Analytical Instrumentation, Methods & Materials

High-Power Quantam-Cascade Lasers with Active Photonic Crystal Structure

View U.S. Patent No. 8,259,767 in PDF format.

WARF: P09338US01

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a compact laser array device capable of emitting mid- to long-wavelength infrared radiation with coherent power.

Overview

Compact laser sources emitting in the mid- to long-wavelength infrared range (4 to 12 microns) currently are of great interest for spectroscopic applications in homeland security, laser photo-acoustic spectroscopy, missile-avoidance systems, medical diagnostics and free-space communications. However, lack of sufficiently powerful, compact sources has drastically limited development in these fields.

Currently, multiple single index beams have been combined in an attempt to generate high-power laser light sources, but these techniques cannot provide the increased beam quality over large distances required by many applications. A method to create a high-power, narrow-beam laser source in the mid- to long-wavelength range is needed.

The Invention

UW–Madison researchers have developed a compact laser array device capable of generating high-power, coherent laser light at mid-infrared wavelengths by scaling the power of quantum-cascade (QC) lasers whereby an active photonic crystal (APC) structure is fabricated in the QC material. The combined APC-QC structure allows the laser device to emit diffraction-limited, stable beams from large apertures.

The compact quantum-cascade laser structure consists of one or more active cores, an optical confinement structure, a cladding structure and laterally-spaced trench regions extending through the structures. The structure has index steps an order of magnitude higher than in conventional structures. Quasi-continuous wave or continuous wave laser operations are desirable in many applications, but often are vulnerable to thermally induced variations in the dielectric constant. The APC-QC structure allows a device to operate as a quasi-continuous wave or continuous wave laser without thermally induced variations. Furthermore, the heat generated in the low-index regions can be effectively laterally removed by materials in the high-index regions.

Applications

- Remote sensing of gases and substances such as explosives or natural gas from a safe distance
- Illuminating targets for range finding in military defense applications
- Communicating directly using Free Space Optics
- Laser marking of products such as food packaging

Key Benefits

- Provides high-power, narrow-beam laser light within the 4 to12 micron wavelength infrared range

- Improves heat transfer by removing the heat generated in low-index regions laterally through structures of high-index steps
- Allows a device to operate as a quasi-continuous wave or continuous wave laser without thermally induced variations

Additional Information

For More Information About the Inventors

- Dan Botez
- Luke Mawst

Related Technologies

- For more information about high-power, high-efficiency lasers emitting in the mid- to long-wavelength infrared range, see WARF reference number P06395US.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Lasers

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