

THIS WEEK



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Plastic fantastic

A resurgence in organic technology is set to transform the world of electronic devices, offering a way to give the very fabric of life enhanced functionality.

The transition from basic science to practical technology is rarely linear. The common view that promising discoveries need only patience, hard work and money to attain commercial success is seldom correct. Often, all kinds of technical, economic and social drivers must also coincide. So forecasts of fortune may fail and fade, only for the idea to re-emerge when the climate is more favourable.

Such a resurgence is now under way in organic electronics, in which polymers and other organic molecules are the active materials in information processing. Hideki Shirakawa discovered in the late 1960s that insulating plastics in the form of polyacetylene films could be made to conduct electricity. Chemists Alan Heeger and Alan MacDiarmid collaborated with Shirakawa in 1976 to boost the material's conductivity by doping with halogens, and went on to make a 'polymer battery'.

Greeted enthusiastically by some firms, this early work soon stalled — the polymers were too unstable and difficult to process, and their properties were hard to control and reproduce reliably. The situation changed in the late 1980s, when Richard Friend and co-workers at the University of Cambridge, UK, found that poly(*p*-phenylene vinylene) could conduct without doping and could be stimulated to emit light, paving the way for polymer light-emitting diodes. It began to seem possible that such substances could be used to make lightweight, flexible devices through simple printing and coating techniques.

The synthesis of gossamer-thin organic electronic circuits by Martin Kaltenbrunner at the University of Tokyo and his colleagues (see page 458) is the latest example of the ingenuity driving this field. Their devices elegantly blend new and old materials and techniques. The substrate is a 1-micrometre-thick plastic foil; organic small molecules provide the semiconductor for the transistors; other organic molecules

and alumina make up the insulating layers; and the electrodes are ultrathin aluminium. The plastic films — 27 times lighter than office paper — can be crumpled like paper and stretched to more than double their length without impairing the device's performance. Adding a pressure-sensitive rubber layer produces a touch-sensing foil that could serve as electronic skin or in medical prostheses.

Wearable and flexible devices have recently made great strides, propelled in particular by the work of John Rogers' group at the University of Illinois at Urbana-Champaign. Made from materials that biodegrade safely, such devices can now be printed on or attached directly to human skin. The possibilities for *in situ* monitoring of wound care, tissue repair, brain and heart function, and drug delivery are phenomenal; the challenge is for medical procedures to keep pace with the technology. Such applications show that organic electronics complements silicon logic, taking information processing into areas that silicon will never reach.

These technologies seem potentially transformative — more so on current showing than graphene. The latest work continues the trend towards a smart environment in which all kinds of functionality are invisibly embedded. What happens when clothing, money and even flesh and blood can receive, process and send information; when the fabric of daily life can be turned, unseen, into a computing and sensing device? Most narratives currently dwell on fears of surveillance or benefits of round-the-clock medical checks and diagnoses. But past experience should teach us that technologies don't simply get superimposed on the quotidian — they both shape and are shaped by human behaviour. Whether or not we get what is good for us, it probably won't be what we expect. ■

Antibiotic threat

In the fight to combat antibiotic resistance, researchers should strengthen their advocacy.

The growing threat of antibiotic resistance has seen a notable rise in awareness among policy-makers and the public (see *Nature* **495**, 141; 2013). This is largely because of the advocacy of researchers, who have urged that the problem be tackled immediately. But antibiotic resistance is a multifaceted global issue, and a coordinated international effort will be needed to maintain the pressure to act.

Some relatively simple interventions could impede the march of resistance and buy time for research responses — such as advising physicians not to give unnecessary prescriptions of antibiotics, and

limiting antibiotic use in livestock for growth promotion (see page 398). But experience has shown how difficult it is to change the expectations of patients and physicians, and agriculture lobbies are not going to give up the use of antibiotics without a fight. Attaining even the low-hanging fruit will therefore be a hard-fought battle that will need persistence.

Yet that call is increasingly being heard (see page 394), and the time is ripe for galvanizing sluggish political will. International public- or animal-health agencies and national authorities are now fully aware of the looming threat, and the World Health Organization in particular has been active in sounding the alarm (see go.nature.com/tzwdmz). Furthermore, antibiotic resistance seems to be moving up the agenda of research funders, although much remains to be done to increase the overall level of funding and to ring-fence it — specifically for research into discovering and developing new antibiotics.

Researchers must continue to lobby politicians, funding agencies and the pharmaceutical industry over the need to implement effective means to curtail the rampant spread of resistance, and to address the glaring dearth of new antibiotics in the drug-development pipeline. ■