



High Efficiency Intersubband Semiconductor Laser

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WARF: P05375US

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a highly efficient, quantum-cascade, intersubband semiconductor laser.

Overview

Intersubband semiconductor lasers represent a new type of laser that emits photons when electrons within a quantum-well structure release their energy during transit from high- to low-energy states. Achieving room-temperature, continuous-wave operation of these lasers at mid- to far-infrared wavelengths (3-12 microns) requires the use of multiple-stage devices called quantum-cascade lasers (QCLs). However, conventional QCLs emitting in the mid-infrared leak carriers from the upper energy level of the active quantum wells and are subject to carrier backfilling, where electrons fill the ground energy level of the active quantum wells. This leads to thermal runaway and rapid device degradation at room temperature.

The Invention

UW-Madison researchers have developed a highly efficient, quantum-cascade, intersubband semiconductor laser. This device is based on the successful deep quantum well active region structures previously described by the researchers (see WARF reference number P04199US). It uses strain-compensated GaAs-based stages, Bragg-type electron mirror regions and AlGaAs-based buried heterostructures to provide lateral heat removal. Unlike conventional QCL devices, the electron injector in this QCL is separated from the electron reflector, which significantly decreases electron backfilling and improves power-conversion efficiency.

Applications

- Provides compact, efficient infrared sources for a variety of applications, including remote sensing of chemical agents and explosives, infrared countermeasures, breath and bodily fluid analysis for medical diagnostics and environmental monitoring

Key Benefits

- Highly efficient emission at mid- to far-infrared wavelengths
- May be formed on substrates, such as GaAs, that are compatible with further semiconductor processing
- Other material systems, such as InP, may also be used
- May be produced using high throughput crystal growth techniques, such as metal-organic chemical vapor deposition (MOCVD)

Additional Information

For More Information About the Inventors

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Related Technologies

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- [See WARF reference number P04199US for the inventors' previous intersubband laser with very deep InGaAs quantum wells sandwiched between very high AlGaAs barrier layers.](#)

Related Intellectual Property

- [View Continuation Patent in PDF format.](#)

Tech Fields

- [Analytical Instrumentation, Methods & Materials : Lasers](#)

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867

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