Tunable White Light Based on Polarization-Sensitive LEDs
Tech ID: 25554 / UC Case 2008-653-0

BRIEF DESCRIPTION
Polarized white LEDs that can improve system efficiency by removing the need for an external polarizer.

BACKGROUND
Commercially available white light-emitting diodes (LEDs) emit unpolarized light and have a fixed color after they are fabricated. Options for polarizing the emission involve costly polarization plates. Tuning the white light involves using a number of different-colored LEDs and changing their intensity individually, or introducing different-colored, fluorescent organic dyes as quantum-well light emitting layers or conjugated hybrid polymers. These methods have manufacturing hurdles and low efficiency.

DESCRIPTION
UC Santa Barbara researchers have created polarized white LEDs that can improve system efficiency by removing the need for an external polarizer. Alternatively, the color-rendering properties of these LEDs can be manipulated through use of a polarizing element. The color of the LED can be easily changed after it is produced by simply rotating the polarizing element. This allows an end user to adjust the LED to their preference for white light.

ADVANTAGES
▶ Polarized white emission can reduce system complexity and cost
▶ Hue of white light is tunable by end user after fabrication
▶ Less costly and simpler than other white light LED manufacturing methods

APPLICATIONS
▶ LEDs
▶ Applications that require uniform color illumination such as display backlighting, two- and three-dimensional image projectors, and architectural lighting

PATENT STATUS

<table>
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<th>Country</th>
<th>Type</th>
<th>Number</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>9,951,912</td>
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CATEGORIZED AS
▶ Engineering
▶ Energy
▶ Lighting
▶ Other
▶ Semiconductors
▶ Design and Fabrication

RELATED CASES
2008-653-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
▶ Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Subtrates
▶ 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
▶ 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
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
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
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
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
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
GaN Interlayer Design to Fully Eliminate V-Pits from InGaN Pseudo-Substrates
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 Pattern of Photonic Crystals
Solid Solution Phosphors for Use in Solid State White Lighting Applications
Multifaceted III-Nitride Surface-Emitting Laser
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
Hexagonal Wurtzite Type Epitaxial Layer with a Low Alkali-Metal Concentration
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
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
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)
Suppression of Defect Formation and Increase in Critical Thickness by Silicon Doping
Wafer Bonding for Embedding Active Regions with Relaxed Nanostructures
Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD