Defects make light work

Numerous conjugated polymers have been shown to emit light when a current is passed through them, giving rise to high hopes for the future of organic displays. One of the most promising families of polymers is that of polyfluorenes, but these molecules sometimes suffer the drawback of photo- or thermal oxidation under device operation. This generates fluorenone defects in the materials causing an unwanted change in the colour of the emitted light. Now, researchers from California and Beijing have put this effect to good use in making an organic white-light-emitting diode (*Appl. Phys. Lett.* 88, 163510; 2006). Sun *et al.* blend a blue- and a green-light-emitting polyfluorene in one layer of their device, and then anneal the polymers at a high temperature to deliberately create fluorenone defects. These defects can then form an exciplex — a complex between two molecules that can only exist when at least one is in its excited state — with a third polymer in another layer. Emission from the exciplex occurs in the red-light region, completing the red–green–blue trio needed to make a diode that emits light that is almost perfectly white.

Terahertz radiation reveals it all

The terahertz spectral region has a large potential for non-destructive imaging. Possible applications range from medical diagnostics to security screening. However, market penetration has been hampered by the notorious difficulties of producing suitable emitters. A promising candidate for compact THz emitters are quantum cascade lasers. These semiconductor lasers offer relatively high emission powers, although at present they still require cooling with liquid nitrogen. Nevertheless, their compact size suggests an attractive alternative to other approaches.

K. L. Nguyen and colleagues (*Opt. Expr.* **14,** 2123–2129; 2006) have demonstrated the potential of quantum cascade lasers for three-dimensional imaging. Their approach is very similar to conventional computer tomography. A THz laser beam is focused on a sample and the transmission is measured along several horizontal slices. The sample is then rotated by a small angle and the procedure is repeated. A three-dimensional image of the sample can be reconstructed from the measurements by using a mathematical algorithm. The imaging system was put to test on a variety of structures, and external and, importantly, internal features — such as a hole (pictured) — were successfully reconstructed.

Metallic polymers

Polymers showing metallic-state conductivity have been reported by a group of researchers based in Korea and the USA (K. Lee *et al. Nature* 441, 65–68; 2006). Polyaniline samples prepared using self-stabilized dispersion polymerization were found to have conductivities in excess of 1,000 S cm^{-1} at room temperature, and a resistivity that monotonically decreased as temperature was lowered down to 5 K. These polymers gave infrared spectra that were characteristic of the Drude model — the free-electron theory that describes conductivity in simple metals. This is the first report of truly metallic transport in polymers. As the preparation method required no added stabilizers as dispersants, the resulting polymer samples were of high-quality and undoped, and had a low density of structural defects, which resulted in the improved conductivity. This method could provide the basis for improving known polymer systems, which could lead to high-performance plastic electronics with a wide range of applications.

Patchy clamp

Patch-clamp technology is the accepted approach for studying ion-channel proteins — whose function is to facilitate the diffusion of ions across biological membranes — and for discovering drugs that affect them. This technique allows the monitoring of ionic current through a membrane patch or an entire cell, but has so far proved expensive and difficult to use. Fred Sigworth and colleagues now report on a microfluidic system integrated with disposable cell-interface partitions that allow simultaneous planar patch-clamp recordings (*Nano Lett.* 6, 815–819; 2006). The electrode arrays consist of glass-supported partitions reversibly sealed by an electrical barrier to a microfluidic system, which includes multilayer fluidic isolation valves and microfabricated Ag/AgCl electrodes. Patch-clamp measurements from rat basophilic leukaemia cells were recorded with a 24% success rate, and simultaneous measurements from valve-isolated electrodes could also be obtained. This microfluidic system is compatible with other types of cell interfaces, and the authors believe that it will prove of practical advantage for high-density arrays of planar patch-clamp electrodes for high-throughput recordings of ion-channel activity.

DNA laundry

Researchers in Switzerland have developed a lab-on-a-chip method of separating DNA from unwanted contaminants using magnetic microparticles to manipulate minute quantities of cellular material. By altering the magnetic field generated by a matrix of coils on a printed circuit board, Ulrike Lehmann and co-workers are able to control the motion of silica-coated magnetic particles (*Angew. Chem. Int. Edn* 45, 3062–3067; 2006). These particles are used to steer an aqueous droplet containing proteins, lipids and DNA through an oil reservoir located directly above the coil matrix. The DNA binds directly to the surface of the particles, but the other organic molecules do not. Each time the droplet passes through larger bodies of aqueous 'wash solution', a fraction of the contaminant molecules are left behind, until eventually only the DNA and microparticles remain. The purified DNA can then either be detected within the structure of the 'chip', or amplified in an external device. DNA recovery rates of approximately 25% can be achieved through this method, using as few as 10 cells as input material.