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 μm^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 μm^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

CONTACT

Pasquale S. Ferrari
ferrari@tia.ucsb.edu
tel: .

INVENTORS

- Chan, Philip
- DenBaars, Steven P.
- Nakamura, Shuji

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

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- 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 Vertical Cavity Surface Emitting Laser (VCSEL) with a Dielectric P-Side Lens
- Aluminum-cladding-free Nonpolar III-Nitride LEDs and LDs
- 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
- Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
- 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
- Method for Enhancing Growth of Semipolar Nitride Devices
- Ultraviolet Laser Diode on Nano-Porous AlGaN template
- Improved Reliability & Enhanced Performance of III-Nitride Tunnel Junction Optoelectronic Devices
- 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
- 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
- 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
- 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
- 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
- Novel Multilayer Structure for High-Efficiency UV and Far-UV Light-Emitting Devices
- III-V Nitride Device Structures on Patterned Substrates
- Method for Increasing GaN Substrate Area in Nitride Devices
- High-Intensity Solid State White Laser Diode
- Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
- 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
- High-Efficiency and High-Power III-Nitride Devices Grown on or Above a Strain Relaxed Template
- 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

University of California, Santa Barbara
Office of Technology & Industry Alliances
342 Lagoon Road, ,Santa Barbara,CA 93106-2055 |
www.tia.ucsb.edu
Tel: 805-893-2073 | Fax: 805.893.5236 | padilla@tia.ucsb.edu