Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
Tech ID: 25741 / UC Case 2016-324-0

BACKGROUND
The development of light emitting devices (LEDs) with optimized materials is essential to increase the overall efficiency of the myriad commercial applications of the LED. Wafer bonding permits extension of the design parameters of these devices by allowing the formation of heterojunctions that are not possible through conventional deposition schemes. Bonding to transparent conductive materials leads to higher efficiency due to enhanced light extraction.

DESCRIPTION
Researchers at the University of California, Santa Barbara have developed a method for bonding transparent conductive oxides on III-nitride materials using wafer bonding techniques. Light emitting devices (LEDs) can be processed using this technique which yields higher efficiency devices than traditional methods and allows for greater design options for fabricating devices such as fully transparent tunnel junction-based III-nitride-based LEDs.

ADVANTAGES
▶ Increased light extraction efficiency
▶ Greater design options for fabricating devices

APPLICATIONS
▶ Fully transparent tunnel junction-based LEDs
▶ LEDs

PATENT STATUS

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<td>United States Of America</td>
<td>Published Application</td>
<td>20200335663</td>
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RELATED TECHNOLOGIES
▶ Contact Architectures for Tunnel Junction Devices
▶ III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
▶ Methods for Fabricating III-Nitride Tunnel Junction Devices
▶ III-Nitride Tunnel Junction with Modified Interface
▶ Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
▶ 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
▶ 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
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

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

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

Selective-Area Mesoporous Semiconductors And Devices For Optoelectronic And Photonic Applications

High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices

Oxyfluoride Phosphors for Use in White Light LEDs

Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices

(In,Ga,AI)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

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

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 (A, 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

Enhancing Growth of Semipolar (A,In,Ga,B)N Films via MOCVD

Thermally Stable, Laser-Driven White Lighting Device

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