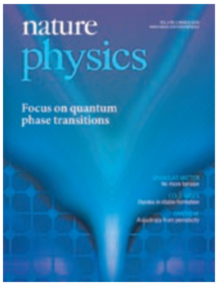
A round-up of recent papers in the field of photonics published by the physical sciences division of the Nature Publishing Group.



X-ray-scattering information obtained from near-field speckle

Nature Phys. **4,** 238–243 (2008)

Whenever coherent radiation impinges on a scattering object, a speckled intensity pattern is produced. In the far field the speckle size and shape do not mirror any properties of the object. Here we show that, in spite of the limited spatial coherence of synchrotron radiation, speckles with remarkable properties can be observed when the sensor is placed in the near field. The statistical analysis of these speckles generates static and dynamic X-ray-scattering data, and the results from two typical scattering samples are given. When compared with conventional far-field techniques, the method enables a substantial increase of around four orders of magnitude in the beam size and power and opens the way to a previously inaccessible region of scattering angles.

An updatable holographic three-dimensional display

Nature **451,** 694–698 (2008)

Holographic three-dimensional (3D) displays provide realistic images without the need for special eyewear, making them valuable tools for applications that require situational awareness, such as medical, industrial and military imaging. Currently commercially available holographic 3D displays use photopolymers that lack image-updating capability, resulting in restricted use and high cost. Photorefractive polymers are dynamic holographic recording materials that allow updating of images and have a wide range of applications, including optical correlation, imaging through scattering media and optical communication. To be suitable for 3D displays, photorefractive polymers need to have nearly 100% diffraction efficiency, fast writing time, hours of image persistence, rapid erasure, and large area—a combination of properties that has not been shown before. Here, we report an updatable holographic 3D display based on photorefractive polymers with such properties, capable of recording and displaying new images every few minutes. This is the largest photorefractive 3D display to date (4 × 4 inches in size); it can be recorded within a few minutes, viewed for several hours without the need for refreshing, and can be completely erased and updated with new images when desired.

Classification and control of the origin of photoluminescence from Si nanocrystals

Nature Nanotech. **3,** 174–178 (2008)

Silicon dominates the electronics industry, but its poor optical properties mean that III–V compound semiconductors are preferred for photonics applications. Photoluminescence at visible wavelengths was observed from porous Si at room temperature in 1990, but the origin of these photons (do they arise from highly localized defect states or quantum confinement effects?) has been the subject of intense debate ever since. Attention has subsequently shifted from porous Si to Si nanocrystals, but the same fundamental question about the origin of the photoluminescence has remained. Here we show, based on measurements in high magnetic fields, that defects are the dominant source of light from Si nanocrystals. Moreover, we show that it is possible to control the origin of the photoluminescence in a single sample: passivation with hydrogen removes the defects, resulting in photoluminescence from quantum-confined states, but subsequent ultraviolet illumination reintroduces the defects, making them the origin of the light again.

Zero-field optical manipulation of magnetic ions in semiconductors

Nature Mater. **7,** 203–208 (2008)

Controlling and monitoring individual spins is desirable for building spin-based devices, as well as implementing quantum information processing schemes. As with trapped ions in cold gases, magnetic ions trapped on a semiconductor lattice have uniform properties and relatively long spin lifetimes. Furthermore, diluted magnetic moments in semiconductors can be strongly coupled to the surrounding host, permitting optical or electrical spin manipulation. Here we describe the zero-field optical manipulation of a few hundred manganese ions in a single gallium arsenide quantum well. Optically created mobile electron spins dynamically generate an energy splitting of the ion spins and enable magnetic moment orientation solely by changing either photon helicity or energy. These polarized manganese spins precess in a transverse field, enabling measurements of the spin lifetimes. As the magnetic ion concentration is reduced and the manganese spin lifetime increases, coherent optical control and readout of single manganese spins in gallium arsenide should be possible.

If citing these articles, please reference the complete version in the appropriate journal rather than *Nature Photonics*.