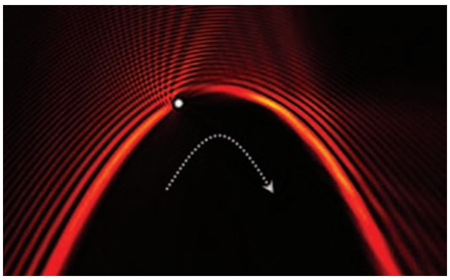
of 532 nm and an estimated power of 17 mW was sent through a 100x high-numerical-aperture oil-immersion objective lens into a sample of 1.5-μm-diameter colloidal silica particles dispersed in water. The researchers observed both up- and downstream particle motion, moving a distance of around 30 μm in 80 s. Numerical analysis suggests that the simultaneous manipulation of multiple objects and the transportation of irregularly shaped objects or objects with inhomogeneous optical properties should also be possible. *NH*

ACCELERATING BEAMS

Non-paraxial-limited

Phys. Rev. Lett. **109,** 193901 (2012)



XIANG ZHANG

Airy beams — accelerating beams that possess non-diffracting and self-healing properties — are subject to a paraxial limit, which means they lose these properties after bending to large angles along their parabolic trajectories. Peng Zhang and colleagues from the USA and Canada have now theoretically and experimentally demonstrated two new classes of accelerating beams that do not suffer from this limitation: non-paraxial Mathieu accelerating beams (MABs) and Weber accelerating beams (WABs). The beams were found as solutions to the Helmholtz equation in elliptical and parabolic coordinate systems, respectively, without the need for a paraxial approximation. The researchers showed that a circular non-paraxial accelerating beam is a special case of an elliptical MAB, and that the Airy beam is a paraxial approximation of a WAB. They experimentally realized the beams by sending a 532 nm laser through a holographic mask whose phase and intensity information were reconfigurable. The findings not only generalize the concept of accelerating beams, but also offer larger degrees of freedom in beam engineering for practical applications, such as microparticle manipulation and surface plasmon routing. *RW*

OPTOFLUIDIC LASERS

In random form

Appl. Phys. Lett. **101,** 151101 (2012)

Shivakiran Bhaktha and colleagues from India and France have demonstrated a mirrorless optofluidic random laser. The device is based on a snake-shaped, dye-filled periodic microfluidic polydimethylsiloxane (PDMS) channel measuring 3 mm long, 28 μm deep and 10 μm thick, with a periodicity of 40 μm ± 0.65 μm. They fabricated the channel using soft lithography and filled it with an ethanolic dye solution. They used a stripe-shaped (3 mm long, 4 μm thick) beam from a *Q*-switched Nd:YAG laser at 532 nm to pump the dye circulating along the channel. Owing to the inherent disorder of the structure resulting from the limited accuracy of the photolithographic process, stimulated photons were multiply scattered at each PDMS–dye interface, thus resulting in random laser action when the losses were overcome. Random lasing was confirmed by the random change of the laser emission spectrum when different pump regions were scanned by the beam. Lasing was observed at a wavelength of 560 nm at a pump threshold power density of 80 μJ mm^{-2}, which is comparable to conventional designs of optofluidic lasers. The researchers anticipate that the simplicity of their design may lead to the large-scale production of complex optofluidic structures. *RW*

OPTICAL BIOSENSORS

Artificial antibodies

Adv. Func. Mater. http://dx.doi.org/10.1002/adfm.201202370 (2012)

Synthesizing natural antibodies, which are required for many forms of biological sensing, can be an expensive process. Abdennour Abbas and colleagues from the Washington University in St Louis and the Siteman Cancer Center in the USA have now fabricated artificial antibodies by surface-imprinting gold nanorods using reversible template immobilization and siloxane copolymerization. Although artificial antibodies have been made before, this new approach has the advantage of providing nanometre-precision control over the imprinting process, thus improving optical biosensor performance. The researchers demonstrated how the artificial antibodies allow plasmonic biosensing and can therefore be used to detect neutrophil gelatinase-associated lipocalin, a biomarker for kidney injury, by localized surface plasmon resonance spectroscopy. They were also able to detect haemoglobin in diluted urine samples, which is relevant to a pathological condition known as haemoglobinuria. To do this, the researchers incubated gold nanorod sensors in a urine sample containing 30 μg mL^{-1} of haemoglobin and then obtained spectra from the rods. They observed a resonance shift of about 3.5 nm due to the presence of the haemoglobin. *DP*

PHOTOCATALYSIS

Plasmonic enhancement

Nature Mater. http://dx.doi.org/10.1038/nmat3454 (2012)

Photocatalysis using semiconductor materials is showing promise, but some researchers think the properties of metals make them more suitable for this application. Phillip Christopher and co-workers from the University of Michigan and the University of California, Riverside, USA, have found that plasmonic metallic nanostructures behave quite differently from semiconductors in their role as a photocatalyst. Specifically, they demonstrated that the photocatalytic reaction rates of metallic nanostructures exhibit a superlinear power law dependence on light intensity. Additionally, photocatalytic quantum efficiencies seem to increase with light intensity and operating temperature, which is not the case for semiconductors. The researchers hope that these characteristics will allow plasmonic nanostructures to become a new family of photocatalysts for reactions that cannot be activated by conventional metals or semiconductors. *DP*

WAVELENGTH CONVERSION

Single-photon chameleon

Appl. Phys. Lett. **101,** 171110 (2012)

Rapidly changing the properties of an optical cavity is a popular technique for converting light from one wavelength to another. Such changes modify the resonant frequency of the resonator and can force the photons to adapt by changing colour to 'fit' into the new cavity. Stefan Preble and colleagues from the Rochester Institute of Technology in the USA have now extended this idea to the low-photon-number regime in a silicon ring resonator. They used a 415 nm pump laser to modify the resonance of the ring cavity through a free-carrier-induced change in its refractive index. The 1,523 nm probe light, produced by an optical parametric oscillator, matched the original resonant frequency of the ring resonator and was attenuated to the single-photon power level. The researchers measured a conversion efficiency of more than 10% for wavelength shifts of around 0.3 nm, although they say this can be increased to 100% in principle. The observed wavelength shift at low photon numbers may have important implications for quantum information applications. *DP*

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