Nonpolar III-Nitride LEDs With Long Wavelength Emission
Tech ID: 24536 / UC Case 2008-063-0

BRIEF DESCRIPTION
A method of growing III-nitride films on nonpolar planes where the MQW barrier thickness can be manipulated.

BACKGROUND
Current nitride-based electronic and optoelectronic devices, including light-emitting diodes (LEDs), use nitride films that are grown on polar surfaces. These surfaces cause polarization, which in turn separates electrons from holes. This separation limits carrier recombination efficiency, and causes the devices to emit mostly in the red region of the spectrum. This polarization severely limits the flexibility of emission wavelength, and thus the colors, that devices can exhibit.

However, polarization can be limited by growing devices on nonpolar planes. By using nonpolar planes, total polarization can be greatly reduced, possibly to zero for certain combinations of alloys on specific planes. There have been successful optoelectronic devices grown on nonpolar planes, but they have had trouble producing longer wavelength emission. The limitation has been due to the barrier thickness of MQWs (multiple quantum wells), which has only allowed for light emission in the violet region of the spectrum.

DESCRIPTION
UC Santa Barbara researchers have developed a method of growing III-nitride films on nonpolar planes where the MQW barrier thickness can be manipulated. This results in the ability to vary the wavelength (color) of light emitted by the devices. Small barrier thickness results in short wavelength visible light, while increasing the barrier thickness results in subsequently longer wavelength emission. The reduced polarization in these devices, coupled with the ability to change the wavelength of emission, would improve the overall performance of optoelectronic devices.

CONTACT
University of California, Santa Barbara Office of Technology & Industry Alliances
padilla@tia.ucsb.edu
tel: 805-893-2073.

INVENTORS
▶ Iso, Kenji
▶ Nakamura, Shuji
▶ Yamada, Hisashi

OTHER INFORMATION
KEYWORDS
indssl, indled, LED, cenIEE, III-nitride, wavelength

CATEGORIZED AS
▶ Engineering
▶ Energy
▶ Lighting
▶ Other
▶ Materials & Chemicals
▶ Other
▶ Semiconductors
▶ Design and Fabrication

RELATED CASES
2008-063-0
ADVANTAGES

- Ability to control wavelength/color of light emitted
- Total polarization is reduced
- Increased overall performance

APPLICATIONS

- LEDs
- Other optoelectronic devices

PATENT STATUS

<table>
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<tr>
<th>Country</th>
<th>Type</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>8,642,993</td>
<td>02/04/2014</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
- 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
- Aluminum-cladding-free Nonpolar III-Nitride LEDs and LDs
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
- Low Temperature Deposition of Magnesium Doped Nitride Films
- Transparent Mirrorless (TML) LEDs
- Improved GaN Substrates Prepared with Ammonothermal Growth
- Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
- Method for Enhancing Growth of Semipolar Nitride Devices
- Ultraviolet Laser Diode on Nano-Porous AlGaN template
- Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals
- Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices
- Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films