



Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)

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BRIEF DESCRIPTION

UC Santa Barbara researchers have improved the performance of GaN LEDs through the addition of ZnO layers to the LED’s surfaces.

BACKGROUND

To improve the light extraction efficiency of LEDs, transparent conductive oxides (TCOs) with high refractive indices — such as indium-tin-oxide (ITO), zinc oxide (ZnO), aluminum-doped-zinc-oxide (AZO) — are widely used. Films of these materials increase the probability of light escaping the LED through the TCO, thus increasing overall light output. ITO, however, is cost prohibitive, making zinc oxide films a better choice for commercial scalability.

DESCRIPTION

UC Santa Barbara researchers have improved the performance of GaN LEDs through the addition of ZnO layers to the LED’s surfaces. These layers can improve the light extraction, heat dissipation, and current distribution of the device. The method of depositing ZnO by a low-temperature, aqueous route is low-cost and flexible, and can be used before or after the LED fabrication processing, resulting in low-cost, high-light-output GaN LED devices.

ADVANTAGES

- ▶ Increased light output
- ▶ Low-cost fabrication

APPLICATIONS

- ▶ LEDs
- ▶ Solar cells
- ▶ GaN-based devices

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,637,334	01/28/2014	2010-183

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OTHER INFORMATION

KEYWORDS

indLED, LED, cenIEE, ZnO,  
  
zinc oxide, transparent  
  
conductive oxide, TCO, indssl

CATEGORIZED AS

- ▶ [Energy](#)
  - ▶ Lighting
- ▶ [Materials & Chemicals](#)
  - ▶ Other
- ▶ [Semiconductors](#)
  - ▶ Design and Fabrication

RELATED CASES

2010-183-0

## ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ 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
- ▶ Aluminum-cladding-free Nonpolar III-Nitride LEDs and LDs
- ▶ 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
- ▶ Implantable Light Irradiation Device For Photodynamic Therapy
- ▶ 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 AlGaIn 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 InGaIn Thin Films, Heterostructures, and Devices
- ▶ Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
- ▶ 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
- ▶ 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
- ▶ 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

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

