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器件制备及器件物理

$In_xGa_{1-x}N$量子阱蓝光LED光电特性与量子阱束缚态能级的关系

李国斌, 陈常水, 刘颂豪
华南师范大学广东省微纳光子功能材料与器件重点实验室激光生命科学教育部重点实验室, 广东 广州 510631

摘要： 运用软件模拟和理论计算的方法分析了量子阱宽度的变化对量子阱束缚态能级与光电性能产生的影响,建立了束缚态分裂能级理论模型。分析结果表明:当量子阱宽较窄时,极化效应导致的能带弯曲是光谱红移的主要原因,而电子泄漏是导致效率下降的主要原因;当阱宽较大时,能级填充是导致光谱红移的主要原因,俄歇复合与载流子离域是导致效率下降的主要原因。由本文得出,当量子阱宽为2.5~3.5 nm时,InGaN/GaN发光二极管获得最大内量子效率与发光效率。

关键词： 量子阱宽 效率下降 数值模拟 InGaN/GaN发光二极管

Relationship Between $In_xGa_{1-x}N$ Quantum-well Blue LED’s Photoelectric Properties and Quantum Well Bound State Energy Level

LI Guo-bin, CHEN Chang-shui, LIU Song-hao
Laboratory of Nanophotonic Functional Materials and Devices, The Key Laboratory of Laser Life Science, Ministry of Education, South China Normal University, Guangzhou 510631, China

Abstract: The software simulation and theoretical calculations are used to analysis the relationship between $In_xGa_{1-x}N$ quantum well blue LED's photoelectric properties and quantum well bound state energy level. A bound state split level model is established. When the quantum well thickness is narrower, the band bending caused by the polarization effects is the main reason for the spectral red-shift, and electron leakage is the main reason for efficiency droop. But as the well width increase, level filling is the main reason for the red-shift of spectrum, Auger recombination and carrier delocalization are the main reason for lower efficiency. By this article, the optimization quantum well width for InGaN/GaN light-emitting diodes can be obtained. The maximum internal quantum efficiency and luminous efficiency can be obtained when the optimization quantum well width is 2.5~3.5 nm.

Keywords: width of quantum well efficiency droop numerical simulate InGaN/GaN LED
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通讯作者: 陈常水
作者简介: 李国斌(1984-), 男, 湖南衡阳人, 主要从事中红外激光稳频与半导体照明器件的研究。 E-mail: lgb198611@126.com
作者Email: cschen@aiofm.ac.cn

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