INTERFEROMETRY

Gravitational phase shift

New J. Phys. http://doi.org/b2tw (2017)

The study of gravitational effects on a single photon is potentially important because it could verify the equivalence between the energy of a single photon and its effective gravitational mass. Unfortunately, given that the gravitational effect is so small such an experiment would require interferometers with arm lengths of a few thousand kilometres in order to be measured. Now, Christopher Hilweg and co-workers from the University of Vienna, Austria and Massachusetts Institute of Technology in the USA have proposed a table-top, fibre-based experimental scheme to tackle the task. The scheme consists of a rotatable three-arm Mach–Zehnder interferometer. To observe a phase shift on the order of 10^{-5} radians for photons at 1,550 nm, each arm had an optical fibre spool containing 100 km of fibre. The interferometry is performed at rotations about an axis parallel to the arms to measure different gravitational potential differences as well as to calibrate the interferometer in the horizontal position. *NH*

BIOMEDICAL OPTICS

Blood monitoring

Nat. Biomed. Eng. **1,** 0028 (2017)

An optical system for real-time monitoring of blood coagulability during medical operations has been developed by scientists in the US. Jose Rafael Guzman-Sepulveda and colleagues at the University of Central Florida developed and tested a fibre-based light-scattering technique that analyses the backscattered signal from blood. Plots of power spectral density versus frequency reveal different signatures for normal coagulation and anticoagulation of blood when anti-clotting agents such as heparin are administered. Light from a 670-nm-wavelength super-luminescent diode with 40 nm bandwidth is sent to the sample via an optical fibre. As a preliminary test, the team tried the approach on hydrogels with nanoparticles, before moving to blood, in which red blood cells dominate scattering properties. The approach allows coagulability to be monitored continuously in real time without special sample preparation in a clinical setting. *DP*

OPTICAL COMMUNICATIONS

Gigabit lighting link

Sci. Rep. **7,** 11 (2017)

Colour mixing of light from red, green and blue laser diodes has enabled the demonstration of an indoor white lighting communication link that can operate at data transmission speeds approaching 10 Gbit s^{-1}. The concept of visible light communication, whereby solid-state lighting is used for the dual purposes of illumination and data communication, has become a highly active topic of research in recent years. However, to date, most demonstrations have made use of LEDs as the light source, which severely limits the speed of the data link due to their broad spectral emission, poor directionality and low coherence. Researchers from National Taiwan University in Taipei have now designed and tested a scheme that overcomes these limitations by combining the output from red, green and blue laser diodes using dichroic mirrors to create white light. The drive current to each laser diode is modulated to create a wavelength-division-multiplexed, white-visible-light communication system that can transmit at a data rate of 8.8 Gbit s^{-1} over a distance of 0.5 m in free space. In terms of illumination, the white light from the system has a colour temperature of 8,382 K and a luminance of 7,540 lux. *OG*

IMAGING

Gas leak detection

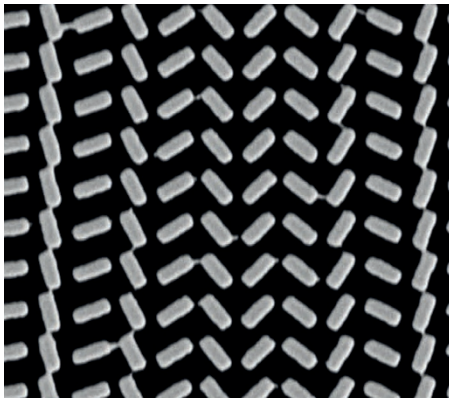
Opt. Express **25,** 2998–3005 (2017)

The ability to image the presence of invisible gases has applications in industrial and environmental monitoring settings. Now, Graham Gibson and co-workers from the University of Glasgow and M Squared Lasers Ltd, UK have developed a real-time imaging system for gas leak detection based on a single-pixel detector and structured illumination. Light from an InGaAs laser diode was sent to a scene containing a methane gas cell with two tubes to collect any gas leaks. A set of orthogonal mask patterns and their corresponding inverse patterns were generated by a high-speed digital micromirror device (DMD). The total intensity of the backscattered laser light from the scene was detected by an InGaAs photodiode that was synchronized with the the DMD. For every alternative reconstruction frame, the wavelength of the laser diode was electrically tuned away from the methane absorption transition at 1.651 μm. By taking the difference of the single-pixel intensity measurement between alternate frames, images were obtained of the gas only. The gas image information was aligned and overlaid on images from a high-resolution, colour CMOS camera. Images with an effective 16 × 16 pixel resolution could be reconstructed at a frame rate of 25 Hz, allowing the source of the leak to be easily identified. *NH*

METASURFACES

Chiral spectrometer

APL Photon. **2,** 036103 (2017)



Spectrometers have fixed spectral resolution and cannot usually distinguish between different types of circularly polarized light without the aid of additional optical elements. Exploiting metasurface technologies, Alexander Zhu and co-workers from Harvard University in the USA and the University of Waterloo in Canada have now demonstrated a compact spectrometer comprising multiple planar off-axis meta-lenses and a CMOS camera that features helicity-resolving capability. The meta-lenses are essentially meta-gratings made of TiO_2 nanofins on a glass substrate acting as birefringent waveguides. The researchers integrate several off-axis meta-lenses on the same substrate to provide spatially separated focal spots. Because of the different numerical apertures used, each meta-lens possesses different spectral resolutions and ranges, and selectively focuses light with opposite circular polarization states. Combining the functions of focusing and dispersive elements in a single planar structure and using dielectric TiO_2 as the working material, which is compatible with the existing CMOS processes, the meta-spectrometer can be made within an area less than 2 × 1 cm^2 and at large scale for potential applications in healthcare and environmental sensing. *RW*

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