Laterally Coupled Quantum-Dot Distributed-Feedback Lasers

These lasers show promise for single-frequency, single-spatial mode operation.

InAs quantum-dot lasers that feature distributed feedback and lateral evanescent-wave coupling have been demonstrated in operation at a wavelength of 1.3 μm. These lasers are prototypes of optical communication oscillators that are required to be capable of stable single-frequency, single-spatial-mode operation.

A laser of this type (see figure) includes an active layer that comprises multiple stacks of InAs quantum dots embedded within InGaAs quantum wells. Distributed feedback is provided by gratings formed on both sides of a ridge by electron lithography and reactive-ion etching on the surfaces of an AlGaAs/GaAs waveguide. The lateral evanescent-wave coupling between the gratings and the wave propagating in the waveguide is strong enough to ensure operation at a single frequency, and the waveguide is thick enough to sustain a stable single spatial mode.

In tests, the lasers were found to emit continuous-wave radiation at temperatures up to about 90 °C. Side modes were found to be suppressed by more than 30 dB.

This work was done by Yueming Qui, Pawan Gogna, Richard Muller, Paul Maker, and Daniel Wilson of Caltech and Andreas Stintz and Luke Lester of the University of New Mexico for NASA’s Jet Propulsion Laboratory. For further information, contact the Technical Support Package (TSP) free on-line at www.nasatech.com.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to its Intellectual Assets Office JPL Mail Stop 202-233 4800 Oak Grove Drive Pasadena, CA 91109 (818) 354-2240 E-mail: ipgroup@jpl.nasa.gov

Refer to NPO-30503, volume and number of this NASA Tech Briefs issue, and the page number.

Bit-Serial Adder Based on Quantum Dots

Adders like this could be used to develop advanced, compact computers.

A proposed integrated circuit based on quantum-dot cellular automata (QCA) would function as a bit-serial adder. This circuit would serve as a prototype building block for demonstrating the feasibility of quantum-dots computing and for the further development of increasingly complex and increasingly capable quantum-dots computing circuits. QCA-based bit-serial adders would be especially useful in that they could enable the development of highly parallel and systolic processors for implementing fast Fourier, cosine, Hartley, and wavelet transforms.

The proposed circuit would complement the QCA-based circuits described in “Implementing Permutation Matrices by Use of Quantum Dots” (NPO-20801), NASA Tech Briefs, Vol. 25, No. 10 (October 2001), page 42 and “Compact Interconnection Networks Based on Quantum Dots” (NPO-20855), which appears elsewhere in this issue. Those