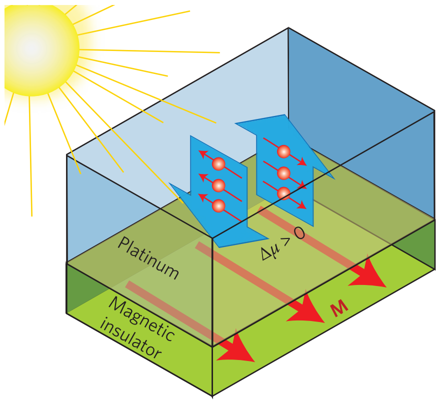
SPINTRONICS

Photon-driven spin current

Nature Phys. http://doi.org/bjmz (2016)



NATURE PUBLISHING GROUP

In the same way as charged electrons give rise to electric currents, electronic spins can generate spin currents. The latter could find applications in electronic devices with low power consumption, but controllable production of spin currents is a challenging task. Now, David Ellsworth and collaborators report the generation of a spin current across a non-magnetic metal thanks to a novel process termed photo-spin-voltaic (PSV) effect, observed in a structure composed of a platinum layer and an yttrium iron garnet film. Having applied a magnetic field to the iron garnet to produce a magnetization **M** in the film plane, the authors illuminated the heterostructure with a halogen light bulb placed on either the top or bottom side of the sample. The response of the resulting spin voltage $\Delta\mu$ to the direction of light illumination and to the orientation of the magnetic field indicated that the PSV effect is unrelated to light-induced temperature gradients, and that its origin is magnetic. Additional measurements, supported by theoretical calculations, pointed to the photon-driven spin-dependent excitation of the electrons in platinum atoms close to the iron garnet film as the mechanism responsible for the creation of a net spin current. *GD*

NANOPHOTONICS

Photon transfer on demand

Sci. Adv. **2,** e1501690 (2016)

Strongly confined photons give access to enhanced light–matter interactions. Marking a further step in the manipulation of trapped light quanta, Ryotaro Konoike and colleagues now demonstrate on-demand photon transfer between two photonic crystal nanocavities at arbitrary positions on a chip. The three nanocavities were separated by 41 μm from each other and connected by waveguides. Initially, cavities A and B were detuned from each other, and the resonant frequency ω_C of nanocavity C was set to be lower than those of the neighbouring cavities: in these conditions, all externally injected photons could be trapped in cavity A. By increasing ω_C adiabatically, the team observed the transfer of photons from cavity A to cavity B. To ensure the required variation of ω_C, nanocavity C was illuminated by 71-ps-long control pulses. Interfering photons dropped from cavity A or B with a pulsed reference beam demonstrated successful photon transfer for three different timings of the control pulses, highlighting the temporal control over this process. The intrinsic lifetime of the trapped photons in the system was about 200 ps, and the maximum transfer efficiency was 90%. *GD*

TERAHERTZ SOURCES

Table-top brilliance

Phys. Rev. Lett. **116,** 205003 (2016)

Intense, high-brightness table-top sources of coherent terahertz (THz) radiation, which remove the need for large and expensive accelerator facilities, are of interest for applications ranging from biomedical imaging to wireless communications. Now, Guo-Qian Liao and colleagues have achieved coherent THz radiation by harnessing the interaction between laser-driven beams of relativistic electrons and a suitable target material. The laser system, based at the Laboratory for Laser Plasmas, Shanghai Jiao Tong University, was used to provide 30-fs-duration *p*-polarized pulses with an energy and wavelength of 2 J and 800 nm, respectively. Focusing these pulses onto the targets with a peak irradiance of $\sim 1.5 \times 10^{19}$ W cm^{-2} enabled coherent transition radiation when the laser-produced electron beam passed through the rear solid/vacuum interface of the target. Three types of target were investigated: polyethylene (PE), Cu foils, and metal–PE samples with variable thickness of the PE layer. The dependence of the THz radiation on the structural parameters of the target was studied in detail and particle-in-cell simulations supported the experiments. The estimated total THz energy from the rear side of the metal foils is ~400 μJ per pulse, corresponding to an energy conversion efficiency from the laser into THz radiation of around 2×10^{-4}. *DP*

IMAGING

UV-enhanced SEM

APL Photon. **1,** 021301 (2016)

Scanning electron microscopy (SEM) is a useful and well-established tool for characterizing nanoscale samples, but comes with limitations. For example, the size of the electron beam varies with the beam current and surface charging issues can occur when imaging samples that are electrical insulators. Now, Gediminas Seniutinas and co-workers have shown that light from an ultraviolet (UV) light-emitting diode can be used to improve material contrast and resolution during SEM experiments. The UV light from the diode generates electrons from the sample surface via the photoelectric effect and these usefully contribute to the imaging, enabling a faster acquisition rate. The authors state that UV illumination also reduces distortions related to surface charging, to the extent that metal coating may not be required. In this work, the authors used a diode emitting light at 260 nm, which corresponds to a photon energy close to the work function of materials such as Ti, Au and Al. The authors thus demonstrated material-dependent contrast not only via secondary electron generation, but also due to differences in work function or photoelectric-generated charges. *DP*

MICROSCOPY

Axial super-resolution

Light Sci. Applications **5,** e16134 (2016)

The axial resolution of confocal microscopy techniques can be enhanced to reach the super-resolution regime by simply replacing the standard microscope slide on which the specimen is mounted with a mirror. That's the finding of Xusan Yang and co-workers, who call their scheme mirror-enhanced axial-narrowing super-resolution (MEANS) microscopy. The approach works because the addition of a mirror behind the specimen leads to interference between the excitation and its reflection from the mirror, which then results in a narrowed point spread function. Yang *et al.* combined the approach with stimulated emission depletion (STED) microscopy to improve axial resolution by a factor of six (to 110 nm) and lateral resolution by a factor of two (to 19 nm) and to probe nuclear pore complexes and viral filaments. A benefit of the approach is that the improvement in resolution comes without the need to increase laser power, which could damage sensitive biological samples. The team says that MEANS is compatible with various confocal microscopy schemes including two-photon imaging, spinning disk microscopy and laser scanning. *OG*

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