Analysis of quantum well size alteration effects on slow light device based on excitonic population oscillation

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Abstract In this paper we investigate the effects of quantum well size changes on slow light device properties. The principle properties such as center frequency and slow down factor of a slow light device are affected by changing the size of quantum well. In this way, the effects of quantum well size on Oscillator Strength and binding energy of exciton are considered separately. First, we investigate the variations in oscillator strength of exciton due to different quantum well size. Second, exciton binding energy level shift due to size of quantum well is investigated. According to this analysis, we have developed a new method for tuning slow light device bandwidth center frequency and slow down factor. Analysis and simulation of a basic GaAs/AlGaAs quantum wells optical slow light device based on excitonic population oscillation shows that size of quantum wells could tune both of the frequency properties and slow down factor of an optical slow light device. Simulation results show that slow down factor and oscillation strength of exciton are proportional to each other in direct manner. Moreover, decreasing the quantum well width, causes enhancement in binding energy of excitons. These achievements are useful in optical nonlinearity enhancements, all-optical signal processing applications and optical communications.

Keywords Slow light · Quantum well · Binding energy · Coherent population oscillation · Exciton oscillator strength

Abbreviations

QW Quantum well
QD Quantum dot
HH Heavy-hole
CPO Coherent population oscillation
EOS Exciton oscillator strength

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