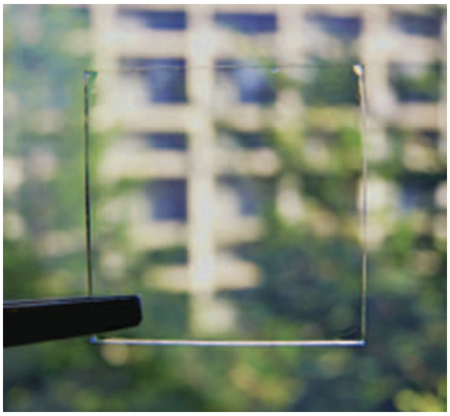
MATERIALS

Smart glass

Nature **500,** 323–326 (2013)



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By introducing tin-doped indium oxide nanocrystals into a thin layer of niobium oxide glass, researchers in Spain and the USA have realized a film whose transmission characteristics can be electronically controlled. The film is highly transparent when a voltage of 4 V is applied. However, at a bias voltage of around 2.3 V, the film selectively blocks near-infrared radiation, and at 1.5 V it provides broadband blocking of visible and infrared radiation. This demonstration implies that 'smart windows' coated with the film could in principle selectively and dynamically control the transmission of solar radiation. The transmission properties of the film can be modified during fabrication by controlling the amount of introduced nanocrystals: a higher concentration leads to greater modulation of near-infrared radiation as a result of there being more free carriers in the film. Experiments reveal that the material is stable and that it retains its properties even after being electrically switched more than 2,000 times. Anna Llordés and co-workers say that the findings demonstrate that when the nanocrystals are covalently bonded to glass the linking plays an important role and can yield new forms of amorphous material with useful functionality. *OG*

BIOPHOTONICS

Gene expression control

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The ability to use light to control and modulate gene expression is an important and desired functionality in cell biology research. However, a suitable means for optical modulation of transcription in the mammalian endogenous genome has remained elusive. Now, Silvana Konermann and co-workers in the USA have developed light-inducible transcriptional effectors (LITEs) that can be activated within minutes. LITEs can be delivered via viral vectors and be genetically designed to target specific cell types. The researchers tested LITEs on primary mouse neurons and the brains of living mice *in vivo*. They say that this technique will help establish the causal roles of genetic and epigenetic regulation in biological processes associated with normal, healthy conditions and in the presence of disease. A train of <1 s pulses of blue (wavelength ~460 nm) light with an intensity of 5 mW cm^{-2} was used to activate LITEs. *OG*

PLASMONICS

Nonlocality simplified

Phys. Rev. Lett. **111,** 093901 (2013)

Nonlocal effects in metal optics systems are often negligible. However, with the feature sizes of structures being reduced to very small length scales in the pursuit of quantum effects and stronger electromagnetic-field enhancement, the finite wavelength of electrons can no longer be ignored. Although various models exist for predicting the behaviour on this scale, theoretical treatments of nonlocality and spatial dispersion can be cumbersome even for simple structures. Yu Luo and colleagues from Imperial College London, UK, have now demonstrated that a virtual local structure can be used to represent a nonlocal plasmonic system. They report that this technique accurately accounts for the smearing of induced charges resulting from nonlocality over a wide frequency range. The nonlocal response was reproduced to a high precision by replacing a nonlocal metal with a local metal that has an appropriate dielectric layer on its surface. Comparison of this technique with the well-known hydrodynamic treatment gave good agreement. Both these models exhibit strong effects and reveal the relevance of nonlocality for gap plasmons, coupled spheres and coupled conical tips having gaps of 1 nm, 0.1 nm and 0.5 nm, respectively. The simplicity of this approach may give a deeper understanding of plasmonic phenomena at the nanometre scale and beyond. *DP*

RECIPROCITY

Magnets not needed

Nature Commun. **4,** 2407 (2013)

Non-reciprocal systems that break time-reversal symmetry are critical for the realization of devices like optical isolators that prohibit the propagation of light in the backward direction. This isolation effect is not attainable using conventional structures such as passive diffraction gratings; instead, a magneto-optical effect or nonlinear process is required. However, the various techniques available for realizing isolation suffer from challenges or limitations associated with integration, miniaturization, and the optical power and frequency range of operation. Dimitrios Sounas and colleagues from the University of Texas, Austin (USA) and the École Polytechnique de Montréal (Canada) have now demonstrated an alternative approach for introducing a non-reciprocal effect. They show that the limitations of present techniques may be overcome by employing angular-momentum-biased metamaterials and time-dependent modulation. They propose a scheme in which spatiotemporal modulation may provide a non-reciprocal response in Fano-resonator structures. The team suggests that this

OPTICAL CLOCKS

Record stability

Science **341,** 1215–1218 (2013)

Atomic clocks have long been instrumental in science and technology, leading to innovations such as global positioning, advanced communications and tests of variations in fundamental constants. The uncertainty of an optical lattice clock is usually constrained by a technical noise source known as the Dick effect. Now, Nathan Hinkley and co-workers from the USA and Italy have succeeded in further suppressing the Dick effect to achieve an unprecedented atomic clock instability of 1.6×10^{-18} after 7 h of averaging. The researchers prepared two independent optical lattice clocks composed of ultracold ^{171}Yb atoms. A clock laser light at 578 nm was prestabilized to an isolated, high-finesse optical cavity using Pound–Drever–Hall detection and electronic feedback to an acoustic-optic modulator and a laser piezoelectric transducer. The laser light was divided into two paths. These beams were then frequency shifted using independent acoustic-optic modulators so that they became resonant with the clock transitions of two atomic systems, which are sensitive to the local environment. Consequently, despite being derived from the same local oscillator, the experimental cycles of each clock system were imperceptibly unsynchronized and had different durations. The frequency difference between the two Yb clock systems was measured to see how the ticking of the two Yb clocks stabilized over time. *NH*