III-Nitride Tunnel Junction with Modified Interface

Tech ID: 25740 / UC Case 2016-245-0

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 for higher tunneling currents.

DESCRIPTION

Researchers at UC Santa Barbara have developed a method for improving the tunneling currents of semipolar III-nitride devices by modifying the very highly doped (n+/p+) interface to reduce the energy barrier associated with tunneling. The modification involves introducing extra charge carriers, such as dopant atoms, or impurities that results in electronic trap states which enhance tunneling.

ADVANTAGES

- Reduced operating voltage
- Current spreading with GaN
- No requirement for a TCO or silver mirrors
- Simple fabrication
- Ability to incorporate multiple active regions into a single device

APPLICATIONS

- LEDs
- Edge emitting laser diodes
- Vertical cavity surface emitting lasers (VCSELs)
- Solar cells

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,685,835	06/16/2020	2016-245

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OTHER INFORMATION

KEYWORDS

indled, indssl, LED, solar cells, edge emitting laser diodes, III-nitride, p-GaN, indfeat, indmicroelec

CATEGORIZED AS

- **Energy**
  - Lighting
  - Other
- **Engineering**
  - Engineering
- **Semiconductors**
  - Design and Fabrication

RELATED CASES

2016-245-0

RELATED TECHNOLOGIES

- III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- 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
- Methods to Produce and Recycle Substates for III-Nitride Materials with Electrochemical Etching
- 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
- 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
- Activation of P-Type Layers of Tunnel Junctions in Micro-LEDs
- High-Intensity Solid State White Laser Diode
- Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
- Epitaxial Light Control Features in Light Emitting Diodes
- High-Efficiency Vertical Cavity Surface Emitting Laser Fabrication
- A Wafer-Scale, Low Defect Density Strain Relaxed Template for III-Nitride-Based High Efficiency and High-Power Devices
- 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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