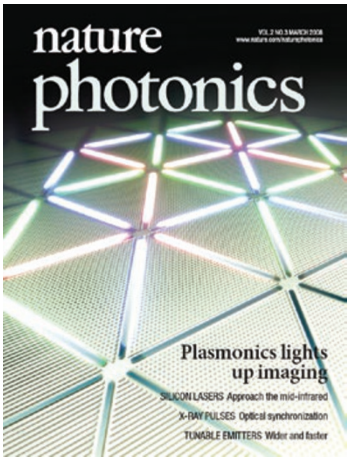


Cover story

Vol.2 No.3 March 2008

Separating photons of different colours is important in optics, and is often performed by filters, gratings or prisms. Now optical scientists have another option in their toolbox thanks to the use of plasmonics. In this issue, Thomas Ebbesen and co-workers report the fabrication of a plasmonic photon sorter made from a silver film containing intricate nanostructured patterns and subwavelength apertures. Light incident on the nanopatterns excites surface plasmons, which channel light of a specific wavelength determined by the period of the nanostructure to a particular aperture. Importantly for imaging applications, nanopatterns designed for different wavelengths can be overlapped, allowing light of different colours striking the same area to be separated — something that is impossible to do using conventional colour filters covering detector arrays. **[Letter p161; News & Views p139; Interview p198]**

FASTER TUNING

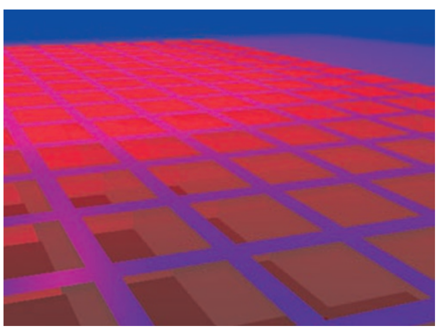
Many applications in photonics, in particular spectroscopy, communications and sensing, require the use of an electronically tunable laser that is able to alter its emission wavelength on demand. So far, tunable lasers tend to have been bulky or limited in their tuning range and speed. Now, a new type of tunable semiconductor laser reported by Michael Huang and co-workers promises to overcome these deficiencies. The so-called nanoelectromechanical optoelectronic (NEMO) laser reported in this issue offers a tuning range of several tens of nanometres in the near-infrared (850 nm) and tuning times of just a few hundred nanoseconds. The design is based on a vertical-cavity surface-emitting laser, but with one important difference. The top distributed Bragg reflector is replaced with a suspended high-contrast grating, which is moved by nano-actuators to tune the length of the cavity and hence its emission wavelength. Beyond spectroscopy and sensing, potential applications for lasers based on the NEMO design include chip-scale atomic clocks or projection displays.
[Letter p180; News & Views p134]

HOLOGRAPHIC VISION

Acquiring three-dimensional images of microscopic specimens is of great interest to biologists. Although schemes such as optical coherence tomography, confocal microscopy and others offer this capability, they all involve piecing together a large number of individual two-dimensional image scans, each of which needs to be collected separately. In this issue, a motionless holographic technique that collects all the necessary information from just three holograms is reported. The so-called FINCHSCOPE built by Gary Brooker and Joseph Rosen consists of a digital camera, a high-numerical-aperture microscope objective, a spatial light modulator and an excitation source. The researchers demonstrate that it can capture fluorescent images from nerve fibres and pollen grains at different depth planes without the need for any movement of the lens or specimen.
[Article p190; News & Views p131]

TERAHERTZ CONFINEMENT

The ability to guide and confine terahertz waves would benefit imaging and sensing applications, but it is notoriously difficult to achieve. Plasmonic metamaterials may provide an answer. In this issue, Stefan Maier and co-workers report the experimental confinement and propagation of surface plasmon polaritons at terahertz frequencies along structured metal surfaces. Their terahertz guides consist of a thin polymer film that is patterned with an array of micrometre-scale square holes and covered with a layer of copper. The researchers conclude that their metamaterial surfaces provide wavelength-scale energy confinement that is two orders of magnitude better than a flat metal sheet and agrees well with previously published theoretical predictions. They expect it to be possible to create waveguides, lenses, mirrors and resonant cavities by varying the size and spatial distribution of the holes.
[Letter p175; News & Views p137]



A pattern of microscale squares can be used to achieve waveguide confinement at terahertz frequencies.

p175

PUSHING SILICON FURTHER

Silicon lasers are highly attractive owing to their potential low cost and the ease with which they can be integrated with electronics. However, until now they have been confined to operation in the near-infrared, around a wavelength of 1.6 μm. There is great appeal in achieving longer wavelengths of operation, especially in the window between 2 μm and 5 μm, which is important for gas sensing and other applications.

Now, it appears that this may soon be possible. In this issue, Haisheng Rong and his colleagues report that they have succeeded in fabricating a silicon-waveguide cascaded Raman laser that emits more than 5 mW at 1.85 μm. Unlike previous designs, the laser uses a second-order Raman shift to push its emission to a longer wavelength. The news suggests that silicon lasers could soon be entering the mid-infrared by using third- or fourth-order shifts.
[Letter p170; News & Views p132]

X-RAY SYNCHRONIZATION

The goal of making molecular movies that chart atomic trajectories and chemical state changes in real-time could be one step closer to reality thanks to the demonstration of a device that can synchronize X-rays and optical pulses with femtosecond accuracy. Although ultrashort X-ray pulses have great potential for femtochemistry, observing and imaging the resulting dynamics requires the use of an optical source. In this issue, Alexander Föhlisch and his co-workers show that X-ray-induced changes in the optical reflectivity of GaAs can be used as a tool for cross-correlation between X-ray pulses emitted from a free-electron laser and light pulses. The team hold the opinion that their approach can be applied to pulses from both present and future free-electron lasers, and could also be extended to single-shot experiments. [**Letter p165**]