Volume 44 Issue 6
June, 2008

Newsbreaks

Closely spaced diode lasers can be addressed independently

Arrays of closely spaced diode lasers that are independently addressable would be useful in such applications as laser printers, optical-disk scanners, and optical interconnects. To make such devices practical, crosstalk between laser stripes must be minimized. Researchers at Xerox Palo Alto Research Center (Palo Alto, CA) have designed a four-element, independently addressable, 785-nm laser array that uses a native-oxide confined-ridge waveguide to achieve spacing of 7 µm. The threshold currents of the lasers are less than 8 mA, with differential quantum efficiencies of more than 35% per facet per channel and crosstalk between two lasers of less than 5%. For two laser stripes not next to each other, there is even less crosstalk. With 14 µm between the second and fourth stripe, for instance, there is less than 2% crosstalk. The researchers said it was much easier to build their device than to build a conventional dielectric-layer confined-ridge waveguide laser because the native oxide forms only around the ridge sidewalls, so no opening for electrical contact needs to be made. *Contact Decai Sun at sun@parc.xerox.com.*

Micromirror device yields fault-tolerant fiberoptic attenuator

Researchers at the School of Optics/Center for Research and Education in Optics and Lasers (CREOL) and start-up company Light Bytes Inc. (both Orlando, FL) have used a two-dimensional digital micromirror device (DMD) to create a fault-tolerant, digitally controlled, multiwavelength variable fiberoptic attenuator for use in wavelength-division-multiplexing networks. The Texas Instruments (Dallas, TX) visible-band, two-dimensional DMD contained an array of 16 x 16-µm aluminum-coated torsion-beam micromirrors with a 17-µm pixel distance. Each micromirror could be set to a tilt of either +10° or -10° with respect to the pixel surface within a 15-µs switching time. To control the path of incident light beams, the researchers developed a "macropixel" approach via optical microelectromechanical systems in which several micromirrors were used to control each beam. The macropixel approach also yielded a higher level of fault tolerance to device failures and misalignments than previous micromirror devices in which beam control is based on single-mirror operation, according to team leader Nabeel Riza. The concept was tested in a four-wavelength, proof-of-concept attenuator (at 1546.92, 1548.52, 1550.12, and 1551.72 nm) and achieved a 26-dB dynamic range with 11-bit resolution.

Riza presented the results last month at the National Fiber Optic Engineers Conference (Chicago, IL) simultaneously with an Optical Society of America (OSA)/New Focus (Santa Clara, CA) Student Award Finalist presentation by Sarun Sumriddetchkajorn at the OSA Annual Meeting (Santa Clara, CA). The concept has also been implemented in a multiwavelength, three-dimensional 2 x 2 fiberoptic switch structure. *Contact Nabeel Riza at riza@creol.ucf.edu.*

Stacked monolayers on fiber generate second-harmonic light

By depositing 184 molecular monolayers of an organic substance on a side-polished single-mode optical fiber and filling the fiber's core with 1064-nm light, researchers at Cranfield University (Cranfield, England) have generated second-harmonic light in the form of Cerenkov radiation. The organic material, a quinolinium dye, was deposited using the Langmuir-Blodgett technique, in which a film is constructed by transferring precisely oriented consecutive monolayers floating on a water surface to a solid substrate. The fiber's cladding was removed to within 2 µm of its 6.4-µm core.

A Q-switched Nd:YAG laser producing 2-ns pulses supplied the 1064-nm light. The center wavelength of the fundamental light could be temperature-tuned, with a rate of change of -0.6 nm/°C. When properly tuned, the transmission of the fundamental light through the fiber dropped by 13 dB, showing its evanescently coupled absorption in the doubling material. The second-harmonic intensity increased as the square of the fundamental intensity and was directed into the fiber's cladding. The conversion efficiency will be optimized by proper orientation of the dye's molecules, say the researchers. *Contact Ralph Tatam at r.p.tatam@cranfield.ac.uk.*

Optical parametric amplifier achieves noiseless image amplification

Researchers at Northwestern University (Evanston, IL) have demonstrated noiseless amplification of an image such that output and input images have essentially the same fogginess. The amplification was performed using a spatially broadband optical parametric amplifier (OPA), which provided noiseless amplification of images in the phase-sensitive configuration. Noise figures almost 2 dB below the quantum limit of an ideal phase-insensitive amplifier and less than 0.5 dB with a ±0.5-dB margin of error were obtained for a gain of approximately 2.5.

The experiment consisted of shining an infrared (IR) signal laser through a double-slit pattern to serve as the image to be amplified. Amplification was accomplished by synchronizing phases of the IR signal and green pump lasers of the OPA. Upon measuring signal-to-noise ratios (S/Ns) at various locations in their one-dimensional image, the researchers found essentially no spatial variation or changes in S/N as a result of amplification. Because of the need to synchronize signal and pump beams, the experiment will not work on incoherent light sources, according to team leader Prem Kumar. *Contact Prem Kumar at kumarp@ece.nwu.edu.*

Liquid crystal produces switchable phase grating

A phase grating that could be switched from a diffracting to a nondiffracting state would be useful in spectrometers, camera lenses, beam steerers, and optical information-processing devices. Adrian Strudwick and Garry Lester at the University of Exeter (Exeter, England) have developed such a phase grating that uses a liquid crystal for switching. They started with glass substrates coated with a transparent indium tin oxide electrode and added photoresist with a refractive index of 1.635. Because liquid crystals are birefringent, applying a voltage causes them to reorient, changing the refractive index. The researchers used liquid crystal with a refractive index of 1.507 in perpendicular orientation and a parallel index of 1.655. The optical phase difference between the liquid crystal and the grooved polymer in which it was contained made a diffraction grating. The researchers could not perfectly match the refractive indices of the grating and polymer in the off state, so there was a faint ghost image of the higher orders of the diffraction pattern. *Contact Adrian Strudwick at A.M.Strudwick@exeter.ac.uk.*

Integrated amplifying module combines eight wavelengths

Researchers at the Ecole Nationale Supérieure des Télécommunications (Paris, France), TEEM Photonics (Meylan, France), and Lucent Technologies (Murray Hill, NJ) have demonstrated a pigtailed, eight-wavelength, planar integrated amplifying combiner and splitter. The device used two types of glass materials, a passive section in silicate glass and an amplifying section in erbium-ytterbium (Er-Yb) doped phosphate glass, to minimize absorption loss in the combiner and to maximize optical gain, respectively. The 5.5-cm-long amplifying section was codoped with 2% by weight Er ions and 4% by weight Yb ions. The two sections of the device were fabricated and optimized separately before being actively aligned with less than 0.3-dB coupling loss using ultraviolet-curing glue. The device was tested in an eight-channel, 2.5-Gbit/s wavelength-division-multiplexed system and simultaneously provided net gain to all channels in a 1531- to 1546-nm optical band, with a maximum variation of 0.4 dB across the eight ports. The eight wavelengths were centered around the 1535-nm gain peak of the device, with 1-nm spacing. Lossless operation was obtained with bit-error rate less than 10^{-10}. *Contact Denis Barbier at d.barbier@teemphotonics.com.*

Telescope optics cancel encoder aberrations

Rotary optical encoders are widely used to measure angular rotation of a shaft; the most-precise of these devices rely on diffraction of a beam by a grating to generate interference fringes, the positions of which are then detected. These encoders rely on a radial grating that unavoidably induces large aberrations in the beam, limiting performance. This problem has been circumvented by researchers at Ahead Optoelectronics and National Taiwan University (both of Taipei, Taiwan), who have built a rotary encoder based on a cylindrical grating combined with dual 1X telescopes that completely cancel aberrations induced by the grating.

Within the optics, the diffracted beam is Fourier-transformed twice and then diffracted a second time by the same grating. Because the diffracted light beam has an antisymmetric wavefront, the beam resulting from the +1 order and the -1 return order is collimated after the second diffraction with canceling of aberrations, including those resulting from misalignment. In a preliminary experiment, results agreed well with angular readings taken by a laser distance-measuring interferometer. *Contact Chi-Tang Hsieh at hsieh@ahead.com.tw.*

Laser light cools semiconductor

Researchers at the Grenoble High Magnetic Field Laboratory (Grenoble, France), the Universidad Autónoma de Madrid (Madrid, Spain), and the Technische Universität München (Garching, Germany) have used laser light to directly cool a semiconductor from 70 K to 63 K by luminescence upconversion. The process relies upon resonant pumping of a particular electronic state, resulting in photoluminescence (PL) arising from higher-energy states excited in phonon-absorption processes. The PL carries away net energy, cooling the solid.

The chosen semiconductor is a two-dimensional gallium arsenide/gallium aluminum arsenide quantum well, which has sharp PL spectral lines that do not overlap. A Ti:sapphire laser emitting at 1.579 eV (785 nm) pumps the material at intensities of up to 4 W/cm2. By applying an external magnetic field of up to 16 T to modify the spectral output and then analyzing the result, the researchers are able to measure the material's temperature without the need for an external thermometer. The technique could someday be used to cool electronic devices, according to the researchers. *Contact Marek Potemski at potemski@labs.polycnrs-gre.fr.*

Patterned thin-slab LED may offer 70% external quantum efficiency

A thin-slab light-emitting diode (LED) developed at the University of California (UCLA; Los Angeles, CA) produces spontaneous emission from the central unpatterned area of a thin film, with light extracted by coherent scattering from a pattern of photonic crystal rows around the periphery. Compared to an unpatterned thin-film LED, there reportedly is a sixfold photoluminescence enhancement that could translate to greater than 70% external quantum efficiency and a high corresponding wall-plug efficiency. The UCLA LED design comprises a perforated semiconductor film with an indium gallium arsenide/indium phosphide (InGaAs/InP) double heterostructure bonded to a glass slide. After separating the slab from its host substrate and bonding it to the glass carrier using an optical ultraviolet-curable epoxy, researchers defined a triangular array of holes with electron-beam lithography. The slab was then etched through by reactive ion etching to leave hexagonal active regions surrounded by photonic crystal rows. The InGaAs/InP film is 420 nm thick, and the InGaAs quantum well active region is 20 nm thick. Due to coherent scattering in the periodic photonic crystal, the LED provides a shorter light escape length and should be superior to random scatterers, which are more susceptible to parasitic adsorption. *Contact Misha Boroditsky at misha@physics.ucla.edu.*

Fri Oct 01 00:00:00 CDT 1999

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