ART CONSERVATION

Quasi-reflectography

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Light is a powerful, versatile and attractive tool for art conservation, as measurements are non-invasive and can be highly sensitive. 'Enhanced' visual techniques such as infrared reflectography involve broadband imaging in spectral regions other than the visible, and can reveal underlying features in a painting. By reversing the basic concept of thermography, in which infrared radiation emitted from a surface provides a measure of temperature, Dario Ambrosini and co-workers in Italy have developed a new non-contact imaging tool called thermal quasi-reflectography. Their technique involves measuring the mid-infrared light (3–5 μm) reflected from a painting's surface, and requires only a mid-infrared camera and a light source, such as a low-cost halogen lamp. The recorded infrared radiation is dominated by the energy reflected from the material's surface, which is strongly related to its surface properties. The researchers tested their technique on two famous artworks: the Zavattari's frescoes in the Chapel of Theodelinda; and Piero della Francesca's 'The Resurrection'. In both cases, thermal quasi-reflectography provided good pigment differentiation, selective mapping of gold and silver decorations and clearer retouch identification than near-infrared reflectography. *JB*

NONLINEAR OPTICS

Negative-frequency mode

Phys. Rev. Lett. **108,** 253901 (2012)

Optical solitons and soliton-like pulses can blue-shift light through a process called resonant energy transfer. Eleonora Rubino and co-workers from Italy and the UK have now predicted that a second blue-shifted propagating mode, known as negative resonant radiation, can be created by coupling the soliton mode to the negative-frequency branch of the material's dispersion relation. The researchers performed two sets of experiments to explore the formation of this new mode: one using a 2-cm-long sample of bulk CaF_2, which exhibited extremely low dispersion in the ultraviolet spectral region; and another using a 5-mm-long photonic crystal fibre to enhance nonlinear optical effects due to tight mode confinement, thus achieving anomalous group-velocity dispersion. As the researchers predicted, femtosecond pulses with a central wavelength of 800 nm were able to generate negative resonant radiation at a wavelength of around 340 nm in CaF_2 and 230 nm in photonic crystal fibre — both of which are much shorter than those of the resonant radiation mode. *NH*

OPTOFLUIDICS

Reconfigurable cavities

Appl. Phys. Lett. **100,** 261107 (2012)

Noud Speijcken and co-workers from The Netherlands and Australia have developed a two-dimensional photonic crystal cavity that has a liquid-induced reversible tuning range. The structure, which is based on hexagonal photonic crystals in 220-nm-thick InGaAsP membranes, has a cavity resonance that can be tuned over 50 nm on a timescale of seconds to minutes by controlling the amount and location of an injected oil. The researchers focused a 660 nm laser to a 2 μm spot on a photonic crystal cavity comprised of six holes arranged in a hexagonal pattern. They investigated the fluid-induced cavity modes by analysing the photoluminescence spectrum around 1,500 nm emitted from InAs quantum dots grown in the membranes. The cavity resonance in the case of complete infiltration was red-shifted by 50 nm with respect to that of the non-infiltrated sample. They successfully reconfigured the position of the oil-infiltrated holes by using the focused laser spot to induce local heating. A laser power of around 0.5 mW was sufficient to evaporate the oil from the membrane. The researchers observed characteristic signs of re-infiltration in the cavity resonance when moving the focal spot slowly from the cavity centre towards the boundary. *NH*

PLASMONICS

Photorefractive control

Opt. Lett. **37,** 2436–2438 (2012)

Stephen Abbott and co-workers from the University of Southampton in the UK have demonstrated that the surface plasmon–polariton (SPP) modes in a liquid-crystal cell can be controlled using the photorefractive effect. By interfering two light beams at the cell to create a light grating (a periodic modulation of the liquid-crystal's refractive index profile along the cell), the researchers successfully coupled energy between two 1.03 eV SPP modes with an efficiency of around 25.3%. Their set-up comprised a hybrid liquid-crystal system — a liquid-crystal layer combined with a 100-nm-thick photoconductive layer — in between a polyimide-coated indium tin oxide glass substrate and a 40-nm-thick gold layer. They used two 532 nm coherent, equal power, collimated 1-mm-diameter beams with a variable separation angle to generate the interference pattern and thus induce SPP–SPP coupling, which was observed by applying a d.c. potential across the indium tin oxide and gold layers. *RW*

SEMICONDUCTOR LASERS

A steady sweep

Electron. Lett. **48,** 867–869 (2012)

For swept source optical coherence tomography and high-speed transient spectroscopy, micro-electromechanical-systems-based vertical-cavity surface-emitting lasers (MEMS-VCSELs) are an appealing optical source owing to their narrow linewidth, continuous single-mode tuning and high-speed tunability. In particular, a wide tuning range (>100 nm) near 1,310 nm would be extremely useful for vascular and cancer imaging. Now, Vijaysekhar Jayaraman and colleagues in the USA have realized a MEMS-VCSEL that offers a continuous tuning range of 150 nm around a wavelength of 1,310 nm. The trick is to form a laser microcavity with a thin wide-gain-bandwidth InP-based multi-quantum-well active region and a wideband GaAs-based fully oxidized mirror. To enable the tuning, the researchers placed a suspended dielectric mirror on top of the cavity. When pumped at 980 nm through the suspended mirror, the MEMS-VCSEL emitted 1,310 nm light from the same side of the device. Applying a static voltage of around 56 V allowed for continuous tuning over a 150 nm span at a repetition rate of 500 kHz. The researchers say that the applications of this device can extend beyond swept source optical coherence tomography to transient spectroscopy for combustion monitoring and engine thermometry. *RW*