Incorporating Temperature-Sensitive Layers in III-N Devices

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BACKGROUND

Typical III-N devices are limited by temperature sensitivity in the active region when growing p-GaN on top at higher temperatures. Due to concerns with unintentional Mg-doping incorporation and the necessary activation step post-growth, p-GaN is typically grown last in a device structure. Growing p-GaN at high temperatures disturbs regions in the device with poor stability at higher temperatures by causing active region degradation. The ability to grow potential devices is restricted by high temperature p-GaN growth.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a III-V device that uses active regions with low temperature stability, such as InN or high indium content InGaN quantum dots or wells. This technology addresses growth concerns associated with p-type GaN by growing p-GaN first, and mitigating impurity incorporation into p-GaN:Mg by depositing the p-GaN prior to the growth of the active region. This technology also leverages the capabilities of the N-polar face, which is the slowest-grown plane in MOCVD. Devices that were previously impossible to grow, due to the high temperature p-GaN growth and capping of InN quantum dots, can be enabled via the slow growth of the N-polar direction – an essential benefit for longer wavelength III-V devices, including infrared.

ADVANTAGES

- Increases device growth potential
- Reduces p-GaN growth temperature
- Long wavelength applications

APPLICATIONS

- LEDs
- 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) Lift-off 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
Near-Infrared, Flip-Chip, TCO-Clad, InGaN Quantum Dot Laser Diode
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
(Al, In,Ga, B)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-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 Patternig 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 Nanostructures
Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD
III-N Based Material Structures and Circuit Modules Based on Strain Management