Optoelectronics World: Imaging and Displays PAGE S1

LaserFocusWorld®

NOVEMBER 2006 WWW.LASERFOCUSWORLD.COM

INTERNATIONAL RESOURCE FOR TECHNOLOGY AND APPLICATIONS IN THE GLOBAL PHOTONICS INDUSTRY

PennWell

Fast 3-D vision speeds rail inspection

PAGE 67

news breaks

All-optical modulator is capable of terahertz speeds

Researchers at the California Institute of Technology (CalTech; Pasadena, CA) have demonstrated intensity modulation of light with light, based on the all-optical Kerr effect in a planar, hybrid silicon-on-insulator/polymer, all-optical device. The group directly measured time-domain intensity modulation at 10 GHz and showed through spectral measurements that intensity modulation at frequencies in excess of 1 THz could be obtained. Integrating the optical polymer through evanescent coupling to the silicon waveguide increased the effective nonlinearity of the waveguide, allowing operation at continuous-wave power levels compatible with telecommunications requirements.

The device was based on a Mach–Zehnder geometry, in which the source waveguide was split into two arms. A gate signal was introduced into one of the arms and induced a phase shift in the source signal via the nonlinear Kerr effect. Intensity modulation was accomplished through interference between the phase-shifted source signal and the optical signal traveling along the reference arm of the Mach-Zehnder interferometer. The interferometer was unbalanced to allow the intrinsic phase shift to be controlled by tuning the source wavelength, an ability that made the Mach-Zehnder easier to characterize. *Contact Michael Hochberg at* hochberg@caltech.edu.

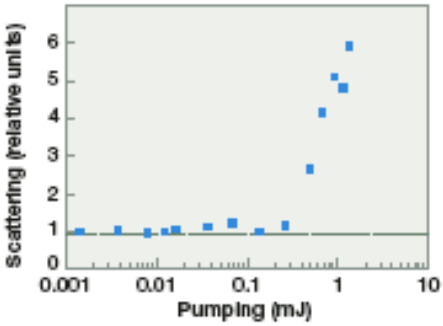
Fiber laser tunes without mechanically moving parts

Fast tunable lasers with a broad tuning range are desirable for Bragg-grating-based fiber-optic sensors and optical coherence tomography. Most tunable fiber lasers or diode lasers use mechanical, rotatable diffraction gratings, mirrors, or filters, limiting tuning speed. But, by varying modulation frequency and chromatic dispersion in the laser cavity (and thus eliminating mechanically moving parts), researchers at the University of Tokyo (Tokyo, Japan) have demonstrated a fast wavelength-tunable modelocked fiber laser that tunes across a range of 100 nm (around a 1330 nm center wavelength) with a sweep rate as high as 200 kHz.

By using an active-modelocking technique in which short pulse trains are generated by directly modulating the injection current to the semiconductor optical amplifier, a predictable wavelength shift can be achieved. The technique—also called dispersion tuning—requires a length of dispersion-compensating fiber (DCF). By adjusting the DCF length, the tuning range and sensitivity of the fiber laser can be modified. The sweep rate of the tunable laser is limited by the cavity length, and could be increased by using a shorter dispersive element. *Contact Shinji Yamashita at* syama@sagnac.t.u-tokyo.ac.jp.

Optical gain enhances surface-plasmon resonance

Surface plasmons (SPs; oscillations of free electrons in a metallic particle) and surface-plasmon polaritons (electromagnetic waves propagating along a metal/dielectric interface) are important to the development of plasmonic nanostructures that can act as optical nanoantennae and nanocircuits, and to surface-enhanced Raman-scattering applications; however, future development of nanoplasmonics is limited by metallic absorption of SPs. Spurred by their theoretical calculations, researchers at Norfolk State University (Norfolk, VA) and Purdue University (West Lafayette, IN) were able to experimentally demonstrate that optical gain in a dielectric medium could compensate for loss in a metal and enhance SP resonance.



In a pump-probe Rayleigh-scattering experiment, a mixture of Rhodamine 6G dye and an aggregate of silver nanoparticles was pumped with a 532 nm Nd:YAG laser and the Rayleigh scattering probed at approximately 570 nm at the peak of the gain spectrum of the dye. A sixfold increase in the Rayleigh scattering from the dye/aggregate mixture (subtracting out spontaneous emission) upon the increase of pumping energy confirmed compensation of the loss in the metal by the gain in the interfacing dielectric of the mixture. *Contact Mikhail A. Noginov at* mnoginov@nsu.edu.