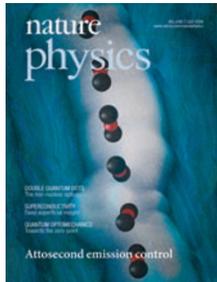


A round-up of recent papers in the field of photonics published by the physical sciences division of the Nature Publishing Group.



### Universal emission intermittency in quantum dots, nanorods and nanowires

*Nature Phys.* **4**, 519–522 (2008)

Virtually all known fluorophores exhibit mysterious episodes of emission intermittency. A remarkable feature of the phenomenon is a power-law distribution of on- and off-times observed in colloidal semiconductor quantum dots, nanorods, nanowires and some organic dyes. For nanoparticles, the resulting power law extends over an extraordinarily wide dynamic range: nine orders of magnitude in probability density and five to six orders of magnitude in time. Exponents hover about the ubiquitous value of  $-3/2$ . Dark states routinely last for tens of seconds—practically forever on quantum mechanical timescales. Despite such infinite states of darkness, the dots miraculously recover and start emitting again. Although the underlying mechanism responsible for this phenomenon remains a mystery and many questions persist, we argue that substantial theoretical progress has been made.

### Coherent control of attosecond emission from aligned molecules

*Nature Phys.* **4**, 545–549 (2008)

Controlling attosecond electron wave packets and soft X-ray pulses represents a formidable challenge of general implication to many areas of science. A strong laser field interacting with atoms or molecules drives ultrafast intra-atomic/molecular electron wave packets on a subfemtosecond timescale, resulting in the emission of attosecond bursts of extreme-ultraviolet light. Controlling the intra-atomic/molecular

electron dynamics enables steering of the attosecond emission. Here, we carry out a coherent control in linear molecules, where the interaction of the laser-driven electron wave packet with the core leads to quantum interferences. We demonstrate that these interferences can be finely controlled by turning the molecular axis relative to the laser polarization, that is, changing the electron recollision angle. The wave-packet coulombic distortion modifies the spectral phase jump measured in the extreme-ultraviolet emission. Our attosecond control of the interference results in attosecond pulse shaping, useful for future applications in ultrafast coherent control of atomic and molecular processes.

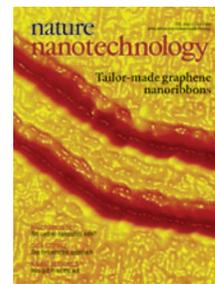


### Photonic metamaterials by direct laser writing and silver chemical vapour deposition

*Nature Mater.* **7**, 543–546 (2008)

Metamaterials are artificial materials that—unlike natural substances—enable magnetism to be achieved at optical frequencies. The vast majority of photonic metamaterials has been fabricated by electron-beam lithography and evaporation of metal films, both of which are well-established two-dimensional (2D) technologies. Although stacking of three or four functional layers made using these methods has been reported, a truly 3D fabrication approach would be preferable for 3D photonic metamaterials. Here, we report first steps in this direction by using a combination of direct laser writing and silver chemical vapour deposition—the 3D analogues of electron-beam lithography and evaporation, respectively. The optical characterization of a planar test structure composed of elongated split-ring

resonators is in good agreement with theory. Retrieval of the effective optical parameters reveals the importance of bi-anisotropy. Once suitable theoretical blueprints are available, our fabrication approach will enable rapid prototyping of truly 3D photonic metamaterials.



### Subwavelength direct-write nanopatterning using optically trapped microspheres

*Nature Nano.* **3**, 413–417 (2008)

A number of non-lithographic techniques are now available for processing materials on the nanoscale, including optical techniques capable of producing features that are much smaller than the wavelength of light used. However, these techniques can be limited in speed, ease of use, cost of implementation, or the range of patterns they can write. Here we report how Bessel beam laser trapping of microspheres near surfaces can be used to enable near-field direct-write subwavelength nanopatterning. Using the microsphere as an objective lens to focus the processing laser, we demonstrate arbitrary patterns and individual features with minimum sizes of  $\sim 100$  nm (which is less than one-third the processing wavelength) and a positioning accuracy better than 40 nm in aqueous and chemical environments. Submicron spacing is maintained between the near-field objective and the substrate without active feedback control. If implemented with an array of optical traps, this approach could lead to a high-throughput probe-based method for patterning surfaces with subwavelength features.

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