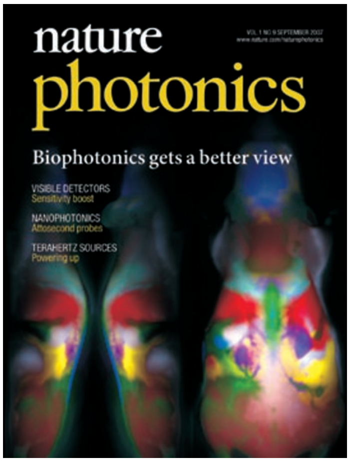


Cover story

Vol.1 No.9 September 2007

Fluorescent molecular imaging is an important tool in medicine for studying biochemical activities in the body as well as the distribution and efficacy of drugs. Unfortunately, anatomical co-registration that enables the origins of the fluorescence to be precisely matched to a location within the body has been a challenging and, until now, unresolved task. Elizabeth Hillman from Columbia University and Anna Moore from Massachusetts General Hospital have come up with an elegant and cost-effective answer to this problem. Their optical scheme uses two angled mirrors to image three orthogonal views of the subject and then captures a time series of images acquired after the injection of inert dyes. The result is an accurate co-registered anatomical overlay of the major internal organs of a small animal. **[Letter p526; News & Views p496; Interview p548]**

SILICON ALTERNATIVE

What makes a good visible-wavelength detector? Sensitivity and gain are certainly important: if many charge carriers can be produced for every absorbed photon, then the device will have better low-light performance. In this issue Gerasimos Konstantatos and colleagues from the University of Toronto report an interesting alternative to the silicon detectors that are commonly used for capturing visible light. Their answer is a thin-film photodetector that is made from a different material system, and is not only very sensitive but also has potential for low-cost fabrication. By careful synthesis of lead sulphide nanoparticles, the researchers were able to shift the response of detectors based on this type of material from the infrared into the visible for the first time. **[Letter p531]**

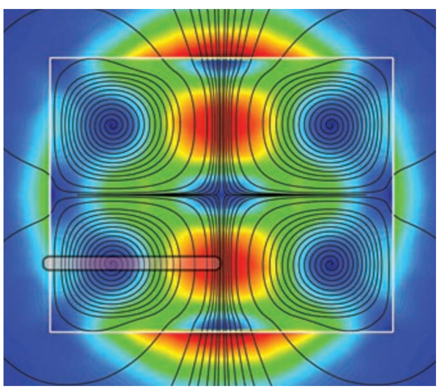
CASCADE CONVENIENCE

Although imaging and spectroscopy systems in the terahertz window (wavelengths of around 30 μm to 1,000 μm) are now capable of impressive performance, the convenience, size and cost of such systems is limited by the complex schemes that are needed to generate terahertz waves. What researchers and industry really need is high-performance, cost-effective semiconductor lasers that operate in the region.

The answer may lie with so-called quantum-cascade lasers (QCLs) that are designed to exploit so-called intraband transitions where an electron switches from one quantum-well energy level to another. This enables the design of semiconductor sources that emit light at a much longer wavelength then would normally be possible given the direct bandgap of the semiconductor. In this issue, Benjamin Williams from the University of California, Los Angeles reviews the development of QCLs as a source of terahertz radiation. In just six years since the first device was demonstrated, terahertz QCLs have advanced to the point that they can now generate milliwatts of continuous-wave light. Good news for a broad range of applications. **[Review p517]**

IMMUNITY FROM ATTACK

Nuclear blasts and electromagnetic-pulse weapons both have the potential to fatally damage electronic circuitry by a burst of electromagnetic energy that literally fries small, sensitive metallic tracks and parts. In particular, radar and communication systems are considered high-risk targets owing to their antennas, which provide a direct conduit for the electromagnetic pulse. Now, Rick Hsu and colleagues from the University of California, Los Angeles, may have an answer to protecting electronics from such an attack. They have designed and fabricated a radiofrequency receiver that has a fully photonic 'front-end' that is free from metallic parts and uses photonics to isolate the sensitive electrical components from such a radiation burst. **[Letter p535; News & Views p493]**



The electric-field distribution inside a nuclear-blast-proof dielectric resonant antenna.

p535

DUAL FUNCTIONALITY

Semiconductor quantum dots that have been engineered to have both fluorescent and parametric properties could be an ideal 'all-in-one' biological probe of the future, taking over from the simple dyes that are used at present. By exhibiting both optical and paramagnetic properties, such quantum-dot probes open the door to so-called multimodal imaging — using both fluorescent and magnetic-resonance imaging. For instance, magnetic-resonance imaging could track the general distribution of the probes on a large scale while fluorescent imaging is used to perform detailed subcellular investigations. In this issue, Rumiana Bakalova and co-workers from the National Institute of Radiological Sciences in Japan describe the status of the technology and the challenges in designing probes for safe and effective *in vivo* use. **[Commentary p487]**

ATTOSECOND NANOSCOPE

As science continues to push back at the limits to our understanding, processes that happen on ever faster timescales and smaller length scales start to garner interest. Surface plasmons are one example — the dynamical processes of electrons at the surface of a metal can take place in just a matter of attoseconds. Mark Stockman and colleagues from Georgia State University, Max-Planck Institut für Quantenoptik and the Ludwig-Maximillians-Universität München, have proposed a scheme for directly observing these nanoplasmonic dynamics. They show that by combining two of the latest imaging techniques, photoelectron emission microscopy and attosecond streak spectroscopy, it should be possible to monitor optical fields with a temporal resolution of 100 attoseconds and a spatial resolution of just a few nanometres. **[Article p539; News & Views p499]**