High-Efficiency Vertical Cavity Surface Emitting Laser Fabrication

Tech ID: 34601 / UC Case 2022-768-0

BACKGROUND

Vertical cavity surface emitting lasers (VCSELs) are a promising technology for applications in virtual and augmented reality (VR/AR) hardware. However, the tensile strain between the AlN and GaN layers of these devices prevents intuitive fabrication of distributed Bragg's reflectors (DBR) for a resonant cavity. This obstacle results in reduced device efficiency and hinders the mass manufacture of VCSELs. Lattice-matched AlInN/GaN DBRs, nano-porous DBRs, and double dielectric DBRs via various overgrowth or film transfer strategies are all solutions to this obstacle, though each carry their own disadvantages.

DESCRIPTION

Researchers at the University of California, Santa Barbara have addressed the efficiency barrier in VCSELs by leveraging epitaxial lateral overgrowth (ELO) and a novel approach to foreign substrate removal. This technology produces crack-free, long lifetime devices with high crystal quality and significantly reduced defect densities and stacking faults compared to devices made directly on a native substrate. This approach is applicable to devices on Si, SiC, and sapphire substrates, regardless of their crystal orientation, and uses liftoff methods that do not damage the device. If a long resonant cavity is desired, this invention can also be applied to devices with curved mirrors.

ADVANTAGES

- Produces highly efficient, crack free, long lifetime VCSELs
- Simplifies fabrication process with flexible substrate requirements and damage free liftoff techniques
- Improves crystalline quality with reduced stacking faults and dislocation density

APPLICATIONS

- VSCELs
- AR/VR

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	20240413610	12/12/2024	2022-768

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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OTHER INFORMATION

KEYWORDS

Laser, Laser fabrication, VCSEL, Vertical cavity surface emitting lasers, AR, VR, ELO

CATEGORIZED AS

- **Semiconductors**
  - Other

RELATED CASES

2022-768-0

- 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
- Method For The Removal Of Devices Using The Trench
- 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
- High-Intensity Solid State White Laser Diode
- Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
- 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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