Near-Infrared, Flip-Chip, TCO-Clad, InGaN Quantum Dot Laser Diode
Tech ID: 31862 / UC Case 2019-963-0

BACKGROUND

Conventional telecommunication laser diodes utilize shorter wavelengths that result in limited temperature performance. Typical systems also employ a quantum well in narrower bandgap material systems that are susceptible to both internal quantum deficiencies in defective materials and defects through the active region because their emitters are not localized.

DESCRIPTION

Researchers at the University of California, Santa Barbara have fabricated a device with a long wavelength (850-1550nm) emission using InGaN quantum dots. Due to the temperature sensitivity of InN, the epitaxial structure is grown in reverse as compared to conventional devices; starting with p-contact layers, p-GaN, and AlGaN electron-blocking layer (EBL) — all at high temperatures. The quantum dot layer, barrier layers, and n-GaN are subsequently grown at a low temperature under 700°C. This device provides telecommunication wavelengths using a III-nitride system with enhanced temperature performance, and the localized nature of the emitters reduces this device’s sensitivity to defects and threading dislocations.

ADVANTAGES

▶ Increased temperature performance
▶ Increased internal quantum efficiencies
▶ Reduced sensitivity to defect

APPLICATIONS

▶ Laser Diodes

PATENT STATUS

Patent Pending

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
▶ 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
▶ Gallium-containing MicroLEDs for Displays
▶ High-Quality N-Face GaN, InN, AlN by MOCVD
▶ 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
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

Wavelength-Selective Phosphor Coating for Laser Lighting Devices

High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes

High Mobility Group-III Nitride Transistors with Strained Channels

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

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

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

Enabling Epitaxial Growth On Thin Substrates

(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

(AI,In,Ga, BJ)N Device Structures

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

Formation of Transparent Integrated MicroLED Displays

Low-Drop 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 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
- 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