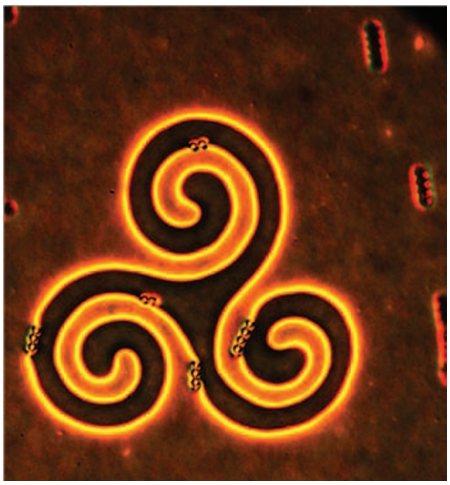
OPTICAL MANIPULATION

Large-scale control

Proc. Natl Acad. Sci. USA **108,** 20891–20896 (2011)



Most techniques for optically manipulating micro- and nanoparticles either rely on high laser powers, have complex designs, are appropriate only for small areas or require specific operating conditions. Angel Martinez and co-workers from the University of Colorado at Boulder and California State Polytechnic University in the USA have now shown that light-controlled surface monolayers containing azobenzene with derivatives of methyl red and a liquid-crystal suspending medium can be used to manipulate fluid-borne colloidal particles and structures over centimetre distances. The intensity of the light used in their technique is 1,000–100,000 times lower than that in conventional optical tweezers. By using a microdisplay and an objective lens to project light patterns onto the monolayer, the researchers show that they can rotate, translate, localize and assemble particles with different sizes, shapes and compositions suspended within a liquid-crystal host. The trick is to manipulate the liquid-crystal director and the overall elastic forces exerted on the colloids by the surrounding anisotropic fluid, which is achieved by controlling the surface boundary condition for the liquid crystals' alignment through the illumination of the azobenzene-based surface monolayers. *RW*

ENDOSCOPY

Nanoprobing

Nature Nanotechnol. http://dx.doi.org/10.1038/nnano.2011.226 (2011)

Ruoxue Yan and co-workers from the USA and South Korea have demonstrated a nanowire waveguide attached to the tapered tip of an optical fibre that can not only guide visible light into the intracellular compartments of a living mammalian cell, but also detect optical signals from subcellular regions with high spatial resolution. The nanowire endoscope can be optically coupled to either an excitation laser to function as a light source for subcellular imaging or a spectrometer to collect local optical signals. It is highly flexible and robust — both mechanically and optically — and can endure repeated bending and deformation during cell imaging. Light-activated mechanisms enable the endoscope to deliver intracellular cargo with high spatial and temporal resolution. Furthermore, the researchers say that insertion of the endoscope into cells and illumination of the guided laser do not induce any significant toxicity in the cells. *JB*

SEMICONDUCTORS

Short-period superlattice

Appl. Phys. Lett. **99,** 251112 (2011)

AlN and GaN — wurtzite group-III nitrides — are promising semiconductors for use in ultraviolet LEDs at wavelengths of 210–365 nm. To obtain high crystalline quality, scientists often grow AlGaN on a template such as sapphire or SiC, which ensures that the ultraviolet emitting surface is always perpendicular to the *c*-axis. Unfortunately, the light polarization of AlN-based LEDs is parallel to the *c*-axis. Yoshitaka Taniyasu and Makoto Kasu of NTT Basic Research Laboratories in Japan have now proposed the use of short-period superlattices to modify the polarization of the emitting light. The researchers first fabricated *c*-plane 30-period AlN/GaN superlattices by metalorganic vapour phase epitaxy. The AlN and GaN layers were 7 and 0.9–2.5 monolayers thick, respectively, and the quantized hole energy level was determined by the heavy-hole band of GaN. The transition between the electron and hole quantized energy levels was therefore allowed for electric fields perpendicular to the *c*-axis. The radiation angle dependence of photoluminescence from the AlN/GaN short-period superlattices showed a maximum intensity when parallel to the *c*-axis. *NH*

LIGHT SOURCES

Fibre 'black light'

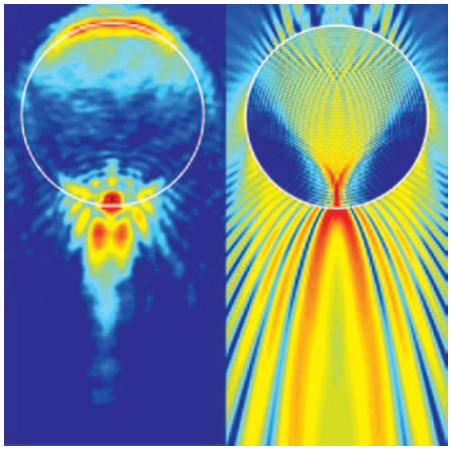
Opt. Lett. **37,** 130–132 (2012)

Scientists in France have developed a fibre-based source of 'black light' — a source that emits broadband ultraviolet radiation but only small amounts of visible light and no infrared light. Thibaut Sylvestre and colleagues from the Université de Franche-Comté and Université des Sciences et Technologies de Lille in France say that their black-light source could be useful for performing gas absorption spectroscopy or exciting various fluorescent proteins used in biological studies. The researchers made their source by pumping a specially designed silica photonic crystal fibre with 355 nm light pulses from a Q-switched frequency-tripled Nd:YAG laser. Four-wave mixing and cascaded Raman generation combine in the fibre to provide a broadband continuum output that spans from around 350 nm to 390–480 nm, with the exact spectral width dependent on the pump power. There is a sharp spectral cut-off beyond this point, with emission at longer wavelengths dropping to a negligible level. Solarization in the fibre causes the bandwidth and spectral power density of the continuum to decrease strongly after 20 minutes of operation. The researchers are now attempting to overcome this limitation by using alternative fibres that are more resistant to ultraviolet-induced damage. *OG*

LIGHT SCATTERING

Photonic nanojets

Opt. Express **20,** 128–140 (2012)



Photonic nanojets are scattered beams of light with a high-intensity main lobe, a weak sub-diffracting waist and a very low divergence angle. Such nanojets are expected to occur when light at optical frequencies is scattered by particles whose diameters are in the range of 1–10 μm. David McCloskey and co-workers from Trinity College in Dublin, Ireland, have now reported the formation of photonic nanojets using 400-nm-high planar disks with diameters of 1–10 μm made from Si_3N_4 on Si wafer covered with a 2-mm-thick layer of SiO_2. When illuminating the disk with a 633 nm plane wave, part of the light was scattered from the Si_3N_4–SiO_2 interface. The team observed an oval shape subwavelength spot on the surface of the disk and found good agreement between the intensity profiles obtained experimentally