Size-Independent Forward Voltage Micro-LED with an Epitaxial Junction
Tech ID: 32268 / UC Case 2020-714-0

BACKGROUND
Conventional tunnel junction micro-LEDs currently face challenges of higher voltage penalties and varied voltage with different device sizes. Unfortunately, size-dependent voltage characteristics limit the applications of micro-LEDs and result in a lack of device reliability. Thus, overcoming the size dependence of the forward voltage in tunnel junction micro-LEDs would increase their potential to meet the demands of next-generation display applications.

DESCRIPTION
Researchers at the University of California, Santa Barbara have fabricated size-independent forward voltage micro-LEDs with an epitaxial tunnel junction comprised of p+GaN and n+GaN layers. This technology employs n+GaN layers with patterns of holes or vias to provide activation of the p+GaN type layer. The micro-LEDs produced using this approach with a Si doping concentration in the n+GaN layers higher than $1.7 \times 10^{20} \text{ cm}^{-3}$ demonstrated a forward voltage at 20A cm$^{-2}$ that was stable and uniform around 3.4V. Therefore, this technique solves the issue of forward voltage variation in different size tunnel junction micro-LEDs by realizing a size-independent low forward voltage.

ADVANTAGES
- Size-independent forward voltage
- Increases reliability of micro-LEDs in expanded applications

APPLICATIONS
- Micro-LEDs

PATENT STATUS
Patent Pending

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OTHER INFORMATION
KEYWORDS
micro-LED, epitaxial tunnel junction, n+GaN, p+GaN, forward voltage

CATEGORIZED AS
- Energy
- Lighting
- Semiconductors
- Design and Fabrication

RELATED CASES
2020-714-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
- Method for Improved Surface of (Ga,Al,in,B)N Films on Nonpolar or Semipolar Subtrates
- 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
- Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
- Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
- Phosphor-Free White Light Source
- Low Temperature Deposition of Magnesium Doped Nitride Films
- Transparent Mirrorless (TML) LEDs
- Improved GaN Substrates Prepared with Ammonothermal Growth
- Laser Diode With Tunnel Junction Contact Surface Grating
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

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