

Sciencewatch

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Wounded plants communicate electrically

Mammalian nervous systems send electrical signals at speeds of about 100 m/s and some plants such as the Venus flytrap are known to send electrical signals that propagate at slower speeds of 3 cm/s to trigger their leaf movements. Other plants move more slowly and none have nervous systems. Nevertheless they can send electrical signals, as Seyed Mousavi of the University of Lausanne and colleagues have recently discovered.

Using thale cress (*Arabidopsis thaliana*) plants with electrodes that are grounded in the soil or connected to the leaves, the researchers found that when Egyptian cotton leaf worm (*Spodoptera littoralis*) larvae walked on



When one leaf of *Arabidopsis thaliana* comes under attack, it sends electrical signals to trigger defence mechanisms in the others. (Image credit: Charles Andr s /CC-BY-SA_3.0.)

the leaves there were no changes in electrical potential.

However, when the larvae started eating, electrical signals appeared at the attack site and propagated to other leaves at speeds of up to 9 cm/s. While this is slow compared with mammalian responses, it is similar to the speed of nerve-signal propagation in mussels.

Wounding in plants is known to send

out a wave of reactive oxygen species. By inhibiting this, the team found that two glutamate-receptor-like proteins are involved in the production of the electrical wave. These are similar to glutamate receptors in animal nervous systems and the findings suggest an early origin for parts of mammalian nervous systems.

● Further reading

SAR Mousavi *et al.* 2013 *Nature* **500** 422.

Soft actuator breakthrough

A long-standing problem is how to build soft actuators – things that could provide the sort of motion that is generated by muscles. Now, Christoph Keplinger of Harvard University and colleagues have developed a class of devices based on ionic conductors based on ionic hydrogels that stretch under an applied electric field. These muscle-mimics are fully transparent across the visible spectrum and can operate at frequencies above 10 kHz. The researchers demonstrated the technology by making a transparent actuator providing large area (up to 167%) strains and a transparent speaker that produces sound across the full audible range of frequencies.

● Further reading

C Keplinger *et al.* 2013 *Science* **341** 984.

Near-infrared metatronic nanocircuits

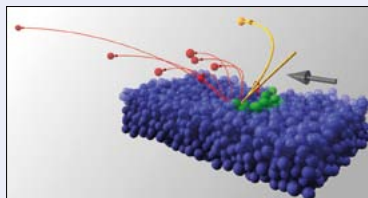
Lumped elements in electrical systems such as resistors, capacitors and inductors are hard to imagine at high frequencies but Humeyra Caglayan and colleagues at the University of Pennsylvania have shown that metamaterials using simple nanorod geometry and transparent plasmonic conducting oxides can do the job all of the way up to near-infrared wavelengths. Earlier approaches using silicon nitride could not reach the 1.55 μm wavelength that is used by most telecommunications optical fibres, a problem that is now overcome using indium tin oxide. Changing the shape and spacing

Collisions in sandstorms

Computer simulations by Marcus Carneiro of the Swiss Federal Institute of Technology in Zurich and colleagues show that there is more to sandstorms than just “sand blowing around”. In a sandstorm, the grains fly mostly close to the ground, but a few – “saltons” – are kicked upwards where they are accelerated by stronger winds. When they fall, they kick up new saltons. Surprisingly, when the simulations included mid-air collisions between grains, rather than diminishing, the amount of sand in the air could double through collisions between lower ejected grains or “leapers”. It turns out that the optimal coefficient of restitution for the collision to maximize sand flux is about 0.7, similar to experimentally measured values.

● Further reading

M V Carneiro *et al.* 2013 *Phys. Rev. Lett.* **111** 058001.



In a simulated sandstorm, a “salton” (yellow) smashes into the dense particle bed near the ground and ejects “leapers” (red). The arrow indicates wind direction.

of the nanorods, adding nickel chromium to the tops of the rods or filling the inter-rod gaps with lead sulphide can all be used to tune the circuits. Band-gap or band-pass filters at almost optical frequencies can now be conceived of and designed as electrical circuitry.

● Further reading

H Caglayan *et al.* 2013 *Phys. Rev. Lett.* **111** 073904.

Nanoscale thermometry in living cells

Taking temperatures at nanoscales has become easier thanks to the work of G Kucsko of Harvard University and colleagues. They use tiny nanodiamonds with single-nitrogen atom impurities, creating a nitrogen-vacancy (NV) centre in which two neighbouring carbon atoms are replaced by a nitrogen atom and a vacancy. The ground state of the NV is split into two energy levels and the difference between them (in the microwave region) is a sensitive function of temperature because it depends on thermally induced lattice strains. Temperature differences of 1.8 mK can be measured on length scales of 200 nm. By putting gold nanoparticles that can be heated by a laser and nanodiamonds into a single human embryonic fibroblast they could also demonstrate temperature-gradient control and mapping at the subcellular level. This opens up new possibilities for research into what goes on inside cells.

● Further reading

G Kucsko 2013 *Nature* **500** 54.



Multi-element X-ray detectors for beam-line applications

SGX Sensortech have a distinguished heritage in the manufacture of Silicon Drift (SDD) and Si(Li) detectors. Previously known as e2v scientific and Gresham Scientific, SGX specialises in producing detectors from standard designs through customised assemblies to complex multi-element detectors. All detectors are designed to meet the highest specifications, including the largest single active area (100mm²) available of its kind.

Applications include:

- Extended X-ray Absorption Fine Structure (EXAFS)
- X-ray Absorption Near Edge Structure (XANES)
- Total Reflection X-Ray Fluorescence (TXRF)
- Particle Induced X-Ray Emission (PIXE)
- Micro X-ray fluorescence (μXRF)
- X-Ray Fluorescence (XRF)



Features

- Available in 1 to 13+ channels
- Individual sensor areas 10mm² - 100mm²
- Resolutions from 127 eV
- Count rate > 1 Mcps
- Windows: Thin Polymer / Beryllium
- Focused or planar sensor arrangements
- Custom collimation
- Application specific designs
- High solid angle
- Vacuum compatible (including UHV)
- Slide options: manual / adapted for translation tables

Also available is a choice of close packed 3 x 100mm² or 6 x 100mm² sensor arrays

