Contact Architectures for Tunnel Junction Devices
Tech ID: 27385 / UC Case 2017-132-0

BACKGROUND

A commonly explored limitation of p-GaN is that it is a poor current spreading layer and that traditional p-contacts will increase operating voltages in III-nitride devices. The introduction of tunnel junctions solves these issues and expands the opportunities for new device designs. This technology seizes the opportunity to improve the light extraction of flip chip LEDs.

DESCRIPTION

Researchers at the University of California, Santa Barbara have optimized light extraction of tunnel junction devices by increasing the reflectivity of the device’s mirror. The high reflectivity of silver has made it the first choice for previous mirror iterations, but its poor conductivity at the requisite thinness requires adjustments which then erode the benefits of its high reflectivity. This technology reconstructs the mirror, replacing silver with aluminum and coating the reflector with a dielectric high-reflection coating. This novel mirror architecture demonstrates a higher reflectivity than pure silver which leads to improved light extraction.

ADVANTAGES

▶ Improved light extraction  
▶ Increased Chip power  
▶ Current spreading with GaN  
▶ No requirement for a TCO or silver mirrors  
▶ Low contact resistivity & high reflectivity

APPLICATIONS

▶ LEDs  
▶ III-Nitride devices  
▶ Tunnel junctions

PATENT STATUS

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<td>Patent Cooperation Treaty</td>
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<td>WO2018035322</td>
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Additional Patent Pending

RELATED TECHNOLOGIES

▶ III-Nitride Tunnel Junction LED with High Wall Plug Efficiency  
▶ Polarization-Enhanced Tunnel Junction Using A Double Heterojunction Between A Wurtzite Material And A Rocksalt Material  
▶ Laser Diode With Tunnel Junction Contact Surface Grating  
▶ Methods for Fabricating III-Nitride Tunnel Junction Devices  
▶ Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide  
▶ III-Nitride Tunnel Junction with Modified Interface  
▶ Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices

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

CONTACT

Sherylle Mills Englander  
englander@tia.ucsb.edu  
tel: View Phone Number

INVENTORS

▶ DenBaars, Steven P.  
▶ Nakamura, Shuji  
▶ Speck, James S.  
▶ Yonkee, Benjamin P.  
▶ Young, Erin C.

OTHER INFORMATION

KEYWORDS

LED, indled, indfeat, Flip chip, tunnel junction, III-nitride devices, surface emitting lasers

CATEGORIZED AS

▶ Energy  
▶ Lighting  
▶ Engineering  
▶ Other

RELATED CASES

2017-132-0
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) Liftoff 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 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
- 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-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 AllnN and AllnGaN 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