LASER SCANNERS

No moving parts

Sci. Rep. **2,** 445 (2012)

Laser scanners are highly useful devices for sensing and imaging a wide variety of objects, but their mechanical and active electronic components limit scanning rates to around 100 kHz. Now, Keisuke Goda and co-workers at the University of California at Los Angeles and the California NanoSystems Institute, USA, have developed a laser scanner that avoids the use of mechanical parts. Instead, their device performs the scanning by using dispersive Fourier transformation to control the light dispersion. The two-step process of frequency-to-time conversion followed by time-to-space conversion allows the light to spread out both in space and time, which increases the amount of information that can be encoded onto the light. Scanning is conducted in the industrially important spectral band around 800 nm at speeds of up to 90.8 MHz. The technique can discriminate between MCF7 breast cancer cells and white blood cells. They expect the method to be useful more broadly in the biomedical industry, for example in the sensing of cells. *SA*

PHOTONIC COMPUTING

Mimicking the brain

Phys. Rev. Lett. **108,** 244101 (2012)

The idea of performing computations based on how the brain processes information has gained increasing popularity over the past decade. Now, Romain Martinenghi and fellow researchers in France have demonstrated a brain-inspired optoelectronic neuromorphic computer. It uses the nonlinear transient response of an optical system to perform processing in a higher dimensional phase space. The wavelength of a tunable laser is used as the dynamic variable that determines the output of an interferometer, which in turn controls the precise expression of a nonlinear function. The information to be processed is transformed according to this function, and in turn undergoes a complex feedback mechanism involving randomly weighted delay lines. They evaluated the performance of the device's computation through a standard spoken digit-recognition test consisting of ten different female speakers reading aloud digits from 0 to 9. The computational efficiency of the scheme was comparable to the best results achieved so far in other systems. The processing time for the recognition of one spoken digit was around 20 ms, but the researchers say this could be reduced to 100 ns by modifying the system to include telecommunications-grade devices. *SA*

LIGHT SOURCES

Sun-powered lasers

Opt. Lett. **37,** 2670–2672 (2012)

Thanh Hung Dinh and colleagues in Japan have constructed a solar-powered laser that provides 120 W of continuous-wave output at a wavelength of 1,064 nm. In the future, lasers pumped by sunlight may play a key part in the conversion of solar energy into chemical energy for storage in magnesium by reducing magnesium oxide to magnesium. Traditional solar-pumped lasers employ hybrid concentrator schemes that comprise a conical cavity surrounding a rod containing the gain medium. Instead, Dinh and co-workers sheathed their lasing medium in a cylinder of coolant, thus providing an additional focusing structure called a 'liquid light-guide lens'. Sunlight entering the lens from the air in the conical cavity is refracted towards the gain medium. The system uses an automatic solar tracking system and a 2 m × 2 m Fresnel lens at the large opening of the cavity. The gain medium is a rod of Nd:YAG measuring 6 mm in diameter and 100 mm in length. The researchers say that the low scattering loss of Nd:YAG, compared with previous solar lasers based on Cr:Nd:YAG, provided a 1.4-times increase in output power. *DP*

SUBWAVELENGTH IMAGING

Polychromatic metalens

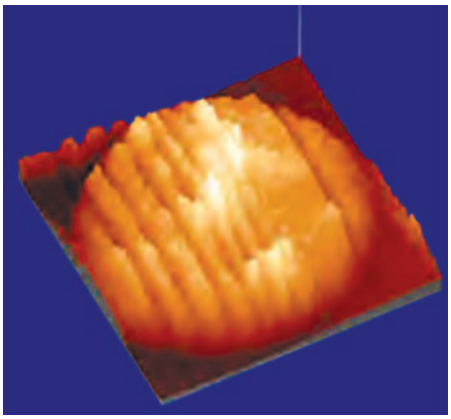
Nature Commun. **3,** 889 (2012)

Far-field polychromatic focusing and imaging at visible wavelengths may be possible by exploiting the dispersive properties of optical resonator arrays. That is the prediction of Fabrice Lemoult and colleagues in France, who considered a single silver rod measuring 30 nm in diameter and 100 nm in length, with a resonance at around 600 nm. A 50-nm-period array of such resonators should create a continuous band of collective modes thanks to the numerous possible symmetric and antisymmetric combinations of the modes. These combinations support subwavelength features of the electromagnetic field that can be accessed (that is, radiation coupled in and out) from the far-field. Calculations suggest that it should be possible to focus optical waves onto a 30-nm-wide focus at the centre of a 700 nm pulse by employing a time-reversal approach while performing polychromatic interferometric far-field subwavelength imaging. *DP*

BIOPHOTONICS

Low-power nanosurgery

J. Biomed. Opt. **17,** 101502 (2012)



Laser-assisted surgery based on the multiphoton absorption of near-infrared laser light has significant potential for high-precision surgery at various depths within cells and tissues. Although low-energy femtosecond pulses can be used to achieve safe, highly localized and ultraprecise manipulation of subcellular organelles, conventional systems for laser micro- and nanoprocessing employ micro- to millijoule energies, which can induce destructive effects in cells. Karsten König and co-workers have now demonstrated an ultrashort femtosecond laser scanning microscope that can perform precise (sub-100-nm spatial resolution) surgery of human cells and metaphase chromosomes. The researchers used a mode-locked, 85 MHz repetition rate Ti:sapphire laser with an 'M'-shaped ultrabroadband spectrum (maxima at around 770 nm and 830 nm), with pulse durations of between 12 fs and 3 ps. Such picojoule pulses were sufficient to induce sub-100-nm multiphoton ablation effects, which are nearly an order of magnitude smaller than the wavelength of light used. The researchers say that this work may lead to compact, cost-effective laser sources for use in future femtosecond laser nanoprocessing and imaging microscopes. *JB*

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