NEWSBREAKS

QC laser becomes free-space communications link

Quantum cascade (QC) lasers provide light at tailor-made wavelengths in the mid-infrared between 3.5 and 20 μm. As a result of the unipolar intersubband nature of the lasing mechanism, QC lasers should have very good direct-current modulation properties, with theoretical predictions showing an upper limit of several hundred gigahertz. The combination of favorable modulation characteristics and a wavelength that can be positioned within a window of atmospheric transparency make the QC laser a potential candidate for high-speed free-space optical transmission. Researchers at Lucent Technologies Bell Laboratories (Murray Hill, NJ) and the Stevens Institute of Technology (Hoboken, NJ) have taken a step toward demonstrating this potential.

A QC laser emitting 7.347-μm light at an average power of 10 mW was modulated at speeds between 100 MHz and 2 GHz. Light from the laser was collected at a distance of 1.5 m away by a mercury-cadmium-telluride detector. Data collected by the researchers show a signal-to-noise ratio of 35 dB at 2 GHz, allowing them to estimate a 5-GHz cutoff frequency. Next, a 10-MHz audio and video signal centered at 66 MHz was transmitted over a 70-m distance (limited by laboratory size) with no noticeable loss in quality. More-advanced modulation schemes are under investigation. *Contact Rainer Martini at* rmartini@stevens-tech.edu.

Laser prints active indium-oxide optical microstructures

Indium-oxide (InO_x) diffractive optical microstructures can be activated with light. Researchers at the Hellas Institute of Electronic Structure and Laser (Heraklion, Greece) are fabricating nonstoichiometric InO_x surface-relief gratings using reactive pulsed-laser deposition. In the process, InO_x thin-film material is selectively transferred onto a glass substrate by ultrafast-laser microprinting via a demagnified photomask to form the structure. The microprinting laser—a hybrid distributed-feedback dye laser and krypton-fluoride excimer laser—delivers 500-fs pulses; the InO_x film is selectively ablated onto a receiver substrate placed 2 to 5 μm from the source substrate. A step-and-repeat process forms the structure.

The resulting transmissive grating has a 10-μm period, a size of 2 × 2 mm, and an initial diffraction efficiency of 5%. A normal-incidence 325-nm helium cadmium laser activates the grating within 4 s, which then diffracts a collinear 633-nm beam from a helium neon laser at higher efficiency. Switching the activation light off causes the InO_x to revert to its original state in about 4 s. The change in diffraction efficiency reaches approximately 10%. The maximum efficiency change exhibited a strong temperature dependency, achieving its maximum of 10% at 40°C, dropping to zero at 30°C, and dropping further to –8% at 20°C. Optimizing the grating height will greatly boost efficiency. The researchers have also activated microprinted InO_x gratings electrically. *Contact Nikos Vainos at* vainos@eie.gr.

Extra layers make ZnTe quantum-well structure lase in green

Although robust and long-lived blue-output semiconductor lasers exist in the form of gallium-nitride-based laser diodes, no practical green equivalent has ever been developed despite much research. Scientists at Tohoku University (Sendai, Japan) are working with a new material they believe has potential for pure-green light-emitting devices. Quantum-well (QW) structures based on zinc telluride (ZnTe), a wide-gap semiconductor, are fabricated that contain some layers of ZnTe made into ternary and quaternary compounds containing cadmium, magnesium, and selenium. In some of these devices, the researchers have achieved room-temperature optically pumped lasing.