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 μm²) 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 μm². 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
▶ 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
▶ Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation
▶ III-Nitride-Based Devices Grown With Relaxed Active Region

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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
- 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 Patterning of Photonic Crystals
- High Efficiency III-Nitride Devices with Smooth Relaxed InGaN Buffer and Strain Compliant Template
- 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 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
- 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 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)
Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD