Effect of lattice constant on band-gap energy and optimization and stabilization of high-temperature $In_xGa_{1-x}N$ quantum-dot lasers

Abstract

We analyze the effect of the lattice constant on the band-gap energy of $In_xGa_{1-x}N$ and optimize the structure of the device with a separate-confinement heterostructure. To vary the lattice constants, we change the In molar fraction, which permits us to investigate a wide range of the band gap of the active material employed in diode lasers. $In_xGa_{1-x}N$ is a promising active material for high-performance 1.55 μm quantum-dot lasers due to its excellent band-gap-energy stability with respect to temperature variations. The band gap of $In_xGa_{1-x}N$ decreases from 3.4 to 0.7 eV, and the necessary band gap can be achieved by changing the lattice parameters depending on the device application. It has been found that $In_{0.86}Ga_{0.14}N$ can be a promising material for emitting light at a wavelength of 1.55 μm.