Laser Diode With Tunnel Junction Contact Surface Grating

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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

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
▶ Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
▶ Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
▶ Achieving “Active P-Type Layer/Layers” In III-Nitride Epitaxial Or Device Structures Having Buried P-Type Layers
▶ High-Quality N-Face GaN, InN, AlN by MOCVD

INVENTORS

▶ Cohen, Daniel A.
▶ DenBaars, Steven P.
▶ Hamdy, Kareem
▶ Mishra, Umesh K.
▶ Nakamura, Shuji
▶ Zhang, Haojun

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
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 SnNx 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
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
High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes
A Structure For Increasing Mobility In A High-Electron-Mobility Transistor
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
Fabrication of Relaxed Semiconductor Films without Crystal Defects
Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices
Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
Methods for Locally Changing the Electric Field Distribution in Electron Devices
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
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
Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDs
GaN-based Vertical Metal Oxide Semiconductor and Junction Field Effect Transistors
Methods for Fabricating III-Nitride Tunnel Junction Devices
Low-Droop LED Structure on GaN Semi-polar Substrates
Contact Architectures for Tunnel Junction Devices
Semipolar 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
Novel Current-Blocking Layer in High-Power Current Aperture Vertical Electron Transistors (CAVEtS)
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
Growth of High-Performance M-plane GaN Optical Devices
Packaging Technique for the Fabrication of Polarisated Light Emitting Diodes
Improved Anisotropic Strain Control in Semipolar Nitride Devices
High Light Extraction Efficiency III-Nitride LED
II-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
- 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 AllInN and AllInGaN 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