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Effects of built-in polarization and carrier overflow on InGaN quantum-well lasers with AlGaN or AlInGaN electronic blocking layers

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Abstract

The effects of built-in polarization and carrier overflow on InGaN quantum-well lasers with a ternary Al0.2Ga0.8N or a quaternary AlInGaN electronic blocking layer have been investigated numerically by employing an advanced device simulation program. The simulation results indicate that the characteristics of InGaN quantum-well laser can be improved by using the quaternary AlInGaN electronic blocking layer. When the aluminum and indium compositions in the AlInGaN electronic blocking layer are appropriately designed, the built-in charge density at the interface between the InGaN barrier and the AlInGaN electronic blocking layer can be reduced. Under this circumstance, the electron leakage and threshold current can be decreased obviously as compared with the laser structure with a conventional Al 0.2Ga0.8N electronic blocking layer when the built-in polarization is taken into account in our simulation. On the other hand, the AlInGaN electronic blocking layer also gives higher refractive index than the Al0.2Ga0.8N electronic blocking layer. Therefore, higher quantum-well optical confinement factor can be obtained by using the AlInGaN electronic blocking layer as well.

Key words: III-V semiconductor; Numerical simulation;
Semiconductor laser