Single or Multi-Color High Efficiency LED by Growth Over a Patterned Substrate
Tech ID: 22788 / UC Case 2005-145-0

BRIEF DESCRIPTION

New LED structures that provide increased light extraction efficiency while retaining a planar structure.

BACKGROUND

As semiconductor materials have improved, the efficiency of semiconductor devices has also improved and new wavelength ranges have been used. Gallium nitride (GaN) based light emitters are probably the most promising for a variety of applications. GaN provides efficient illumination in the ultraviolet (UV) to amber spectrum, when alloyed with varying concentrates of indium (In), for example. Unfortunately, most of the light emitted within a semiconductor LED material is lost due to total internal reflection at the semiconductor-air interface. Typical semiconductor materials have a high index of refraction, and thus, according to Snell's law, most of the light will remain trapped in the materials, thereby degrading efficiency. By choosing a suitable geometry for the LED, a higher extraction efficiency can be achieved.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed new LED structures that provide increased light extraction efficiency while retaining a planar structure. The planar structure makes the new LED structures easy to manufacture and at low cost.

ADVANTAGES

▶ Increased light extraction efficiency
▶ Lower manufacturing costs

APPLICATIONS

▶ LED manufacturing

This technology is available for licensing.

PATENT STATUS

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<td>United States Of America</td>
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CATEGORIZED AS

▶ Engineering
▶ Energy
▶ Lighting
▶ Optics and Photonics
▶ All Optics and Photonics
▶ Semiconductors
▶ Design and Fabrication

RELATED CASES

2005-145-0

INVENTORS

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▶ Weisbuch, Claude C.

OTHER INFORMATION

KEYWORDS

LED, photonic crystal, indssl, indled, indphoto, cenIEE, indfeat

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
▶ Etching Technique for the Fabrication of Thin (Al, In, Ga)N Layers
▶ Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
▶ Flexible Arrays of MicroLEDs using the Photoelectrochemical (PEC) Liftoff Technique
Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation

Gallium-containing MicroLEDs for Displays

High Speed Indium Gallium Nitride Multi-Quantum Well (InGaN MQW) Photodetector

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

Photonic Structures for Efficient Light Extraction and Conversion in Multi-Color LEDs

Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes

Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices

Volumetric Hole Injection with Intentional V-Defects

Low Temperature Deposition of Magnesium Doped Nitride Films

Transparent Mirrorless (TML) LEDs

Laser Diode With Tunnel Junction Contact Surface Grating

Optimization of Laser Bar Orientation for Nonpolar Laser Diodes

Wavelength-Selective Phosphor Coating for Laser Lighting Devices

High Efficiency Semipolar AIGaN-Cladding-Free Laser Diodes

Method for Growing Self-Assembled Quantum Dot Lattices

Method for Enhancing Growth of Semipolar Nitride Devices

III-Nitride Tunnel Junction with Modified Interface

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

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,Aj)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 MicrLEDs

Methods for Fabricating III-Nitride Tunnel Junction Devices

3D Hole Injectors for InAlGaN Light-Emitting Diodes

Formation of Transparent Integrated MicroLED Displays

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

In-Situ Methods Of Preventing Interfacial Impurities And Dry Etch-Induced Damage In Regrown III-Nitride Structures

Enhanced Hole Injection by P-Type Active Region and Lateral Injection in InAlGaN LEDs

Improved Manufacturing of Solid State Lasers via Patterned of Photonic Crystals

Solid Solution Phosphors for Use in Solid State White Lighting Applications

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
Photoelectrochemical Etching for Chip Shaping Of 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
Burying Impurities And Defects In Regrown III-Nitride Structures
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
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
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