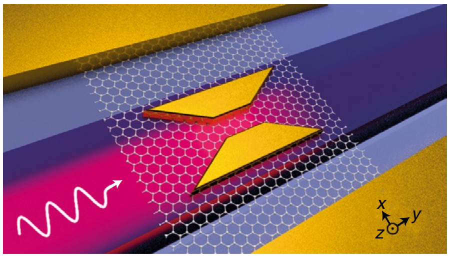
PHOTODETECTORS

Graphene gets gap plasmons

ACS Photon. https://doi.org/cx9z (2018)



Credit: American Chemical Society

Ping Ma, Yannick Salamin and colleagues at ETH Zurich, Switzerland have demonstrated a waveguide-integrated graphene photodetector that is both fast and responsive. The device uses a 6-μm-long layer of graphene with a series of bowtie metallic structures to enable plasmonically enhanced absorption, resulting in a device with an external responsivity of 0.5 A W^{-1} and a photoresponse of up to 110 GHz. The device's improved performance is a result of several factors. First, there is the enhancement at the interface of the metal and dielectric, typical for surface plasmons. Second, the structure also features tapered gaps between the metallic halves of each nanostructure, which focuses two-dimensionally localized gap plasmons. Finally, the structures have a bowtie shape with a narrow central gap between the entry and exit tapers. *DFPP*

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METAMATERIALS

Broadband achromatic lens

Light Sci. Appl. **7**, 85 (2018)

Polarization-independent, achromatic metalenses that operate across a broad window in the near-infrared have been developed and tested by Sajan Shrestha and co-workers from Columbia University and Brookhaven National Laboratory in the USA. The key innovation behind the design of the lenses is the use of suitable meta-units — the building blocks of metasurfaces — to provide diverse phase dispersions. As a proof-of-principle demonstration, a dielectric metasurface platform of amorphous silicon nanostructures on a quartz substrate was employed. Based on the numerical simulation of the phase dispersion for each meta-unit, metalenses composed of the three meta-units, singular pillers, annular pillars and concentric pillars with a height of 1,400 nm, were built. The lenses were experimentally characterized by passing a tunable beam from a supercontinuum laser source through a monochrometer and to the metalens. The three-dimensional intensity distribution around the focal point was then measured by acquiring a stack of two-dimensional images at different distances from the metalens. A focused beam diameter of 200 μm was consistently obtained at a focal distance of 800 μm (numerical aperture of about 0.13) over the wavelength range of 1,200–1,650 nm. The beam diameter was nearly diffraction-limited with no obvious distortion. *NH*

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NANOPHOTONICS

Strain-tunable dots

Nano Lett. **18**, 7969–7976 (2018)

Quantum dots (QDs) are promising light sources for on-chip quantum photonic circuits because they can generate near-ideal single photons. However, precise control over the spatial position and emission wavelength of QDs is still a challenge. To address these issues, Ali Elshaari and co-workers from Switzerland, The Netherlands, China and Canada have now developed a waveguide-coupled nanowire single-photon source. To tune the emission wavelength by strain, a Si_3N_4/SiO_2 (core/clad) waveguide was fabricated on a 300-μm-thick piezoelectric crystal composed of lead magnesium niobate–lead titanate (PMN–PT) that is connected to Cr/Au electrodes. Preselected InAsP/InP nanowire QDs were then transferred onto the Si_3N_4 layer using a nanomanipulator with a positional accuracy of within 500 nm. The thicknesses of the Si_3N_4 and SiO_2 layers were 230 nm and 2 μm, respectively. The QDs were cooled at 5.8 K and excited non-resonantly at 795 nm. When the piezovoltage was tuned from −600 to +600 V, the wavelength of the emitted single photons was linearly tuned around 885 nm by up to 0.39 nm. The tuning range was increased to 1.6 nm by depositing additional layers of Si_3N_4 and SiO_2 onto the nanowire. *NH*

https://doi.org/10.1038/s41566-019-0353-2

EXTREME-ULTRAVIOLET LIGHT

Gas optics

Nature **564**, 91–94 (2018)

Inhomogeneous gas jets rather than solids may provide an answer to the tricky question of how to make refractive optical elements that operate in the extreme-ultraviolet (XUV) region. Unlike the visible and infrared regions where glass and plastic elements can be used to manipulate light beams, in the EUV region the strong absorption of most materials prevents this from being feasible. Now, a team of scientists from the Max-Born-Institut in Berlin, Germany have shown that helium and argon gas jets with a graded density profile can be used to make prisms and lenses for XUV light. The precise value of the deflection angle of a gas prism or the focal length of a gas lens can be controlled by the pressure of the gas jet, with increasing pressure yielding a stronger element, and the team demonstrates focal spots as small as a few tens of micrometres. Furthermore, as the gas is constantly replenished these XUV elements are immune to laser-induced damage. *OG*

https://doi.org/10.1038/s41566-019-0354-1

STRUCTURED LIGHT

Tunable quantum interference

Phys. Rev. Lett. **122**, 013601 (2019)

Vector beams, in particular vector vortex beams, have recently found many applications because of their unusual focusing and symmetry properties. However, to maximize their potential for use in quantum optics, control over two-photon quantum interference between these beams is important, especially for applications such as quantum communication, sensing and metrology. Now, Vincenzo D'Ambrosio and colleagues from Spain and Italy have demonstrated that a q-plate made of an inhomogeneous liquid-crystal slab can provide tunable quantum interference for such beams. The team tune the birefringent phase shift of the q-plate via an externally controlled voltage and an offset angle (in this experiment, 0 and $\varpi/4$) to modify the amount of quantum interference between the two structured photons and also control the quantum phase in the output state. *RW*

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Oliver Graydon, Noriaki Horiuchi, David F. P. Pile and Rachel Won