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# (In,Ga,AI)N Optoelectronic Devices with Thicker Active Layers for Improved Performance

Tech ID: 23146 / UC Case 2013-329-0

#### CONTACT

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#### **BRIEF DESCRIPTION**

A novel invention to enable the fabrication of (In,Ga,Al)N optoelectronic devices with thick active layers containing a high concentration of indium (In).

#### **INVENTORS**

- ▶ DenBaars, Steven P.
- ► Keller, Stacia
- ► Mishra, Umesh K.
- Neufeld, Carl J.

#### **BACKGROUND**

Currently, the fabrication of heterojunctions for optoelectronic devices is limited to the combination of layers with either the same lattice constants or layers where the thickness of the lattice mismatched layers did not exceed its critical thickness. However, thick active regions are attractive for light emitting diodes (LEDs) with significantly reduced droop and solar cells requiring thick active regions for efficient absorption. Moreover, LED development is restricted by the green gap due to deep green LED sources being difficult to produce.

# OTHER INFORMATION

## **KEYWORDS**

TIAlighting, lattice mismatch, heterojunctions, LED, solar, indssl, indled, cenIEE, indfeat

## **DESCRIPTION**

Researchers at the University of California, Santa Barbara have developed a novel invention to enable the fabrication of (In,Ga,AI)N optoelectronic devices with thick active layers containing a high concentration of indium (In). The In content of the active region can be increased while maintaining a low lattice mismatch between the active region and the current carrying layers, mitigating deterioration of device performance in the green gap. Consequently, relaxed (In,Ga,AI)N films with a lattice constant between GaN and InN can be fabricated on GaN layers of all orientations, including (0001) c-plane GaN.

## **CATEGORIZED AS**

- **►** Energy
  - Lighting
  - Solar
- Semiconductors
  - Design and

Fabrication

# **RELATED CASES**

2013-329-0

# **ADVANTAGES**

- Improved performance of existing devices which require a combination of layers with large lattice mismatch
- Mitigation of defect formation in active layers
- Increase the thickness of the active layers

### **APPLICATIONS**

- LEDs
- Solar Cells

This technology is available for licensing.

# **PATENT STATUS**

Country	Туре	Number	Dated	Case
United States Of America	Issued Patent	9,076,927	07/07/2015	2013-329

#### ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- ▶ Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation
- ▶ Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
- ▶ A Structure For Increasing Mobility In A High-Electron-Mobility Transistor
- ▶ Improved Reliability & Enhanced Performance of III-Nitride Tunnel Junction Optoelectronic Devices
- ► Thermally Stable, Laser-Driven White Lighting Device
- ► GaN-based Vertical Metal Oxide Semiconductor and Junction Field Effect Transistors
- ► III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- ► Iii-N Transistor With Stepped Cap Layers
- ▶ 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
- ▶ III-N Based Material Structures and Circuit Modules Based on Strain Management



in