Cover story

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The idea of deliberately applying a harmonic vibration (pressure wave) to a liquid lens so that it constantly changes its shape may seem odd, given that past research has strived to dampen any transient deformations in lens shape. However, Carlos López and Amir Hirsa from Rensselaer Polytechnic Institute have done just that by connecting a liquid lens to a speaker. The result is a liquid lens that has a rapid oscillating shape and thus focal length. By synchronizing the oscillations of the lens's focal length with the timing of electronic image capture on a sensor, the researchers have created a millimetre-scale variable focus liquid lens with a response time of 100 Hz. The approach may be useful for creating miniature lenses with fast response times for adaptive optics and other applications.
[Letter p610; News & Views p595; Interview p638]

NEAR-FIELD INTEGRATION

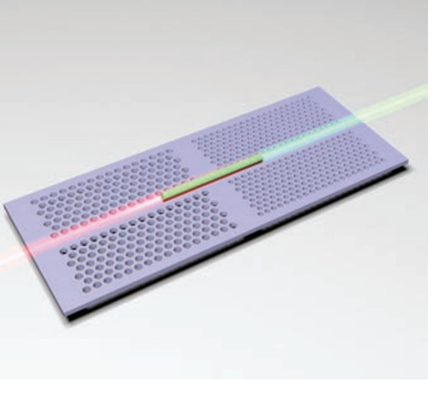
Near-field imaging in the terahertz region looks set to become simpler to perform, more sensitive and higher-resolution thanks to the demonstration of a miniature integrated probe and detector on a chip. The cryogenically cooled device reported by Yukio Kawano and co-workers from RIKEN and the Japan Science and Technology Agency in Saitama, Japan, consists of a planar near-field probe (a 100-nm-thick gold film shaped into two opposing tips) and an 8-μm-diameter aperture fabricated on top of a GaAs/AlGaAs chip. A two-dimensional electron gas located 60 nm beneath the chip surface acts as a terahertz detector through changes in resistance. The approach avoids the need for separate devices and coupling optics between them (terahertz lenses and waveguides), which can be lossy and hard to align. [**Letter p618**]

SPLIT-RING INSIGHT

Metamaterials with unique and interesting electromagnetic properties have become a hot topic in recent years. At the heart of many designs are arrays of tiny split-ring resonators, which are carefully fabricated to give the desired electromagnetic response. Martin Husnik and colleagues from Karlsruhe in Germany, have now measured the absolute extinction ratio of a single split-ring resonator, rather than studying the collective behaviour of an array. They find that the value is about one seventh of the square of the resonance wavelength (which is at 1.4 μm in the near infrared). Theoretical analysis reveals that the absorption cross-section and scattering cross-section contribute one third and two thirds of this value, respectively. In addition they deduce that the effective capacitance and inductance of the split rings in their study are 19 aF and 30 fH, respectively.
[**Letter p614**]

LIGHTING UP PHOTONIC CRYSTALS

An efficient means of getting light into and out of photonic-crystal circuitry is a challenge that needs to be overcome for nanoscale optical chips to become a practical proposition. The latest idea from Hong-Gyu Park and co-workers from Korea University and Harvard University is to integrate light-emitting CdSe/CdS or InGaN semiconductor nanowires with photonic-crystal waveguides.
The researchers investigate electrically and optically excited light-coupling characteristics. They also build a hybrid structure in which two colours of light (red and green) emitted from a CdS–CdSe nanowire are coupled into adjacent photonic-crystal waveguides and transmitted in opposite directions.
The wavelength selective transmission is due to the waveguides having different lattice constants designed to match different wavelengths of light. Such active hybrid devices may prove useful building blocks for future all-optical processing schemes.
[**Article p622**]



Hong-Gyu Park and co-workers tackle the challenge of coupling light into and out of photonic-crystal circuitry.
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TERAHERTZ POWER

Radiation sources at wavelengths between 30 μm and 3 mm are much weaker than those at other wavelengths. This is despite a number of very important applications for so-called terahertz light. Nonlinear optics in atomic gases provides a potentially very important source of pulsed terahertz light, but there is a need to better understand and optimize this process. The challenge is now taken up by Ki-Yong Kim and colleagues at the Los Alamos National Laboratory. The team created bright broadband terahertz radiation by passing a laser pulse, 50 fs long and at a wavelength of 815 nm, through a nonlinear crystal to generate second-harmonic light. The two beams then interact in the gas. The key to maximizing the output intensity is to ensure the correct phase difference between the two. The team experimented with a number of gases, and found that krypton produced the brightest pulses with an energy in excess of 5 μJ, comparable to large electron accelerators.
[**Letter p605; News & Views p596**]

HELPING HIGH-FIELD SCIENCE

Thanks to continual advances in diode-pumped thin-disk laser technology, highly compact mode-locked femtosecond oscillators are now able to provide microjoule-pulse energies at megahertz repetition rates. This level of performance means that such sources are now becoming suitable for demanding high-field experiments, such as high-harmonic generation and photoelectron imaging spectroscopy, which in the past required much larger, more complex laser systems operating at kilohertz rates. In this issue, Thomas Südmeyer and colleagues report on the progress that has been made in improving the performance of femtosecond lasers in recent years and the experiments that could benefit as a result.
[**Progress Article p599**]