correlation measurements demonstrated that the defects were entangled, and quantum-state tomography revealed that the states had a fidelity of 0.67. *NH*

OPTICAL TRAPPING

Gigapascal pressures

Phys. Rev. Lett. **110,** 095902 (2013)

The diamond anvil cell is a useful research tool as it can compress small samples of a material to pressures of up to hundreds of gigapascals. However, physical access to a pressurized sample is limited, thus making it difficult to perform measurements. To overcome this constraint, Richard Bowman and colleagues from the UK and Italy have constructed a customized optical tweezer set-up that makes it possible to create an optical trap within a diamond anvil cell. The key to their approach is the use of an objective lens with a long working distance and a liquid-crystal spatial light modulator to form two annular beams that create the trap. The result is a scheme that overcomes the limited acceptance angle of the cell and needs access from only one direction. The team demonstrated the effectiveness of their approach by performing viscosity measurements of water under pressures of up to 1.3 GPa. They claim that their approach is unique in that it can be used to perform absolute viscosity measurements so that measured values do not need to be scaled to the accepted value at atmospheric pressure. *RW*

SENSING

Singlet oxygen detection

Opt. Express **21,** 5005–5013 (2013)

It is desirable to monitor the level of singlet oxygen $^1O_2$, the excited state of molecular oxygen, owing to its importance in many biological systems. However, luminescence from $^1O_2$ occurs only with a very low emission probability ($\sim 10^{-8}$) and a short lifetime ($<<1$ μs), thus making optical detection difficult. Now, scientists in the UK, Canada and the Netherlands have developed a detection system based on a superconducting nanowire single-photon detector. In a proof-of-concept demonstration, they delivered a pulsed laser beam with a wavelength of 532 nm to the sample and collected the photoluminescence using a fibre-coupled NbTiN superconducting nanowire single-photon detector. Instead of a series of lenses and a dichroic beamsplitter, they used two separate delivery and collection fibres. The time-correlated signal through a bandpass filter centred at 1,270 nm showed a weak but definitive signal from $^1O_2$ luminescence. They confirmed the results by adding a singlet oxygen quencher and a protein to a sample. The researchers believe that the system is a significant step towards realizing dose monitoring in clinical treatments such as photodynamic therapy. *NH*

TERAHERTZ WAVES

Cool generation

Opt. Lett. **38,** 796–798 (2013)

Intense, ultrafast terahertz (THz) pulses are required for a wide variety of applications, and there is keen interest in scaling the peak output power of THz generation schemes. Optical rectification using the nonlinear crystal lithium niobate ($LiNbO_3$) is one promising method for generating high-peak-field THz pulses, but to date the maximum energy-conversion efficiency from pump to THz output has been less than 0.25%. Now, Shu-Wei Huang and co-workers from the USA, Spain and Germany have improved this by more than an order of magnitude. They achieved a record-high conversion efficiency of 3.8% by carefully optimizing the pump pulse duration to maximize the effective length of the nonlinear interaction for THz pulse generation. They further enhanced the efficiency by cooling their $LiNbO_3$ crystal to 100 K to reduce THz absorption in the sample. They sent a pump laser with a central wavelength of 1,030 nm, a pulse duration of 680 fs, and a fluence of 4.7 mJ cm^{-1} to a prism-shaped $LiNbO_3$ crystal doped with 6% MgO. The generated THz power increased monotonically as the temperature decreased to about 150 K. Below this temperature, the conversion process saturated. The conversion efficiency of 3.8% is not far from the maximum theoretical limit of 6% for $LiNbO_3$ at 100 K. *NH*

METROLOGY

Imaging polarization

Opt. Express **21,** 4106–4115 (2013)

Knowledge of the polarization of light is useful for many photonic applications, and there are many different polarimetry schemes for measuring the state of polarization. Roshita Ramkhalawon and co-workers from the Institute of Optics at the University of Rochester, USA, have now reported a new approach for achieving this goal. Their scheme relies on using a CCD image sensor (480 × 640 pixels) to capture the polarization-dependent nature of the point spread function of a focused laser beam. They show that such measurements can be mapped to a probability density function on the Poincaré sphere, which is used to represent polarization states. An advantage of their approach is that it involves single measurements without splitting the beam and sending it to multiple polarization analysers. The researchers say that their approach to polarization measurement could be especially useful for analysing light with very small photon numbers and characterizing polarization-entangled quantum states. *OG*

CRYPTOGRAPHY

Quick response codes

Opt. Express **21,** 5373–5378 (2013)

Quick response codes, which are compact two-dimensional square barcodes that can be read by smartphones and tablet computers, have been growing in popularity in recent years and are now commonly found in many forms of consumer advertising and packaging. Now, a team of scientists from South America has considered the application of such codes for the transmission of encrypted information. The idea is to encrypt quick response codes instead of the corresponding raw information as their binary nature could prove far more resilient to speckle noise, thus resulting in higher quality information retrieval after decryption. Encryption tests with double random phase encoding, where two random phase masks are used to encrypt and decrypt the quick response codes, indicate that this is indeed the case. The researchers from the Universidad de Antioquia in Colombia and the Universidad Nacional de la Plata in Argentina are now investigating the use of multiplexing and synchronization to transfer movies by this method. *OG*

Written by Oliver Graydon, Noriaki Horiuchi, David Pile and Rachel Won.