

Effect of Band-offset Ratio on Characteristics of 405-nm InGaN
Quantum-well Lasers

導電帶與價電帶井深比例對 405-nm 氮化銦鎵量子井雷射特性之影響

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Abstract

The effect of band-offset ratio on the characteristics of the 405-nm InGaN quantum-well lasers is studied numerically. Specifically, the optical properties are investigated when the band-offset ratio of the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ heterojunction is $7/3$. Compared to a band-off-set ratio of $3/7$, which was widely accepted before the year 2002, the laser performance is better and the distribution of carrier concentration in the quantum wells becomes more uniform when the band-offset ratio is $7/3$, which is accepted by most researchers recently. Several formulae are derived from simulations, which can be used as a handy tool to calculate the thickness of $\text{In}_x\text{Ga}_{1-x}\text{N}$ well layer in the 405-nm laser structure for specific indium compositions of $\text{In}_x\text{Ga}_{1-x}\text{N}$ well alyer and $\text{In}_y\text{Ga}_{1-y}\text{N}$ barrier layer.

Key words : InGaN; Band-Offset ratio; Quantum-well laser; Threshold current

中文摘要

本文以數值計算來探討導電帶與價電帶井深比例對 405-nm 氮化銦鎵量子井雷射特性的影響。特別是導電帶與價電帶井深比例為 $7/3$ 的 $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ 異質結構的光學特性。比較顯示現今大家所認同的井深比例為 $7/3$ 比 2002 年以前一般所認同的井深比例為 $3/7$ 有較佳的雷射效能及在量子井有較均勻的載子濃度分布。本文亦由模擬的結果推導出 405nm 雷射結構在一些特定銦含量的披覆層時，其量子井厚度與量子井銦含量的關係式，以作為設計的參考。

關鍵字：氮化銦鎵；導電帶與價電帶井深比例；量子井雷射；臨界電流