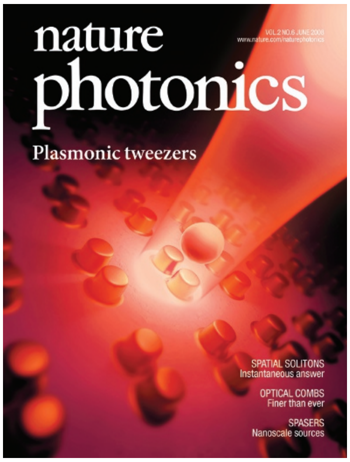

Cover story

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Optical tweezers, which use a focused light beam to trap and manipulate nanoscale objects, have become an important tool in the fields of biology and physics. However, with the conventional tweezer design the minimum size of the trap is constrained by diffraction, and trapped objects can wander within the trap as a result of brownian motion. To enable tighter trapping, Alexander Grigorenko and co-workers from the University of Manchester, UK, have developed a plasmonic trap that exploits a nanostructured substrate consisting of an array of pairs of gold nanopillars. When the trapping light beam strikes a pair of pillars, it gives rise to enhanced localized fields in the small gap between them, creating extra forces that reduce the trapping volume beyond the diffraction limit. As a result, nanoparticles are trapped with far greater precision than usual. **[Article p365; News & Views p333; Interview p382]**

NEW HOST FOR SPATIAL SOLITONS

Incoherent optical spatial solitons are self-trapped light beams that occur in a nonlinear medium when diffraction broadening is balanced by a nonlinear self-focusing effect. In essence the beams behave as if they are being confined to a waveguide, and their time-averaged intensity structure does not change. However, all such solitons observed until now have propagated in mediums that have a slow nonlinear response time that is much longer than the characteristic fluctuation time of the beam. Now Mordechai Segev and co-workers from Technion in Israel and the University of Colorado, USA, have demonstrated that it is possible for incoherent spatial solitons to exist in materials with an instantaneous nonlinear response, provided that the nonlinearity is non-local in nature. The experiments suggest the attractive possibility of imaging through materials that have a highly non-local nonlinear response. **[Article p371; News & Views p334]**

NANOTUBE PROPERTIES

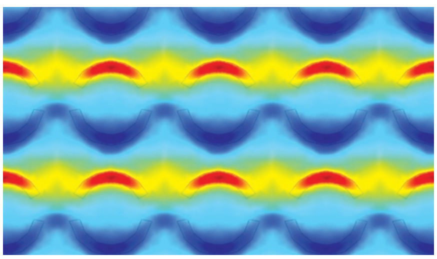
The optical properties and potential optoelectronic applications of carbon nanotubes are described by researchers from IBM's Watson Research Labs in the USA in this month's Review. Although nanotubes have already been put to good use in electronics, materials science, biology and chemistry, Phaedon Avouris, Marcus Freitag and Vasili Perebeinos explain that nanotubes could also prove useful in the world of photonics. For instance they could aid the creation of devices, such as light-emitting transistors, organic LEDs, photovoltaic cells or saturable absorbers for generating ultrashort light pulses, or they could be used to enhance the performance of these devices. However, to do so it is important that researchers gain a comprehensive understanding of their optical properties, such as their radiative emission dynamics and optical nonlinearity. **[Review p341]**

FINE FREQUENCY COMBS

The production of high-power and phase-stable optical frequency combs is important for applications ranging from metrology through to high-resolution spectroscopy. Now Thomas Schibli and co-workers from JILA in Colorado and IMRA America in Michigan have demonstrated a fibre-laser-based frequency comb with a submillihertz linewidth and greater than 10 W average power. What's more it is their opinion that the technology can be scaled to powers beyond 10 kW. The source used to generate the high-power comb is an ultrashort pulse Yb:doped fibre oscillator, followed by a fibre-based chirped pulse amplification stage. The results indicate that such sources could serve as a convenient alternative to Kerr-lens mode-locked femtosecond lasers, which are larger and require careful alignment. **[Letter p355]**

LASING SPASER

By combining the concepts of metamaterials (nanostructured materials with tailored electromagnetic properties) and spasers (amplifiers of surface plasmons) researchers expect to be able to create a new type of thin planar source of spatially and temporally coherent radiation. The theoretically proposed device, which Nikolay Zheludev and co-workers call a lasing spaser, consists of a two-dimensional array of tiny plasmon resonators that is combined with a layer of gain material, for example, an optically or electrically pumped semiconductor. Trapped current oscillations in the resonators give rise to lasing action, so long as the gain material is able to overcome any radiation and Joule losses. Introducing a slight asymmetry into the plasmon resonator design allows a fraction of the trapped energy to escape into free space (analagous to the role of an output coupler optic in a conventional laser). According to the researchers, the approach should enable very high gain amplification and lasing in a very thin layer of material, making it attractive for integrated devices. In addition, the wavelength of the emitted radiation is determined by the size of the plasmon resonators and can be tuned. **[Letter p351; Commentary p327]**



Zheludev and co-workers have exploited surface plasmons to design a nanosource of coherent light.

p351

SELF PATTERNING

A single laser pulse is able to make a layer of disordered metal nanoparticles on a thin membrane rearrange themselves into one- and two-dimensional grating patterns with subwavelength periodicity. That's the finding of Dinko Chakarov and co-workers from Chalmers University of Technology in Sweden. Such self-patterning, which has not been observed before, is attributed to interference between the incoming light beam and light that is coupled into waveguided modes of the membrane. Patterning is observed for laser wavelengths where the nanoparticle films exhibit surface plasmon resonances, suggesting their role in the phenomenon. The exact pattern generated depends on the wavelength, polarization and angle of incidence of the laser pulse, as well as the properties of the supporting membrane. The findings may lead to useful non-contact methods for fabrication of nanostructures. **[Letter p360]**