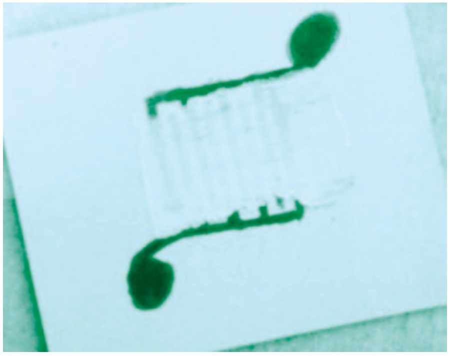
SENSORS

Paper and pencil

Appl. Phys. Lett. **100,** 211104 (2012)



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Paper and pencil — long-valued tools for writers and artists — may also have unexpectedly useful applications in optoelectronics. Kamran ul Hasan and co-workers from Linköping University in Sweden have developed a paper-based ultraviolet-light sensor by printing an ink containing ZnO nanocrystals onto paper covered with pencil-drawn graphite electrodes. Illuminating the paper with 365 nm ultraviolet light generates electron–hole pairs, causing a rapid rise in photocurrent followed by a slow fall once the light is switched off. The researchers say that their sensor, despite being highly economical and easy to fabricate, demonstrates characteristics comparable to those made through more expensive and complex techniques. Experiments suggest that the use of a 4B pencil creates the best graphite electrodes, with a line resistance of around 3 MΩ. *OG*

WAVEGUIDES

Metal-filled fibres

Opt. Lett. **37,** 2946–2948 (2012)

Ho Wai Lee and colleagues from the Max Planck Institute for the Science of Light in Germany have observed strong splitting of optical modes in photonic crystal fibres containing metals. The researchers started with single-mode silica photonic crystal fibres whose holes measured ~1 μm in diameter and were spaced by ~3 μm. They then filled one or two holes with gold and illuminated the fibre with broadband 400–1,700 nm light from a supercontinuum source. Coupling to modes in the metal caused dips in the transmission spectrum, owing to increased loss associated with plasmon damping. The researchers also observed a single 'loss peak' for a fibre containing a single metal-filled hole, but two peaks for a fibre containing two metal-filled holes, for appropriate polarizations of light. This splitting is due to the possibility of symmetric and antisymmetric mode combinations, which has been observed previously in waveguides and other systems. Large splitting of up to 100 nm was possible for some polarizations, but for other polarizations the splitting was too small to be observed in the presence of the resonance broadening due to plasmon-related damping. *DP*

COLOURIMETRY

Combinatorial wetting

Lab Chip http://dx.doi.org/10.1039/c2lc40489c (2012)

Colourimetry is a simple and low-cost technique for determining the concentration of coloured compounds in a solution. Although some properties of a compound can result in a colour change in an indicator material, coupling a colourimetric response that is sensitive to a general physical or chemical property is much more of a challenge. Ian Burgess and co-workers from Canada and the USA have now demonstrated a simple colourimetric litmus test for differentiating organic liquids. The test achieves chemical specificity by employing a combination of colourimetric wetting patterns produced from liquids in an array of inverse opal films, each having a graded wettability but using different surface groups to define the wetting gradient. The widespread applicability of this sensing platform is due to its sensitivity to wettability, which is a property of all liquids. A simple-to-use reference-based scoring system allows qualitatively perceptible degrees of wetting to be translated into numerical values, which can then be assigned by eye without the need for sophisticated equipment. This provides chemical specificity without causing a significant sacrifice in terms of portability or ease of use. *JB*

PHOTODETECTORS

Cerium fluoride UV detector

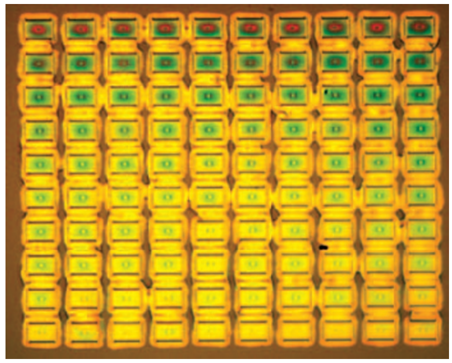
Jpn. J. Appl. Phys. **51,** 062202 (2012)

The Earth's atmosphere absorbs most ultraviolet (UV) light below a wavelength of 280 nm. As a result, short-wavelength UV light can be captured during flame luminescence experiments without problems associated with background radiation. Wide-bandgap materials such as GaN, ZnO and diamond are typically used to detect weak flame luminescence, but fabricating large detectors from such materials is a significant challenge. Mirai Ieda and co-workers in Japan have now shown that CeF_3 thin films could be an attractive alternative. They began by depositing CeF_3 thin films on quartz glass substrates by pulsed laser deposition using third-harmonic (355 nm) light from an Nd:YAG laser. A laser fluence of 20 J cm^{-2} was sufficient to evaporate CeF_3, whose melting point is 1,597 K. The film, which was grown at a substrate temperature of 670 K, exhibited transmission of around 30% at a wavelength of 300 nm. The researchers investigated the film's current–voltage characteristics using light from a mercury lamp at a power density of 12 mW cm^{-2}. At an applied bias of 600 V, the dark current was 0.32 nA and the photocurrent was 0.54 nA. Changing the substrate temperature to either 470 K or 870 K caused a decrease in photoconductivity due to crystalline degradation. *NH*

PHOTONIC CRYSTALS

Spectrometer success

Appl. Phys. Lett. **100,** 231104 (2012)



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Scientists in Germany and the USA have fabricated a miniature high-resolution spectrometer based on a planar array of GaP photonic crystal cavities. Each cavity outcouples light of a specific resonant wavelength to a photodetector, thus allowing the spectral signature of incoming light in a waveguide to be determined. Although this proof-of-principle device is based on a 3 × 3 or 10 × 10 array of cavities, scaling the design to match a megapixel detector array should be possible, allowing millions of wavelength channels to be monitored simultaneously. The device operates in the near-infrared around 840 nm and has a resolution of 0.3 nm. However, the researchers say that improving the fabrication quality should provide an order of magnitude increase in resolution. The design could also be extended to operation in either the visible or deep-infrared. The absence of any moving parts and the small size of the device (each photonic crystal cavity has lateral dimensions of just a few micrometres) means that it could be appealing as a tool for convenient chemical and biological analysis. *OG*

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