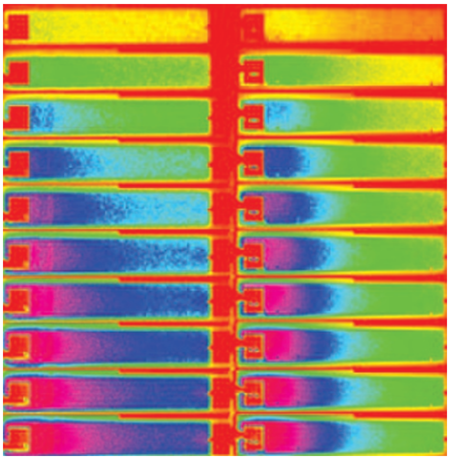
LIGHT-EMITTING DIODES

Indium-free alternative

Opt. Express **20,** A13–A19 (2012)



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Indium tin oxide (ITO) is widely used as the transparent conductive material in LEDs because of its excellent conductivity and high transparency to visible light. However, ITO is expensive and many improvements can still be made to the transparent layer. Arthur Reading and co-workers from the University of California at Santa Barbara in the USA have found that ZnO — a cheap, highly transparent and highly conductive alternative material — offers improved series resistance, external quantum efficiency and luminous efficacy over its ITO counterpart. The team deposited heteroepitaxial ZnO transparent current-spreading layers with low sheet resistances on GaN-based LEDs using aqueous solution phase epitaxy at temperatures below 90 °C. They measured luminous efficacies of 157 lm W^{-1} at 0.5 A cm^{-2} and 84.8 lm W^{-1} at 35 A cm^{-2}, which are 24% and 50%, respectively, higher than LEDs that exploit ITO. The researchers attribute these improvements to the lower sheet resistance and lower optical absorption of the ZnO layer, which together minimize current crowding and allow more light to escape from the LED dye. *RW*

OPTOFLUIDICS

On-chip aerosol trap

Lab Chip **12,** 295–301 (2012)

Compact and robust optofluidic devices for the *in situ* characterization of single airborne particles — aerosols — are highly desirable for studying fundamental processes in physics and physical chemistry on a microscopic scale. However, past efforts have focused primarily on droplets and particles immersed in liquids, leaving optofluidic research into aerosols still in its infancy. Marcel Horstmann and co-workers at the Westfälische Wilhelms-Universität Münster in Germany have now presented a chip-integrated optical trapping system that allows single aerosol particles measuring 0.5–19 μm in diameter to be manipulated and spectroscopically characterized using cavity-enhanced Raman spectroscopy. The system consists of an injection chamber and a sample chamber connected by a light-guiding glass capillary, two fibre-delivered laser beams forming a counter-propagating beam trap, and a multimode fibre to collect the Raman-scattered light. Single aerosol particles drifting into the beam inside the injection chamber are propelled through the capillary into the sample chamber by radiation pressure. The researchers showed that the droplets can be translated along the fibre axis by adjusting the ratio of the laser powers, and that the two-dimensional manipulation of multiple particles is possible with additional optical tweezers. The researchers say that the possibility to integrate multiple chambers with different atmospheric conditions on a single chip will allow the study of reactions between selectively prepared particles. *JB*

OPTICAL COHERENCE TOMOGRAPHY

Tunable for medicine

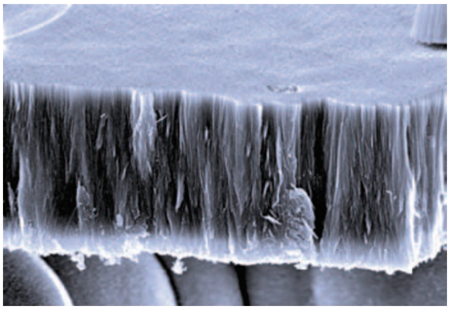
IEEE J. Quant. Electron. http://dx.doi.org/10.1109/jqe.2011.2165317 (2011)

Optical coherence tomography (OCT) is a medical imaging technique that provides information about an object by analysing the coherence of reflected light. OCT devices containing fixed reference mirrors are simpler and require less power than those exploiting moving reference mirrors, albeit with the need for a tunable laser. Bauke Tilma and colleagues have now designed and characterized a monolithically integrated tunable laser containing quantum-dot amplifiers, phase modulators and passive components for use in medical OCT. The device operates at a central wavelength of 1,700 nm, which reduces absorption due to water in human tissue and minimizes Rayleigh scattering. The tuning bandwidth of more than 100 nm is the largest hitherto demonstrated for an arrayed waveguide-grating-controlled tunable laser, and the device's linewidth of less than 0.07 nm provides the 6 mm coherence length necessary for medical imaging. In addition, this device demonstrates that the active–passive integration technology designed for the 1,550 nm telecommunications wavelength region can also be used in the 1,600–1,800 nm range. *JB*

PHOTOCHEMISTRY

Visible photocatalysis

Nano Lett. **12,** 26–32 (2012)



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Titanium dioxide (TiO_2), a material used throughout a wide range of photoelectrochemical devices, responds mainly to the ultraviolet portion of the solar spectrum, owing to its large bandgap of around 3 eV. Son Hoang and colleagues from the University of Texas at Austin in the USA have now managed to shift the absorption range of TiO_2 to visible wavelengths of around 520 nm. The researchers used a hydrothermal synthesis technique to fabricate TiO_2 wires with feature sizes of 5 nm and lengths of up to 4.4 μm. Visible light activity was enabled by nitridation of the nanowire arrays in NH_3 at lower temperatures than in previous approaches. The incident photon conversion efficiency was approximately 5% at 420 nm and 1% at 520 nm. Although this is an improvement in the visible regime, the ultraviolet response peak of around 45% at 340 nm is lower than in previous work. However, the researchers suggest that the ultraviolet response can be restored or even improved with the use of a cobalt water oxidation co-catalyst. Cobalt-treated $TiO_{1.957}N_{0.043}$ yielded an incident photon conversion efficiency of around 86% at 340 nm and 18% at 420–460 nm. *DP*

PHOTONIC CRYSTAL LASERS

Long CW operation

Appl. Phys. Express **4,** 122101 (2011)

Scientists from Seoul National University and the Korea Photonics Technology Institute in Gwangju have demonstrated the continuous-wave (CW) operation of a 1,550 nm photonic crystal laser for a duration of 18 hours. The researchers say that the achievement was made possible by the use of an efficient heat-dissipating submount comprised of silicon, diamond, MgF_2 and an additional MgF_2 confinement layer on the top surface of the device. Heat generated in the structure's light-emitting InGaAsP multi-quantum wells passed through to the 2-μm-thick