Method for Manufacturing Improved III-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected III-Nitride LEDs

Tech ID: 23890 / UC Case 2014-416-0

BRIEF DESCRIPTION
A novel device structure for III-nitride devices grown on non-polar or semipolar planes.

BACKGROUND
The usefulness of III-nitrides has been well established for fabrication of visible and ultraviolet optoelectronic devices and high power electronic devices. Growing these devices on nonpolar or semipolar planes of the crystal is a popular solution for reducing the polarization effects. One of the challenges of nonpolar and semipolar growth is that when green III-nitride LEDs and LDs are grown with active regions with high indium contents, the active region can form extended defects and can easily be degraded by subsequent high temperature growth steps. This degradation is due to the growth of the p-type layers after the growth of the active region, which uses high temperatures and impedes device performance.

DESCRIPTION
A novel device structure has been developed for III-nitride devices grown on non-polar or semipolar planes that does not involve the growth of p-type layers after the active region. This configuration reduces the defects and device degradation common in III-nitride LEDs and LDs grown on semipolar planes, and has the potential for creating green III-nitride LEDs and LDs with improved performance and higher wall-plug efficiency.

ADVANTAGES
· Reduced contact resistance, absorption loss, and spreading resistance in p-GaN devices
· Decreased operating voltage of LEDs and LDs leads to increased wall-plug efficiency
· Reduced thermal losses from resistive p-GaN layers

APPLICATIONS
· Light emitting diodes (LEDs)
· Laser diodes (LDs)

PATENT STATUS

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KEYWORDS
indLED, semipolar plane, light emitting diode, laser diode, III-nitride, ceniEE, indssl, indfeat

CATEGORIZED AS
· Energy
· Lighting
· Other

RELATED CASES
2014-416-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
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
III-Nitride-Based Devices Grown With Relaxed Active Region
Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
Photonic Structures for Efficient Light Extraction and Conversion in Multi-Color LEDs
Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
Low Temperature Deposition of Magnesium Doped Nitride Films
Transparent Mirrorless (TML) LEDs
Improved GaN Substrates Prepared with Ammonothermal Growth
Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
Size-Independent Forward Voltage Micro-LED with an Epitaxial Junction
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
High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
Method for Growing High-Quality Group III-Nitride Crystals
Controlled Photoelectrochemical (PEC) Etching by Modification of Local Electrochemical Potential of Semiconductor Structure
Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
Highly Compact, High-Index Dielectric Nanostructures for Deep-Ultraviolet Devices
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
Photoelectrochemical Etching Of P-Type Semiconductor Heterostructures
Semipolar-Based Yellow, Green, Blue LEDs with Improved Performance
III-Nitride-Based Devices Grown On Thin Template On Thermally Decomposed Material
Growth of Semipolar III-V Nitride Films with Lower Defect Density
III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
Improved Manufacturing of Solid State Lasers via Patternning of Photonic Crystals
High Efficiency III-Nitride Devices with Smooth Relaxed InGaN Buffer and Strain Compliant Template
Tunable White Light Based on Polarization-Sensitive LEDs
Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
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
III-V Nitride Device Structures on Patterned Substrates
Activation of P-Type Layers of Tunnel Junctions in Micro-LEDs
Method for Increasing GaN Substrate Area in Nitride Devices
Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
GaN-Based Thermoelectric Device for Micro-Power Generation
Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patternning
LED Device Structures with Minimized Light Re-Absorption
Growth of Planar Semi-Polar Gallium Nitride
UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaN Alloys
III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture
Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD