Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
Tech ID: 23858 / UC Case 2013-490-0

BRIEF DESCRIPTION
A method for making a high power blue-violet III-nitride semipolar laser diode.

BACKGROUND
Conventional solid-state lighting systems use a III-nitride light emitting diode (LED) that emits blue light to excite a phosphor that emits yellow light. Although LEDs show promise for solid state lighting applications, they nevertheless suffer from efficiency droop at high injection levels. Laser diodes are a suitable replacement for generating blue light in solid state lighting systems, since they do not experience the same droop effects.

DESCRIPTION
Researchers at the University of California, Santa Barbara have developed a method for making a high power blue-violet III-nitride semipolar laser diode. These laser diodes have output powers in excess of 1W, slope efficiencies of more than 1 W/A, external quantum efficiencies (EQEs) in excess of 35%, and show great potential for use in solid state lighting systems.

ADVANTAGES
▶ Precise control of directionality and efficiency of light extraction
▶ Higher efficiency at high operating power

APPLICATIONS
▶ Solid state lighting

PATENT STATUS

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<th>Type</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>9,356,431</td>
<td>05/31/2016</td>
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CATEGORIZED AS
▶ Energy
▶ Lighting
▶ Semiconductors
▶ Design and Fabrication
▶ Other

RELATED CASES
2013-490-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
▶ Method for Improved Surface of (Ga,AI,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
- Hybrid Growth Method for Improved III-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 AlGaN-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 III-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected III-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
- Oxyfluoride 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 III-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
- Semipolar-Based Yellow, Green, Blue LEDs with Improved Performance
- 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 Patterning
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 Nanostructures
Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD