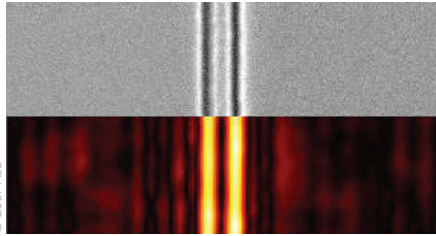


SUPERLENSES

Far and away



Nano Lett. doi: 10.1021/nl062635n; 2007
 Superlensing — imaging beyond the diffraction limit — could be achieved in the far-field and without the need for time-consuming scanning, according to recent research. Information about an object is stored in reflected light, either as propagating waves or decaying evanescent waves. Although propagating waves can be collected by standard lenses, move too far from the object (the far-field) and the evanescent information is lost, limiting the resolution of the image to about half the wavelength. Superlenses amplify evanescent waves making subwavelength resolution imaging possible. Now, Xiang Zhang and colleagues at the University of California at Berkeley have extended this important concept. Using surface plasmons on a silver surface, the team converts evanescent waves to propagating waves, allowing all the information to be collected by a standard optical system. This is experimentally verified by imaging two 50-nm strips of chromium separated by 70 nm, with laser light at a wavelength of 377 nm. This approach could prove to be real competition for near-field optical microscopy, which involves scanning a probe over the object, limiting where it can be applied and the speed at which images are generated.

QUANTUM INFORMATION

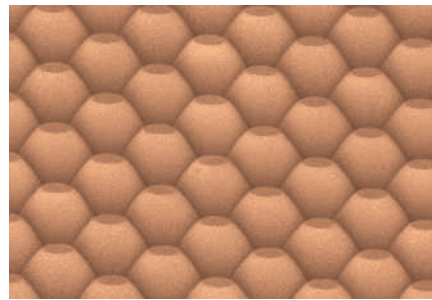
More entanglement

Phys. Rev. Lett. **98**, 010502 (2007)
 In the world of quantum information, photons are important for transmitting data whereas atoms are useful for storing that information. Many believe that the ideal network would contain confined entangled atoms that communicate through optical channels. The question is, just how entangled can those atoms get? Researchers from Spain and Germany now provide some interesting insights into this question.

Any two atoms can become entangled by collecting the photons they give off — the entanglement arises owing to interference in the measurement process. Current dogma suggests that the degree of entanglement is fundamentally limited to one entanglement bit or ‘ebit’. Lamata and colleagues now show that it is possible to generate an arbitrary amount of entanglement using a device known as an entangling two-photon detector (ETPD). The detector clicks whenever two photons arrive at the same time and their momenta satisfy a particular constraint. By analysing the results from the ETPD measurements the authors prove mathematically that two atoms can be entangled with any number of ebits. In practice, obtaining large numbers of ebits might be tricky, nevertheless, interesting tests of quantum physics or entanglement of whole atomic clouds could be performed.

LIQUID-CRYSTAL DISPLAYS

Light but bright



¹*Jpn J. Appl. Phys.* **46**, 194–199 (2007)
²*Jpn J. Appl. Phys.* **46**, 182–186 (2007)
 Liquid-crystal displays are now commonplace in personal computers, mobile products and televisions as well as many other items. However, as LCDs are passive optical components, they do not create light and require a backlight. A better backlight leads to higher-quality, brighter images and lower power consumption. In order to make LCDs lighter and brighter, Katsuya Fujisawa and colleagues in Japan are investigating placing the light source at the edge of the display¹. The light is guided behind the LCD by a thin plate and then redirected upwards by a film patterned with fine lenses. By changing the shape of the fine lenses and their spacing, the emission properties of the display can be controlled. With this technique, they report extraction efficiencies at least 10% higher than in a conventional backlight unit.

Another approach, taken by a group of Chinese researchers at the National Chiao Tung University in Taiwan, China, is to integrate organic light-emitting diodes with the LCD to create a so-called emi-flective display². With no air gap inbetween the emi-flective (emissive and reflective) components, this device eliminates undesired reflection and offers lighter weight (<90%), thinner thickness (<40%), and lower power consumption (<2%, under sunlight) in comparison with conventional LCDs.

LIQUID LENSES

Varifocals

Adv. Mater. **19**, 401–405 (2007)
 The curved surface of a liquid drop can bend rays of light, just like a glass lens. The beauty of such liquid lenses is that their shape can be altered, providing a way of adapting their focal length. Liang Dong and co-workers at the University of Wisconsin-Madison in the USA are developing a focus-control technique that, unlike approaches investigated so far, doesn't require bulky external power supplies. They use a material known as a hydrogel that expands and contracts with temperature, swelling by as much as ten times as the temperature decreases below a critical point. The water-based lenses, a few millimetres across, were shaped by 750- μm -deep hydrogel channels; rectangular channels produced a cylindrical lens, and a grid of circles created a spherical microlens array. A small heater on the back of the device increases the temperature from 21 °C to 43 °C, allowing control over the meniscus shape and hence tuning the focus length of the lens. In the case of the cylindrical microlens, the shape changed from convex to concave at about 34 °C. By simplifying the way liquid lenses are controlled, these components could be readily integrated into lab-on-a-chip systems.

