantum-dot · Semiconductor optical amplifier · Mach–Zehnder interferometer

1 Introduction

An important step in the development of all-optical logic technology, which includes key functionalities in fundamental and system-oriented level such as buffering, demultiplexing, clock recovery, packet processing, wavelength conversion, data regeneration, optical encryption/decryption, etc., is the demonstration of optical logic elements that can operate at ultra

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