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LED Device Structures with Minimized Light Re-Absorption
Tech ID: 22796 / UC Case 2007-670-0

BRIEF DESCRIPTION
A III-nitride light emitting diode (LED), in which light can be extracted from two surfaces of the LED before entering a shaped optical element and subsequently being extracted to air.

BACKGROUND
The LED structure affects how much light is emitted. In order to increase the light output power from the front side of the LED, conventional LEDs are typically equipped with a mirror placed on the backside of the substrate, or a mirror coating on the lead frame. However, this reflected light is re-absorbed by the active region of the LED, because the photon energy of emitted light is almost as same as the band-gap energy of the light emitting materials. Due to this re-absorption of the emitted light by the active region, the net output power or the efficiency of the LED is decreased. Therefore, to achieve highly output power efficiency of the LED, device structures in which re-absorption of the light is minimized are desirable.

DESCRIPTION
Researchers at the University of California, Santa Barbara have developed a III-nitride light emitting diode (LED), in which light can be extracted from two surfaces of the LED before entering a shaped optical element and subsequently being extracted to air. This technology minimizes the light re-absorption at the LED active region by eliminating light reflection at the p-type side surface of the LED chip.

ADVANTAGES
- Reduces light reflections
- Increased light extraction efficiency

APPLICATIONS
- LED manufacturing

This technology is available for licensing.

PATENT STATUS

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<th>Type</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>8,368,109</td>
<td>02/05/2013</td>
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<td>United States Of America</td>
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<td>8,124,991</td>
<td>02/28/2012</td>
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CATEGORIZED AS
- Engineering
- Energy
- Lighting
- Other
- Semiconductors
- Design and Fabrication

RELATED CASES
2007-670-0

RELATED 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

OTHER INFORMATION
KEYWORDS
LED, indssl, indled, cenIEE, indfeat
Flexible Arrays of MicroLEDs using the Photoelectrochemical (PEC) Liftoff Technique

Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation

Gallium-containing MicroLEDs for Displays

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

High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes

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

Near-Infrared, Flip-Chip, TCO-Clad, InGaN Quantum Dot Laser Diode

Incorporating Temperature-Sensitive Layers in III-N Devices

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

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

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/LED Devices on Relaxed Template with Misfit Dislocation at Hetero-interface

Photocatalytic Hydrogen Production via Metal Nanoparticles on III-Nitride Films

Growth of GaN on sapphire using Metal-Organic Vapor Phase Epitaxy

Current Blocking III-Nitride Tunnel Junctions with Doped Host GaN

Improved Light Extraction Efficiency III-Nitride LEDs
- 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
- 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 Nanofeatures
- Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD