High Efficiency III-Nitride Devices with Smooth Relaxed InGaN Buffer and Strain Compliant Template

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BACKGROUND

The demand for high resolution, high brightness, wide color gamut, and highly efficient displays has increased significantly in recent years with the development of near-eye technologies, smartphones and other boundary-pushing innovations. Indium gallium nitride (InGaN) micro-LEDs are a promising alternative to liquid crystal displays (LCDs) and organic light emitting diodes (OLEDs) displays because they span the visible spectrum with higher power efficiency, brightness, and lifetime. However, red InGaN emitters still face efficiency obstacles due to the large lattice mismatch between their material layers. Strain compliant templates (SCTs) provide a solution by relaxing the strain caused by the lattice mismatch in the active layer, but their performance is limited by rough surface morphology which reduces crystal quality and, in turn, efficiency.

DESCRIPTION

Researchers at the University of California, Santa Barbara have improved the efficiency of red InGaN emitters by growing smooth buffer layers on mechanically flexible strain compliant templates (SCTs) for III-nitride based devices. This technology produces a smooth surface morphology on the InGaN buffer layer and top surface of each device, improving the crystal quality of the SCT and providing better metal contact for n- and p-type layers. These improvements translate to increased external quantum efficiencies (EQE), which is especially welcome in red light-emitting devices. Higher crystal film quality, lower defects, and higher EQE in LEDs and laser diodes (LDs) are necessary improvements for pioneering the next generation of display technology.

ADVANTAGES

▶ Higher external quantum efficiency (EQE) in III-nitride devices
▶ Fewer defects

APPLICATIONS

▶ LEDs and LDs
▶ Near eye technologies (VR/AR)
▶ Micro-LED displays

PATENT STATUS

Patent Pending

CATEGORIZED AS

▶ Optics and Photonics
▶ Imaging

OTHER INFORMATION

KEYWORDS
InGaN Buffer, InGaN micro-LED, Strain compliant template, SCTs, smooth buffer, flexible, crystal quality, external quantum efficiencies, EQE, red, lower defects, LEDs, laser diodes, Near eye technologies, AR, VR, display

RELATED CASES

2022-763-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

▶ Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates
▶ Enhanced Optical Polarization of Nitride LEDs by Increased Indium Incorporation
▶ Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
▶ Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
▶ Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation
▶ III-Nitride-Based Devices Grown With Relaxed Active Region
▶ Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
▶ Defect Reduction in GaN films using in-situ SiNx Nanomask
▶ Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
▶ Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes