III-Nitride-Based Devices Grown On Thin Template On Thermally Decomposed Material

Tech ID: 32660 / UC Case 2021-888-0

BACKGROUND

Micron-sized (less than 100 \(\mu m^2\)) InGaN-based LEDs are well regarded as the future of display technology due to their high wall plug efficiency and wide color gamut compared to conventional alternatives. Despite the technology’s promising outlook, the external quantum efficiency (EQE) of long wavelength InGaN-based LEDs is lacking. Maintaining high efficiency requires an increased Indium content, but the fabrication parameters and composition pulling effect pose substantial barriers. Solutions have surfaced to address this issue, but they are found to be time consuming and still fall short of desired results.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed highly efficient III-nitride devices with high-quality, long-wavelength active regions. This technology relaxes a large-area buffer layer across an entire substrate in a single growth with no other processing required. A high growth temperature of 870°C improves Indium incorporation and results in the highest-available crystal quality of InGaN and AlGaN layers; nearly three times higher than current market offerings. This technology has much higher relaxation (85%) across the whole area of the InGaN layer grown on a 2-inch substrate compared to traditionally relaxed regions that are less than 10 \(\mu m^2\). This simpler cost-effective approach to growing smaller LED and LDs in a single MOCVD step can be applied to any III-nitride devices, such as electronic devices, high frequency devices, HEMTs, FETs, various detectors, and even solar cells.

ADVANTAGES

▶ Efficient long-wavelength LEDs
▶ High InGaN relaxation (biaxially 85% relaxed) compared to InGaN grown on porous GaN (uniaxially 40~50%)
▶ Higher growth temperature resulting in market-leading crystal quality

APPLICATIONS

▶ LEDs, micro-LEDs and Laser Diodes
▶ RF devices
▶ HEMTs
▶ FETs
▶ Solar cells

PATENT STATUS

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

▶ 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
▶ Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation
▶ III-Nitride-Based Devices Grown With Relaxed Active Region
▶ 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

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OTHER INFORMATION

KEYWORDS

micron-sized, LED, external quantum efficiency, crystal quality, laser diodes, Thin Template, III-nitride device, electronic device, high frequency, HEMTs, FETs, solar cells, InGaN, AlGaN

CATEGORIZED AS

▶ Optics and Photonics
▶ All Optics and Photonics
▶ Energy
▶ Lighting
▶ Other
▶ Solar
▶ Engineering
▶ Other

RELATED CASES

2021-888-0
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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
Improved GaN Substrates Prepared with Ammonothermal Growth
Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
Size-Independent Forward Voltage Micro-LED with an Epitaxial Junction
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
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
(In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
Thermally Stable, Laser-Driven White Lighting Device
MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
Highly Compact, High-Index Dielectric Nanostructures for Deep-Ultraviolet Devices
Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDs
Methods for Fabricating III-Nitride Tunnel Junction Devices
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 Patternning of Photonic Crystals
High Efficiency III-Nitride Devices with Smooth Relaxed InGaN Buffer and Strain Compliant Template
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
Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
GaN-Based Thermoelectric Device for Micro-Power Generation
Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
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

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