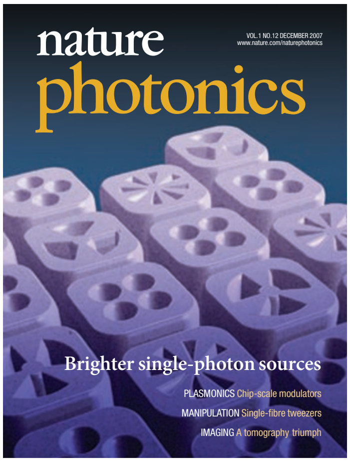


Cover story

Vol.1 No.12 December 2007

Single-photon sources with improved performance are required to help support the development of quantum information processing. So far, schemes based on individual molecules, dopant ions and microcavities have been limited by their low emission rates, rapid saturation characteristics and awkwardness to control. Now, Stefan Strauf and co-workers have demonstrated a quantum-dot microcavity-based single-photon source that offers an emission rate of up to 31 MHz and voltage-controlled tuning of the emitted photon's polarization state. The design consists of a GaAs/AlGaAs microcavity with a high Q-factor of 50,000 that contains embedded individual InAs quantum dots. Carefully designed trenches and an oxide aperture within the microcavity optimize the source's emission characteristics. **[Letter p704; News & Views p686]**

COOLING DOWN

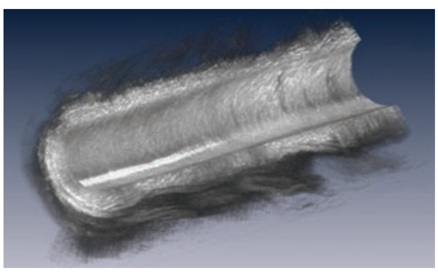
Although the use of lasers to cool and trap atoms has been widely studied and resulted in a Nobel Prize in Physics a decade ago, it is not nearly so well known that lasers can actually cool solids on a much larger scale. In this issue, Mansoor Sheik-Bahae and Richard Epstein describe the progress that has been made in cooling samples of rare-earth-doped glass and semiconductors by illuminating them with laser light. The idea is that once optimized the technique could be useful for making an 'optical refrigerator' that could potentially outperform conventional mechanical and thermoelectric coolers.
[Progress Article p693]

ALL-OPTICAL ANSWER

As the drive towards the deployment of all-optical communication networks continues, there is an increasing need for devices that can manipulate light signals without requiring them to be first converted into electrical signals. Now, Brian Fluegel and co-workers describe the first all-optical tunable wavelength shifter based on plasmonics. The need to control and shift the wavelength of data streams is important for routing traffic in networks that use wavelength-division multiplexing. The wavelength shifter reported in this issue relies on bouncing the signal beam off a semiconductor sample made from GaAs quantum wells. The signal beam is Raman scattered to a new wavelength by optically excited plasmons in the semiconductor. The size of the wavelength shift is determined by a control beam, which regulates the distribution of photo-excited electrons in the sample. Fluegel *et al.* say that the approach has several potential benefits, including compatibility with multiple simultaneous signal wavelengths, bit-rate transparency and polarization insensitivity. However, before it can become a practical option its temperature of operation (160 K) and wavelength-conversion efficiency (10^{-9}) will need to be improved.
[Letter p701; News & Views p689]

TOMOGRAPHY SPEED BOOST

The advent of frequency-domain mode-locked (FDML) lasers that can rapidly scan their emission wavelength across hundreds of nanometres is now opening the door to much-higher-performance optical-coherence-tomography (OCT) systems. In this issue, James Fujimoto and co-workers report three-dimensional endomicroscopy with an FDML-based OCT system that offers a 100-kHz scan rate, a 160-nm tuning range and an axial resolution of better than 7 μm. The system is capable of capturing images at 50 frames per second with 2,000 axial lines per frame and was tested by imaging a rabbit's colon. The researchers say that the high imaging speed and resolution enabled the visualization of microscopic features such as individual colonic crypts. They also believe that in the future advances in data-acquisition technology will push performance of three-dimensional OCT to even higher speeds.
[Article p709; News & Views p684]



High-speed lasers are improving the performance of optical coherence tomography.

p709

QUANTUM DOTS GET BRIGHTER

Quantum–dot-based LEDs potentially have a bright future in displays, lighting and other applications where efficient, broad-area and narrow-bandwidth visible sources are required. However, so far their use has been hindered by their limited performance. Now, researchers in China have succeeded in fabricating visible quantum-dot-based LEDs, which set new standards in terms of brightness, efficiency and lifetime. The devices, based on a CdSe core and a CdS/ZnS shell, are the result of careful optimization of the dots' ingredients, layer thickness and uniformity. Yongfang Li and co-workers report that they have realized quantum-dot-based LEDs with a surface area of 1.5 × 2.5 cm^2, a luminance of up to 9,064 cd m^{-2} and an efficiency in terms of candelas per amp of up to 2.8%.
[Letter p717; News & Views p683]

ALL-FIBRE TWEEZERS

Optical tweezers are a convenient tool for manipulating microscale biological samples. However, so far most designs have involved microscope objectives and free-space optics and there is a strong drive to realize miniature fibre-based systems. Now, scientists in Italy have developed an all-fibre probe that is smaller than a syringe needle, has a long working distance and can trap and manipulate microscale objects in three dimensions. The device is based on a single bundle of four fibres with carefully shaped end faces that induce total internal reflection and thus achieve beam focusing similar to a high-numerical-aperture lens. To demonstrate the performance of the probe, Paolo Minzioni and co-workers used it to manipulate 10-μm-diameter polystyrene beads. In the future they believe that potential applications could include single-particle X-ray spectroscopy or *in vivo* biological tasks.
[Article p723; News & Views p688]