

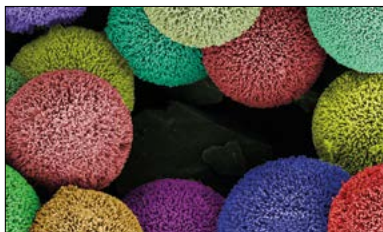
Sciencewatch

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‘Hedgehog particles’ to help the environment

Maintaining colloidal suspensions is done typically by coating particles with, for example, surfactants, organic tethers or polymers, which have an affinity for the solvent and help the colloidal particles to repel each other. A new approach is based on the shape of the colloidal-particle surfaces, corrugating them to make them look like tiny hedgehogs.

Joong Hwan Bahng and colleagues in Nicolas Kotov’s group of the University of Michigan in Ann Arbor attached nanoscale ZnO spikes to carboxylated polystyrene microspheres. The spikes of the



distinct “hedgehogs” made this way do not interpenetrate, and a complex combination of effects, including trapped air and solvent autoionization, provides colloidal stability

This coloured electron-microscope image of “hedgehog” particles by PhD student J H Bahng took top prize in the Materials Research Society’s Science as Art competition in 2013. (Image credit: Materials Research Society.)

via physical effects. These findings could help to reduce the use of environmentally unpleasant solvents and surfactants, just by suitable roughening of the colloid surfaces.

● Further reading

J H Bahng *et al.* 2015 *Nature* **517** 596.

Quantum memory sticks?

Quantum information offers the possibility of unbreakable encryption. Manjin Zhong of the Australian National University in Canberra and colleagues have now made a quantum hard-drive with storage time 100 times better than possible previously. Using a ground-state hyperfine transition of europium ions in yttrium orthosilicate, and optically detected nuclear magnetic resonance techniques, the researchers achieved a decoherence rate for qubits of 8×10^{-5} per second over 100 ms – the timescale for light transmission at a global scale.

With dynamic decoupling, they reached coherence times of 370 ± 60 minutes at 2 K. This is six hours of quantum storage, making it possible to imagine carrying quantum information in the future not via photons, but stored on quantum memory sticks. In addition to its obvious commercial importance, this work also opens the way to tests of quantum entanglement over very long distances.

● Further reading

M Zhong *et al.* 2015 *Nature* **517** 177.

Electrostatic charging of identical insulators

That identical insulators, brought into contact and separated, can develop charges, has been a long-standing mystery, known since ancient Greece. Lightning-like discharges in sandstorms, volcanic-dust plumes and grain and coal plants are all well-known phenomena, but have defied

Antibiotics without resistance

Most modern antibiotics were derived from screening cultured soil organisms, but today this source seems close to being wiped out, and many strains of dangerous bacteria have become resistant. Uncultured organisms are 99 times more numerous in nature, and new techniques have been developed recently to grow them in their natural environment – with some amazing results.

Kim Lewis of Northeastern University in Boston and colleagues in the US, Germany and the UK have isolated a new cell-wall inhibitor, teixobactin, from such uncultured bacteria. Amazingly, it seems to trigger no detectable genetic resistance in the bacteria that it attacks. The reason may be that it targets lipids, which cells synthesize from precursors, rather than proteins, which are coded for directly by genes, and are susceptible to mutation. This could lead to families of new antibiotics to which bacteria have little chance of developing resistance.

● Further reading

L L Ling *et al.* 2015 *Nature* **517** 455.

complete explanation.

Now, Yanzen Zhang of the China University of Petroleum in Qingdao and colleagues have shown that for this to happen, a small amount of water and a small pre-existing electric field are all that are needed, breaking the symmetry of the insulators being identical. The charge separation seems to be driven by the ionization of surface-adsorbed water, and

explains why wind-blown sand produces electrical discharges only if a thunderstorm is nearby.

● Further reading

Y Zhang *et al.* 2015 *Phys. Rev. X* **5** 011002.

Sodium explosions

Almost everyone who has had an introductory chemistry course has seen a piece of sodium or potassium tossed into water and watched it react, bursting into flames and exploding, but only now is a picture emerging of what goes on. Explosions normally require good mixing of reactants, but this is a surface reaction, and it would be reasonable to expect self-quenching from the products, with the steam and hydrogen released also forming a buffering layer.

Pavel Jungwirth of the Academy of Sciences of the Czech Republic in Prague and colleagues took high-speed pictures of liquid droplets of Na/K alloy falling into water, and discovered anything but typical explosions. Electrons are released almost immediately from the surface (which is visible as a blue colouration if ammonia is used in place of water), leaving the droplet charged. It grows spikes of metal on a sub-millisecond timescale, and then undergoes a “Coulomb explosion” where electrostatic repulsion reaches the Rayleigh limit, tearing the droplet apart and exposing more surface, therefore hastening the reaction and causing the well-loved explosion.

● Further reading

P E Mason *et al.* 2015 *Nature Chemistry* DOI: 10.1038/NCHEM.2161.

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