High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
Tech ID: 25552 / UC Case 2007-317-0

BRIEF DESCRIPTION
An (Al, Ga, In)N light emitting device in which high light generation efficiency occurs by fabricating the device using non-polar or semi-polar GaN crystals.

BACKGROUND
The thickness of the quantum well (QW) in conventional GaN-based LEDs and LDs is only around 2-5 nm, due to the c-axis oriented GaN crystals which limit the thickness of the QW that can be achieved without losing efficiency. Conventional LEDs also utilize mirrors to increase the light output power from the front side of the LED. Reflected emissions are partially re-absorbed by the LED, further reducing the output power and efficiency of the LED.

DESCRIPTION
Researchers at UC Santa Barbara have developed an (Al, Ga, In)N light emitting device in which high light generation efficiency occurs by fabricating the device using non-polar or semi-polar GaN crystals. This geometry allows for a QW layer larger than 5 nm with low piezoelectric effects so that higher efficiencies at higher current densities can be achieved. The device also minimizes internal reflections within the LED by eliminating mirrors and/or mirrored surfaces, in order to minimize re-absorption of light by the emitting or active layer of the LED.

ADVANTAGES
▶ More effective generation of polarized light than c-plane devices
▶ Higher efficiency LEDs
▶ Reduced internal reflections within the LED

APPLICATIONS
▶ LEDs and LDs

PATENT STATUS
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<th>Type</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>9,130,119</td>
<td>09/08/2015</td>
<td>2007-317</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Etching Technique for the Fabrication of Thin (Al, In, Ga)N Layers
- 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
- III-Nitride Based Tunnel Junction with P-Type Superlattice
- 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
- Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
- 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
- Increased Light Extraction with Multistep Deposition of ZnO on GaN
- 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
- 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
- III-Nitride-Based Devices Grown On Thin Template On Thermally Decomposed Material
- Growth of Semipolar III-V Nitride Films with Lower Defect Density
- III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- III-Nitride-Based Vertical Cavity Surface Emitting Laser (VCSEL) with an Activated Tunnel Junction
- 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

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

III-Nitride Based-Tunnel Junction with Interlayer

Growth of Planar Semi-Polar Gallium Nitride

High-Efficiency and High-Power III-Nitride Devices Grown on or Above a Strain Relaxed Template

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