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Numerical study of the advantages of ultraviolet light-emitting diodes with a single step quantum well as the electron blocking layer

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Abstract The advantages of ultraviolet light-emitting diodes with a single step quantum well used as electron blocking layer (EBL) are studied numerically. The energy band diagrams, hole concentrations, electrostatic field near the EBL, current–voltage curve and internal quantum efficiency (IQE) are investigated by using the Crosslight simulation programs. The simulation results show that the structure with a single step quantum well has better performance over the conventional one, which can be attributed to the mitigated band bending near the EBL due to the change of electrostatic field by using a step well. Therefore, the efficiency of hole injection is improved, with which both the IQE and the total lighting power are increased.

Keywords Step quantum well · Ultraviolet light-emitting diodes (UV-LEDs) · Band bending · Polarization

1 Introduction

In recent years, the III-nitride ultraviolet light-emitting diodes (UV-LEDs) have received much attention because of their potential usages in air, water, and surface sterilization (Shur and Gaska 2010), high density optical storage systems, full-color displays, chemical sensors, and medical applications (Li et al. 2006; Tsuzuki et al. 2009). Specially, the AlGaN LEDs are widely studied due to the advantages of wide spectrum coverage, low power consumption, compact size, and long lifetime over conventional mercury lamps (Pernot et al. 2010; Hwang et al. 2011). However, the common UV-LED using AlGaN bulk material as the electron

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