Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-150)

Tech ID: 24435 / UC Case 2010-150-0

BRIEF DESCRIPTION
This method produces an LED structure using ZnO nanorod arrays on surfaces other than the (0001) p-GaN surface and also on multiple surfaces of the LED.

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
This method produces an LED structure using ZnO nanorod arrays on surfaces other than the (0001) p-GaN surface and also on multiple surfaces of the LED. The ZnO nanorod arrays can be synthesized using low-cost solution processing methods and produced on various LED surfaces such as GaN-faced C-plane surfaces, non-polar and semi-polar surfaces, and also non-GaN surfaces such as substrates and transparent current-spreading layers. It enhances light output from both lateral and vertical-type LEDs.

ADVANTAGES
▶ Increased light output
▶ Low-cost fabrication

APPLICATIONS
▶ LEDs
▶ Solar cells
▶ GaN-based devices

PATENT STATUS
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>8,841,691</td>
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CATEGORIZED AS
▶ Energy
▶ Lighting
▶ Materials & Chemicals
▶ Other
▶ Semiconductors
▶ Design and Fabrication

RELATED CASES
2010-150-0

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
▶ 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
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

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