Laser Diode With Tunnel Junction Contact Surface Grating
Tech ID: 31761 / UC Case 2019-938-0

BACKGROUND
Tunnel junction contacts substantially improve the conductivity and reduce operating voltages for current laser diodes. Distributed feedback (DFB) gratings enable the wavelength compatibility, high spectral purity, and frequency stability of current laser diodes. Combining these two elements in a single device affords new design, fabrication and performance benefits.

DESCRIPTION
Researchers at the University of California, Santa Barbara have symbiotically merged the performance-enhancing properties of tunnel junction contacts and DFB gratings to realize new opportunities for laser diode design. The individual fabrication properties of the DFB grating and the tunnel junction contact complement each other by improving the fabrication techniques of the other component. Using a tunnel junction contact allows the DFB grating to be closer to the active region, improving the coupling between the grating and the lasing mode. Using a DFB grating leaves areas of exposed p-type GaN, facilitating activation of the p-type layers without additional device processing that is typically necessary for MOCVD-grown tunnel junction designs.

ADVANTAGES
» Improved conductivity
» Reduced operating voltage
» Single longitudinal mode emission
» Reduced optical losses
» Simple fabrication

APPLICATIONS
» Laser Diodes

PATENT STATUS
Patent Pending

RELATED TECHNOLOGIES
» Contact Architectures for Tunnel Junction Devices
» 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
» 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

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
» Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
» Flexible Arrays of MicroLEDs using the Photoelectrochemical (PEC) Liftoff Technique

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OTHER INFORMATION
KEYWORDS
DFB grating, tunnel junction, MOCVD, GaN, laser diode

CATEGORIZED AS
» Optics and Photonics
» All Optics and Photonics
» Semiconductors
» Design and Fabrication

RELATED CASES
2019-938-0
Improved Manufacturing of Solid State Lasers via Patterning of Photonic Crystals

III-N Transistor With Stepped Cap Layers

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

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

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

Polarization-Doped Field Effect Transistors with Increased Performance

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 Nanofeatures

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

III-N Based Material Structures and Circuit Modules Based on Strain Management