Heterogeneously Integrated GaN on Si Photonic Integrated Circuits
Tech ID: 30118 / UC Case 2019-394-0

BRIEF DESCRIPTION
A process that results in new capabilities of GaN lasers. Functionalities include surface emission, beam steering, enhanced performance, low waveguide loss, and superior reliability.

BACKGROUND
Many gallium nitride (GaN) lasers are composed of GaN and its alloys and grown on bulk-GaN wafers. This architecture of GaN lasers employs expensive metal packaging and lacks innovation in performance, control, and energy conservation. Additionally, the recyclability of materials can be improved.

DESCRIPTION
Researchers at the University of California, Santa Barbara have developed new capabilities of GaN lasers through heterogeneous integration of GaN lasers on Si photonic integrated circuits. Functionalities of the new process include surface emission, beam steering, enhanced performance, low waveguide loss, and superior reliability. Additionally, separation of a light output port from a heat-generating InGaN gain section reduces the cost of production because the expensive metal packaging typically used for GaN lasers becomes unnecessary. These new lasers also have the potential to reuse the expensive GaN substrate wafers.

ADVANTAGES
▶ Surface emission
▶ Beam steering
▶ Low waveguide loss
▶ Superior reliability
▶ Reduced cost
▶ Potential to reuse expensive GaN wafers

APPLICATIONS
▶ GaN lasers
▶ Power electronics
▶ Li-Fi
▶ LEDs

PATENT STATUS

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<tr>
<td>Patent Cooperation Treaty</td>
<td>Published Application</td>
<td>WO2020096950</td>
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OTHER INFORMATION
KEYWORDS
indfeat, indled, GaN, Lasers, Wafers, Heterogeneous Integration, Integrated Circuits

CATEGORIZED AS
▶ Energy
▶ Lighting
▶ Materials & Chemicals
▶ Electronics Packaging

RELATED CASES
2019-394-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
▶ Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates
▶ Bonding of Heterogeneous Material for Improved Yield and Performance of Photonic Integrated Circuits
▶ High Efficiency LED with Optimized Photonic Crystal Extractor
▶ Enhanced Optical Polarization of Nitride LEDs by Increased Indium Incorporation
▶ Epitaxial Laser Integration on Silicon Based Substrates
▶ Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
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
Low Temperature Deposition of Magnesium Doped Nitride Films
Transparent Mirrorless (TML) LEDs
Integrated Bidirectional Optical Amplifier (BOA) for Optical Interconnects
Improved GaN Substrates Prepared with Ammonothermal Growth
Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes
A Hybrid Silicon Laser-Quantum Well Intermixing Wafer Bonded Integration Platform
Size-Independent Forward Voltage Micro-LED with an Epitaxial Junction
Method for Enhancing Growth of Semipolar Nitride Devices
Integrated Reconfigurable Circulator
III-Nitride Tunnel Junction with Modified Interface
Magneto-Optic Modulator
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
Controlled Photoelectrochemical (PEC) Etching by Modification of Local Electrochemical Potential of Semiconductor Structure
Oxyfluoride Phosphors for Use in White Light LEDs
Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
Ring Resonator-Based Optical Isolator and Circulator
(In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
Method For The Removal Of Devices Using The Trench
Thermally Stable, Laser-Driven White Lighting Device
MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
Integrated Dielectric Waveguide and Semiconductor Layer
Orthogonal Mode Laser Gyro
Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDs
Methods for Fabricating III-Nitride Tunnel Junction Devices
Loss Modulated Silicon Evanescent Lasers
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
Improved Manufacturing of Solid State Lasers via Patterned of Photonic Crystals
Multifaceted III-Nitride Surface-Emitting Laser
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
- Monolithically Integrated Laser-Nonlinear Photonic Devices
- Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
- 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
- Unipolar Light Emitting Devices On Silicon Based Substrates
- Misfit Dislocation Free Quantum Dot Lasers
- LED Device Structures with Minimized Light Re-Absorption
- 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