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
- Longer wavelength emission

APPLICATIONS

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

PATENT STATUS

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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
ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates
- High Efficiency LED with Optimized Photonic Crystal Extractor
- Enhanced Optical Polarization of Nitride LEDs by Increased Indium Incorporation
- Edge-Emitting Laser Diode with Via-Activated Tunnel Junction Contact
- Etching Technique for the Fabrication of Thin (Al, In, Ga)N Layers
- Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
- Flexible Arrays of MicroLEDs using the Photoelectrochemical (PEC) Lift off Technique
- Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- Gallium-containing MicroLEDs for Displays
- High Speed Indium Gallium Nitride Multi-Quantum Well (InGaN MQW) Photodetector
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
- Internal Heating for Ammonothermal Growth of Group-III Nitride Crystals
- 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
- Hybrid Growth Method for Improved Ill-Nitride Tunnel Junction Devices
- Phosphor-Free White Light Source
- Volumetric Hole Injection with Intentional V-Defects
- Control of Photoelectrochemical (PEC) Etching by Modification of the Local Electrochemical Potential of the Semiconductor Structure
- Low Temperature Deposition of Magnesium Doped Nitride Films
- Transparent Mirrorless (TML) LEDs
- Improved GaN Substrates Prepared with Ammonothermal Growth
- Laser Diode With Tunnel Junction Contact Surface Grating
- Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
- High Efficiency Semipolar AIGaN-Cladding-Free Laser Diodes
- Method for Growing Self-Assembled Quantum Dot Lattices
- Method for Enhancing Growth of Semipolar Nitride Devices
- III-Nitride Tunnel Junction with Modified Interface
- Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals
- Nonpolar III-Nitride LEDs With Long Wavelength Emission
- Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices
- Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
- Increased Light Extraction with Multistep Deposition of ZnO on GaN
- Method for Manufacturing Improved Ill-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected Ill-Nitride LEDs
- Selective-Area Mesoporous Semiconductors And Devices For Optoelectronic And Photonic Applications
- High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
- Method for Growing High-Quality Group III-Nitride Crystals
- Near-Infrared, Flip-Chip, TCO-Clad, InGaN Quantum Dot Laser Diode
- Incorporating Temperature-Sensitive Layers in III-N Devices
- Oxysfluoride Phosphors for Use in White Light LEDs
- Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
- (In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
- MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
- Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
- Heterogeneously Integrated GaN on Si Photonic Integrated Circuits
- (Al, In,Ga, B)N Device Structures
- Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDS
- Methods for Fabricating Ill-Nitride Tunnel Junction Devices
- 3D Hole Injectors for InAlGaN Light-Emitting Diodes
- Formation of Transparent Integrated MicroLED Displays
- 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
- Photoelectrochemical Etching Of P-Type Semiconductor Heterostructures
Growth of Semipolar III-V Nitride Films with Lower Defect Density

III-Nitride Tunnel Junction LED with High Wall Plug Efficiency

In-Situ Methods Of Preventing Interfacial Impurities And Dry Etch-Induced Damage In Regrown III-Nitride Structures

Enhanced Hole Injection by P-Type Active Region and Lateral Injection in InAlGaN LEDs

Improved Manufacturing of Solid State Lasers via Patternning of Photonic Crystals

Solid Solution Phosphors for Use in Solid State White Lighting Applications

Multifaceted III-Nitride Surface-Emitting Laser

Tunable White Light Based on Polarization-Sensitive LEDs

Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN

III-Nitride VCSEL with a High Indium Content Active Region

Growth of High-Performance M-plane GaN Optical Devices

Packaging Technique for the Fabrication of Polarized Light Emitting Diodes

Improved Anisotropic Strain Control in Semipolar Nitride Devices

High Light Extraction Efficiency III-Nitride LED

Photoelectrochemical Etching for Chip Shaping Of LEDs

III-V Nitride Device Structures on Patterned Substrates

Hexagonal Wurtzite Type Epitaxial Layer with a Low Alkali-Metal Concentration

Method for Increasing GaN Substrate Area in Nitride Devices

Burying Impurities And Defects In Regrown III-Nitride Structures

Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy

Single or Multi-Color High Efficiency LED by Growth Over a Patterned Substrate

GaN-Based Thermoelectric Device for Micro-Power Generation

Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patternning

Improved Manufacturing of Semiconductor Lasers

LED Device Structures with Minimized Light Re-Absorption

Improved Light Extraction with Geometrically Tuned LED Arrays

Growth of Planar Semi-Polar Gallium Nitride

Nonpolar (Al, B, In, Ga)N Quantum Well Design

UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaN Alloys

Defect Reduction of Non-Polar and Semi-Polar III-Nitrides

III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture

Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-150)

Suppression of Defect Formation and Increase in Critical Thickness by Silicon Doping

Wafer Bonding for Embedding Active Regions with Relaxed Nanofeatures

Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD