LIQUID CRYSTALS

Self-assembled fibres

Opt. Express **21,** 30233–30242 (2013)

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A new class of liquid-crystal-based optical fibres have been fabricated by scientists in Germany and Slovenia. They grew the fibres by self-assembly in an immiscible water-based mixture containing a surfactant. The fibres consist of a series of coaxial, rolled-up layers of the liquid crystal 8CB, and are highly birefringent. The size of the fibres varies with the exact growing conditions, but the researchers say that they typically have a diameter ranging from a few micrometres to about 100 μm, and can reach several centimetres in length. The fibres were observed to guide light, and, when doped with a suitable dye such as Nile Red and optically pumped, they can lase as a result of the creation of whispering gallery modes. The threshold for laser operation was estimated to be 75 μW cm^{-2} with emission occurring at around 630 nm. The team says that such soft-matter structures formed from complex ordered fluids represent an exciting new family of photonic devices that can be grown and manipulated in a manner similar to living organisms. *OG*

WHITE LEDS

Ultrathin emissive layers

Appl. Phys. Express **6,** 122101 (2013)

Hybrid white organic light-emitting diodes (WOLEDs) commonly employ two emissive layers of different colours — one doped with blue fluorescent emitters and the other with green or red/orange phosphorescent emitters — to generate white light. They are highly promising light sources for display and lighting applications. Now, scientists based in Guangzhou, China, have realized high-performance hybrid WOLEDs that use ultrathin emissive layers. They found that the efficiency of their devices increases significantly as the emissive layers are made thinner. For example, a device with a 0.2-nm-thick phosphorescent emissive layer exhibited a high power efficiency of 7.3 lm W^{-1} and a high luminance of 46,923 cd m^{-2}. In addition, its efficiency dropped very little as the current density was increased. A second hybrid WOLED in which both the blue and orange emissive layers were thinner than 1 nm had an even higher efficiency of 8.9 lm W^{-1} as well as a low driving voltage and a high colour-rendering index of 75. *SP*

DISPLAYS

Wide-angle head-up display

Appl. Opt. **53,** A121–A124 (2014)

Head-up displays are widely used in the aviation industry to display important information on the cockpit windows of aircraft, reducing the need for pilots to look down to read instruments. The same approach is also being considered for use in road vehicles to improve road safety. Most head-up displays reflect light into the user's eyes, but this method produces ghost images as the result of multiple reflections. Now, researchers in Taiwan have produced a design for a head-up display that instead uses scatter to display the image and offers a large viewing angle. The scatterers consist of a regular array of narrow Al_2O_3 columns that are fabricated by using a combination of atomic-layer deposition and electron-beam evaporation to deposit Al_2O_3 on a template of hollow nanospheres. Like conventional head-up displays, this display still requires drivers to adjust the focal distance of their eyes to read the information. *SP*

QUANTUM OPTICS

Nondestructive detection

Science **342,** 1349–1351 (2013)

Optical detectors usually annihilate a photon on detection, with the photon being absorbed by the detector material. However, Andreas Reiserer and co-workers from the Max-Planck-Institut für Quantenoptik in Germany have now demonstrated a novel non-destructive scheme for detecting photons. The photon detector consists of a Fabry–Pérot resonator containing a single trapped ^{87}Rb atom. The cavity induces strong coupling between a light pulse and the atom when it is one of two states, but not when the atom is in the other state. These atomic states are controlled by Raman lasers. When the atom is not coupled to the incoming light, the photon enters the cavity before being reflected. Although there is no atom–photon interaction, the photon induces a phase shift of π in the state of the atom. In contrast, when the atom is coupled, the photon is reflected without entering the cavity, and hence it does not induce a phase shift. By reading out the atomic phase, it is possible to detect a photon without it being absorbed. This detector achieved a single-photon detection efficiency of 74%. *NH*

METAMATERIALS

Nanoantenna holography

Nature Commun. **4,** 2808 (2013)

Metasurfaces — engineered monolayers with custom-designed optical properties — offer a new medium for performing high-resolution holography, according to Lingling Huang and a team of researchers from the UK, China, Germany and Singapore. They report how metasurfaces composed of an array of subwavelength metallic nanoantennas are proving valuable for performing three-dimensional holography at visible and near-infrared wavelengths. The nanoantennas serve as pixels, and their orientation angle stores the phase information needed to recreate the hologram. Experiments were performed with an array of gold antennas that had dimensions of 150 × 75 nm^2. The information required to create a three-dimensional airplane model that was a few hundred micrometres in size was stored in the orientation of the antennas during fabrication of the metasurface hologram. The hologram consisted of 800 × 800 pixels, and had a lattice constant of 500 nm. The images were reconstructed at wavelengths of 670 nm, 810 nm and 950 nm. Importantly, the use of a metasurface eliminated the undesirable effect of multiple diffraction orders that usually accompany holography. *NH*

OPTICAL SWITCHES

Photochromic gate

Appl. Phys. Lett. **103,** 221115 (2013)

Martti Pärs and colleagues from the University of Bayreuth in Germany have fabricated an optical gate for controlling the fluorescence emitted from a chromophore. This approach allows the emission of millions of photons to be modulated by the absorption of just tens of photons. It relies on creating a molecular triad that combines two fluorescent molecules of perylene