**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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<tr>
<th>Country</th>
<th>Type</th>
<th>Number</th>
<th>Dated</th>
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<tr>
<td>United States Of America</td>
<td>Issued Patent</td>
<td>9,951,912</td>
<td>04/24/2018</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**
- 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
- III-Nitride-Based Devices Grown With Relaxed Active Region
- 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
- Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
- 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
- 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
- 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
- Highly Compact, High-Index Dielectric Nanostructures for Deep-Ultraviolet Devices
- 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
- 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
- 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
- Improved Manufacturing of Solid State Lasers via Patterned of Photonic Crystals
- High Efficiency III-Nitride Devices with Smooth Relaxed InGaN Buffer and Strain Compliant Template
- 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
- 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
- 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
- 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