**McCormick News Article**

# Researchers Demonstrate 100-Watt-Level Mid-infrared Lasers

*December 1, 2009*

Northwestern University researchers have achieved a breakthrough in quantum cascade laser output power, delivering 120 watts from a single device at room temperature.

The results are particularly attractive for infrared countermeasure, a way of misguiding incoming missiles to protect commercial and military aircrafts.

The research, led by Manijeh Razeghi, Walter P. Murphy Professor of Electrical Engineering and Computer Science at the McCormick School of Engineering and Applied Science, was published in the journal Applied Physics Letters on Dec. 1.

Unlike conventional interband semiconductor lasers, such as those used in DVD players, the quantum cascade laser (QCL) is an intersubband device that requires only electrons to operate. Because of this fundamental difference, a QCL shows unique properties that a conventional laser lacks. One of these properties is that the linewidth enhancement factor of a QCL is close to zero, compared to two to five for a conventional laser. This difference has serious implications in terms of power scaling with broad-area devices.

Researchers at the Center for Quantum Devices at Northwestern, led by Razeghi, found that the QCL is exceptionally resistant to filiamentation, a phenomenon that limits the ridge width of conventional broad-area semiconductor lasers. In this work, Razeghi's team demonstrated that the ridge width of a broad-area QCL can be increased up to 400 microns, without suffering from filiamentation. As a result, room temperature peak output power as high as 120 watts was obtained from a single device, which is up from 34 watts only a year ago.

This work is partially supported by the Defense Advanced Research Projects Agency's Efficient Mid-Infrared Laser (EMIL) program. Additional funding is provided by the Office of Naval Research.

You can read the paper here.

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# Mid-infrared 100-watt-level laser created

Published: Dec. 2, 2009 at 10:28 AM

EVANSTON, Ill., Dec. 2 (UPI) -- U.S. scientists say they have achieved a breakthrough in quantum cascade laser output power, delivering 120 watts from a single device at room temperature.

The Northwestern University researchers, led by Professor Manijeh Razeghi, said their accomplishment is particularly attractive for infrared countermeasures -- a way of misguiding incoming missiles to protect commercial and military aircraft.

Unlike conventional interband semiconductor lasers, the scientists said their quantum cascade laser is an intersubband device requiring only electrons to operate.

Razeghi's team demonstrated the ridge width of a broad-area quantum cascade laser can be increased up to 400 microns, without suffering from filiamentation -- a phenomenon that limits the ridge width of conventional broad-area semiconductor lasers. As a result, the scientists said room temperature peak output power as high as 120 watts was obtained from a single device, which is up from 34 watts only a year ago.

The complex research appears in the journal Applied Physics Letters.

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# Northwestern researchers demonstrate 100-W-level mid-IR QC lasers

**December 2, 2009**--Researchers at Northwestern University (Evanston, IL) have achieved a breakthrough in pulsed quantum cascade laser (QCL) peak output power, delivering 120 W from a single device at room temperature. The figure is a peak-power value for a QCL emitting 200 ns pulses at a 0.2% duty cycle.[1] The device emits at a 4.45 micron wavelength from a 400-micron-wide aperture.

The results are attractive for IR countermeasures (a technique to disorient incoming IR-guided missiles to protect commercial and military aircraft).

Unlike conventional interband semiconductor lasers (diode lasers), the QCL is an intersubband device. Because of this fundamental difference, a QCL shows unique properties that a conventional laser lacks. One of these properties is that the linewidth enhancement factor of a QCL is close to zero, compared to two to five for a conventional laser. This difference has serious implications in terms of power scaling with broad-area devices.

**Resistant to filamentation**

Led by Manijeh Razeghi, the Northwestern researchers found that the QCL is exceptionally resistant to filamentation, a phenomenon that limits the ridge width of conventional broad-area semiconductor lasers. In this work, Razeghi's team demonstrated that the ridge width of a broad-area QCL can be increased up to 400 microns without suffering from filamentation. The room-temperature peak output power of as high as 120 W is up from 34 W only a year ago.

The mode number of the output is proportional to the laser's ridge width; the farfield output has two lobes at +/-38 degrees.

This work is partially supported by the Defense Advanced Research Projects Agency's Efficient Mid-Infrared Laser (EMIL) program. Additional funding is provided by the Office of Naval Research.

REFERENCE

1. Y. Bai *et al*., *Applied Physics Letters* 95, 221104 (2009).

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