Superficial impact

In ink-jet printing it is important that droplets do not stray after being placed on a surface. But if the surface is water-repellent, it can cause these droplets to bounce. High-speed photography provides valuable information about the crucial first milliseconds of such events — and reveals some surprises.

Denis Bartolo and colleagues observe that a fine jet can emerge from a water drop as it impinges on a hydrophobic surface (*Phys. Rev. Lett.* **96**, 124501; 2006). The velocity of the jet can be up to 40 times larger than the impact speed, a behaviour that the authors trace back to the formation (and subsequent collapse) of an air cavity inside the drop.

In a separate effort, Mathilde Reyssat *et al.* take a close look at drops falling onto a super-hydrophobic landscape made of micrometre-sized pillars (*Europhys. Lett.* **74**, 306–312; 2006). Drops of moderate speed rebound completely, but at higher velocities they sink inside the surface structure and wet it. When the impact is made even more forceful, small satellite droplets appear on the microstructured surface.

TRUSTING THE BLIND WATCHMAKER

The use of evolutionary algorithms in engineering is not new, and has been applied to the design of everything from airplanes to pharmaceuticals. Yet, despite this process being responsible for the design of all life on Earth, rarely do designers trust it to find solutions to a given problem from scratch, but rather seed it with an intelligent guess that is presumed to be almost optimal.

Not Michal Lipson and colleagues, who set out to construct a high-quality optical cavity with no assumptions beyond the refractive indices of the materials used to make it (*Phys. Rev. Lett.* **96**, 143904; 2006). By applying an evolutionary algorithm to an initially random pattern of high- and low-index materials, they discover a structure that arguably no-one would purposefully engineer to confine light, but it nonetheless does, with a quality factor of 300 and a modal volume much smaller than the light's wavelength.

Silicon goes nuclear

Micrometre-scale structures and assemblies can be machined with ever-increasing sophistication, adding more and more to the (potential) capabilities of 'labs-on-a-chip'. A power source on a chip is a promising prospect. Towards this goal, Baojun Liu and colleagues developed a technique to occlude tritium in a silica host (*Appl. Phys. Lett.* **88**, 134101; 2006). As a beta emitter, this radioactive isotope serves as an electron source, and might be harnessed for power production or ionizing nearby molecules.

As with its big-scale counterparts, safety is a prime concern in the miniature nuclear power plants. To include tritium in the host material — and keep it there — Liu *et al.* load the gas under high pressure into silica films. Subsequent irradiation with a deep-ultraviolet laser triggers the formation of stable Si–OT bonds, which effectively immobilize the tritium at selected locations.

Experiments indicate that the locked tritium is stable up to temperatures of 400 °C, which is 200 °C higher than without laser treatment.

Teravision in 3D

Of the many potential uses for terahertz radiation, imaging is one of the most attractive. This is because it can penetrate deep into a wide variety of materials, including living tissues, ceramics and wood, without causing the damage that is typically associated with X-rays and other types of ionizing radiation. To date, most efforts in this field have concentrated on doing so in only two dimensions.

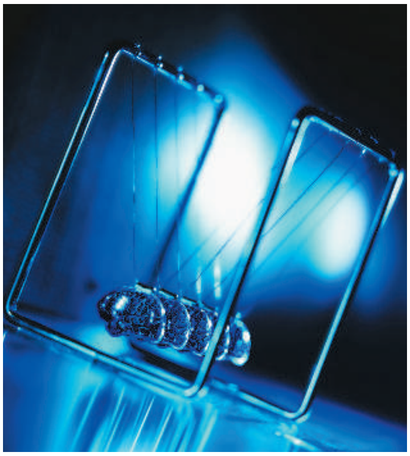
K. Lien Nguyen and colleagues take this a step further to demonstrate the first use of THz radiation to image solid objects in full 3D (*Opt. Express* **14**, 2123–2129; 2006). Combining similar image acquisition techniques to those used for computed tomography with a high-power THz quantum cascade laser, they collect a series of cross-sectional images through a range of polystyrene objects that enables them to reconstruct 3D maps of both their exterior and interior structures.

Keep swinging

In a flock of particles, thermal equilibrium is typically established through collisions. But anyone who has played with 'Newton's cradle' will have observed that in such a one-dimensional array of particles the velocity distribution does not change. The colliding balls — ideally — merely exchange momenta, and this does not help to find a common equilibrium. Toshiya Kinoshita and co-workers now set out to play the game in the quantum world (*Nature* **440**, 900–903; 2006).

In their experiment, tiny gas clouds, each consisting of a few hundred rubidium atoms, are made to clash. When oscillating in a one-dimensional optical potential, they collide over and over again. But even after thousands of encounters, no sign of settling down in an equilibrium arrangement is seen. In contrast, thermalization is reached within a few collisions in an equivalent three-dimensional gas.

The findings of Kinoshita *et al.* contradict the ergodic hypothesis of statistical mechanics (according to which a closed system is expected to explore the whole phase space that is at its disposal), and thus highlight the limits of this assumption — and might help to explore it further.



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