Contact Architectures for Tunnel Junction Devices

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BACKGROUND

A commonly explored limitation of p-GaN is that it is a poor current spreading layer and that traditional p-contacts will increase operating voltages in III-nitride devices. The introduction of tunnel junctions solves these issues and expands the opportunities for new device designs. This technology seizes the opportunity to improve the light extraction of flip chip LEDs.

DESCRIPTION

Researchers at the University of California, Santa Barbara have optimized light extraction of tunnel junction devices by increasing the reflectivity of the device's mirror. The high reflectivity of silver has made it the first choice for previous mirror iterations, but its poor conductivity at the requisite thinness requires adjustments which then erode the benefits of its high reflectivity. This technology reconstructs the mirror, replacing silver with aluminum and coating the reflector with a dielectric high-reflection coating. This novel mirror architecture demonstrates a higher reflectivity than pure silver which leads to improved light extraction.

ADVANTAGES

- Improved light extraction
- Increased Chip power
- Current spreading with GaN
- No requirement for a TCO or silver mirrors
- Low contact resistivity & high reflectivity

APPLICATIONS

- LEDs
- III-Nitride devices
- Tunnel junctions

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,348,908	05/31/2022	2017-132

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OTHER INFORMATION

KEYWORDS

LED, indled, indfeat, Flip chip, tunnel junction, III-nitride devices, surface emitting lasers

CATEGORIZED AS

- **Energy**
  - Lighting
- **Engineering**
  - Other

RELATED CASES

2017-132-0

RELATED TECHNOLOGIES

- III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- Methods for Fabricating III-Nitride Tunnel Junction Devices
- Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- 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
- Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
- Ultraviolet Laser Diode on Nano-Porous AlGaN template
- Improved Reliability & Enhanced Performance of III-Nitride Tunnel Junction Optoelectronic Devices
- (In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
- Thermally Stable, Laser-Driven White Lighting Device
- Methods for Fabricating III-Nitride Tunnel Junction Devices
- III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- Novel Multilayer Structure for High-Efficiency UV and Far-UV Light-Emitting Devices
- A Method To Lift-Off Nitride Materials With Electrochemical Etch
- High-Intensity Solid State White Laser Diode
- Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
- High-Efficiency and High-Power III-Nitride Devices Grown on or Above a Strain Relaxed Template
- III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture

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