PHOTOACOUSTICS

Laser streaming

Sci. Adv. **3**, e1700555 (2017)

The speed, direction and flow of a liquid suspension of gold nanoparticles can be controlled by a laser beam. That's the finding of a team of scientists from China and the US. Yanan Wang and co-workers discovered that when a focused spot of laser light is shone onto the window of a glass cuvette containing an aqueous solution of gold nanoparticles a flow will commence after a few minutes. Investigations indicate that the flow is driven by a photoacoustic interaction between the pulsed laser light (150 ns pulse duration, 1 kHz repetition rate and 527 nm wavelength) and the nanoparticles that establishes a long-lasting ultrasound wave. The effect called 'laser streaming' appears to have a laser power threshold and disappears for a power below 60 mW. The maximum speed of the flow is estimated to be around 4 cm s^{-1} for a laser power of 120 mW, which is more than sufficient for many applications in microfluidics. Fluorescent polymer microspheres were added to the solution to visualize the flow. The researchers believe that following optimization and further refinement the laser streaming could be useful for applications such as laser propulsion, surgery and chemical mixing. *OG*

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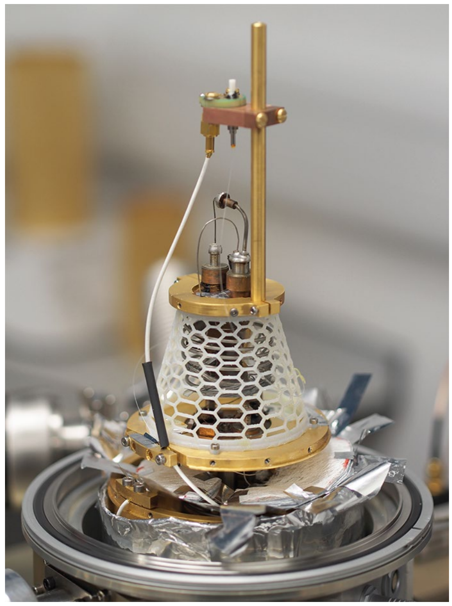
DETECTORS

Practical photon counting

Supercond. Sci. Technol. **30**, 11LT01 (2017)



Credit: Robert Hadfield, University of Glasgow

Superconducting single-photon detectors have emerged over the past decade as the gold standard for infrared photon counting, enabling important achievements in quantum optics, space-to-ground communication and long-range remote sensing. However, these sought after devices operate just a few degrees above absolute zero and such low temperatures are challenging to achieve outside of the laboratory. Researchers at the University of Glasgow and Rutherford Appleton Laboratory UK have now adapted a miniaturized cooler first developed for space missions to house a fibre-optic-coupled superconducting detector, provided by the Dutch start-up Single Quantum BV. The packaged system offers a detection efficiency of 10% at a wavelength of 1,310 nm. The cooling to a temperature of 4 K is achieved through the use of three cold finger stages. A first Stirling stage reduces temperature to ~170 K, a second to 20 K and finally a Joule–Thompson stage takes the device to 4 K. The convenience and capabilities of the device have been shown in a range of infrared photon-counting demonstrations, including time-of-flight ranging and dose monitoring for laser cancer treatment. *OG*

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SILICON PHOTONICS

Reconfigurable chips

Light Sci. Appl. **6**, e17053 (2017)

Integrated photonic circuits typically rely on fixed waveguides to route light around a chip, but it can be desirable to have more flexibility and dynamic control over the routing opportunities. Now, Carlos García-Meca, Sergio Lechago and colleagues from the Universitat Politècnica de València in Spain have done away with conventional interconnecting waveguides, demonstrating reconfigurable 'optical wireless' links between ports on an integrated optical chip. The approach makes use of silicon nanoantennas with high directivity and thermo-optical tuning to provide the reconfigurability. The antennas are formed by a taper and an arrangement of rectangular director bars to enhance directivity. A simple two-director geometry with a directivity of 114 was deemed sufficient for many applications. The concept allows broadband operation with a −3 dB bandwidth of over 900 nm around the 1,550 nm telecommunications window. In experiments, cross-talk was low enough to allow transmission of 160 Gb s^{-1} over a 100-μm-long free-space link by using four channels to simultaneously transmit at 40 Gb s^{-1}. Another set-up, with 100-nm-thick titanium heater elements, exploited the thermo-optic effect to shift phase and allow beam steering from a four-element phased-array antenna. The team were able to steer the beam in a 30° window (−3 dB), allowing switching between 100-μm links with switching time and power of 5.2 μs and 8.3 mW, respectively. *DFPP*

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PLASMONICS

Photoswitches

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Devices designed for continuous monitoring of light typically need to remain 'on' and consume electrical power. However, for some applications, such as remote battery-powered sensors for detecting infrequent events like fires or earthquakes, it would be useful to conserve power, and only switch on the detector when a relevant event is occurring. Now, Zhenyun Qian and a team at Northeastern University in the USA have done just that and demonstrated an infrared digitizing sensor that becomes active only when light of a particular wavelength impinges on the device.

The detector system makes use of plasmonics to actuate a micromechanical switch, with the incoming light 'powering' a micromechanical relay and activating the system. The structure relies on microcantilevers with thermally sensitive bimaterial legs that actuate on heating. Heating is generated by the incident light, via the generation of plasmons on a metallic array whose intrinsic absorption losses result in a change of temperature and mechanical displacement enabling the relay switch. For the scheme to work, absorption and losses are deliberately maximized in the structure with 50-nm-thick Au patches, a 100-nm-thick SiO_2 spacer layer and a 100-nm-thick Pt metal reflector. The set-up is naturally wavelength-selective and different regions of the spectrum can be targeted by adjusting the structural geometry of the absorber. The digitized output from the device is produced at mid-infrared frequencies when incident power is above ~500 nW. *DFPP*

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Oliver Graydon and David F. P. Pile