



Semipolar-Based Yellow, Green, Blue LEDs with Improved Performance

Tech ID: 23656 / UC Case 2008-415-0

BRIEF DESCRIPTION

A novel approach to reducing or possibly eliminating the polarization effects in GaN-based optoelectronic devices.

BACKGROUND

Conventional nitride technology for electronic and optoelectronic devices employs nitride films grown along the polar c-direction. However, conventional structures in III-nitride based optoelectronic and electronic devices suffer from the undesirable quantum-confined Stark effect (QCSE), due to the existence of strong piezoelectric and spontaneous polarizations. One approach to eliminating the polarization effects in devices is to grow the devices on nonpolar planes of the crystal. Unfortunately, growth on nonpolar nitrides remains challenging and has not yet been widely adopted in the III-nitride industry.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a novel approach to reducing or possibly eliminating the polarization effects in GaN-based optoelectronic devices. This approach includes growing the devices on semipolar planes of the crystal. Using semipolar planes instead of c-plane nitrides will reduce total polarization, and there may even be zero polarization for specific alloy compositions. Reducing the polarization field allows for the growth of thicker quantum wells. With thicker quantum wells, higher Indium composition and thus longer wavelength emission can be achieved. The novel approach allows for the fabrication of blue, green, and yellow LEDs on semipolar (Al, In, Ga, B)N semiconductor crystals.

ADVANTAGES

- ▶ Growth of thicker quantum wells
- ▶ Reduced polarization fields in the device structure
- ▶ Reduced defect formation in the active layer

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INVENTORS

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OTHER INFORMATION

KEYWORDS

indssl, indLED, green LED,
blue LED, infeat

CATEGORIZED AS

- ▶ **Engineering**
- ▶ **Energy**
 - ▶ Lighting
 - ▶ Other
- ▶ **Semiconductors**
 - ▶ Design and Fabrication

RELATED CASES

2008-415-0

- ▶ Longer wavelength emission

APPLICATIONS

- ▶ Green, yellow, and blue GaN based light emitting diodes
- ▶ Laser diodes
- ▶ Multi-junction solar cells

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,299,452	10/30/2012	2008-415
United States Of America	Issued Patent	8,148,713	04/03/2012	2008-415

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- ▶ Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation
- ▶ III-Nitride-Based Vertical Cavity Surface Emitting Laser (VCSEL) with a Dielectric P-Side Lens
- ▶ Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
- ▶ Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
- ▶ Ultraviolet Laser Diode on Nano-Porous AlGaIn template
- ▶ Improved Reliability & Enhanced Performance of III-Nitride Tunnel Junction Optoelectronic Devices
- ▶ Nonpolar III-Nitride LEDs With Long Wavelength Emission
- ▶ Improved Fabrication of Nonpolar InGaIn Thin Films, Heterostructures, and Devices
- ▶ Oxyfluoride Phosphors for Use in White Light LEDs
- ▶ (In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
- ▶ Thermally Stable, Laser-Driven White Lighting Device
- ▶ Methods for Fabricating III-Nitride Tunnel Junction Devices
- ▶ Low-Droop LED Structure on GaN Semi-polar Substrates
- ▶ Contact Architectures for Tunnel Junction Devices
- ▶ Semi-polar LED/LD Devices on Relaxed Template with Misfit Dislocation at Hetero-interface
- ▶ III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- ▶ Tunable White Light Based on Polarization-Sensitive LEDs
- ▶ Improved Anisotropic Strain Control in Semipolar Nitride Devices
- ▶ Novel Multilayer Structure for High-Efficiency UV and Far-UV Light-Emitting Devices
- ▶ A Method To Lift-Off Nitride Materials With Electrochemical Etch
- ▶ High-Intensity Solid State White Laser Diode
- ▶ Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
- ▶ GaN-Based Thermoelectric Device for Micro-Power Generation
- ▶ Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
- ▶ High-Efficiency and High-Power III-Nitride Devices Grown on or Above a Strain Relaxed Template
- ▶ UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaIn Alloys
- ▶ III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture

