ORGANIC CHEMISTRY

Catalysis gets all tied up in knots

Over the past decade, chemists have used metal ion templating to prepare a wide variety of knotted molecular strands. Marcos *et al*. now show that one such pentafoil knot can be applied to catalysis. When held taut by zinc ions, the knot can capture a chloride or bromide ion from a halocarbon, thereby unleashing the reactivity of the residual cation for applications such as Lewis acid catalysis. Removing the zinc ions lowers the knot's affinity for the halides, offering a reversible modulation mechanism for the catalysis. — JSY

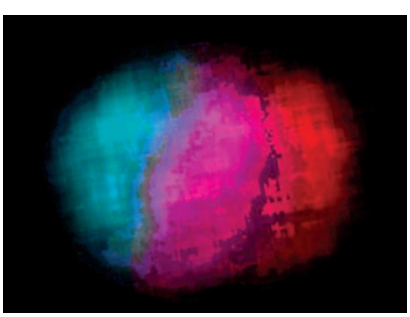
Science, this issue p. 1555

NANOMATERIALS

Multimetal nanoparticle synthesis

Multicomponent nanoparticles can be difficult to synthesize. Rather than mixing in one type of particle, the compounds often separate and form distinct particles. Using dip-pen lithography, Chen *et al.* show how adding reactants to very small volumes forces the reactants to form single particles containing various combinations of five different transition metal ions. Scanning transmission electron microscopy and energy-dispersive x-ray spectroscopy revealed the shapes of the nanoparticles and how metallic composition varied within them. For example, the quinary particle containing gold, silver, cobalt, copper, and nickel consisted of three domains of binary alloys. — PDS

Science, this issue p. 1565



PHOTOS (FROM TOP): HARTPHOTOGRAPHY/SHUTTERSTOCK.COM; CHEN *ET AL.*

Single nanoparticles can contain multiple domains of transition metal ion alloys.

CYSTIC FIBROSIS

Mini-guts for testing drug therapy

Cystic fibrosis is caused by mutations in the *CFTR* gene, which reduce the function of the CFTR protein. New drugs for treating cystic fibrosis modulate CFTR protein function, but drug efficacy is dependent on which CFTR mutation a patient carries. Dekkers *et al*. show that the efficacy of these drugs can be individually assessed using epithelial cells cultured as mini-guts from rectal biopsies from cystic fibrosis patients. The drug response observed in these rectal organoids can help predict which patients may be potential responders to the drug. This preclinical test may help to quickly identify responders to CFTR-modulating drug therapy, even when patients carry very rare CFTR mutations. — OMS

Sci. Transl. Med. **8**, 344ra84 (2016).

IMMUNOLOGY

Nanoparticles restore tolerance

Autoimmune diseases, such as type 1 diabetes, are caused by immune cells attacking healthy cells. One way to treat type 1 diabetes is to activate T regulatory (T_{reg}) cells to suppress inflammatory T cell activity and restore tolerance, so that the inflammatory T cells stop destroying pancreatic ß cells. Yeste *et al*. used gold nanoparticles to induce tolerance in a mouse model of type 1 diabetes. The mice had more T_{reg} cells and less severe disease symptoms when given nanoparticles coated with proteins that induced tolerance. Nanoparticle-based therapies may be useful in restoring tolerance in other autoimmune diseases as well. — JFF

Sci. Signal. **9**, ra61 (2016).

IN OTHER JOURNALS

Edited by **Kristen Mueller** *and* **Jesse Smith**

Google Trends data allow for monitoring of disease outbreaks.

INFECTIOUS DISEASE

Disease information-seeking behavior

Chickenpox is usually a mild disease of children and, consequently, national vaccination and reporting policies vary widely. In countries that do not immunize against chicken pox, Google Trends recorded a strong seasonal signal in search behavior for information about chickenpox. Tellingly, Bakker *et al*. found that the seasonal search signal reverses between the Southern and Northern Hemispheres and declines when a country mandates vaccination. Thus, Google data allow for monitoring of an underreported viral infection, forecasting outbreaks and measuring the impact of immunization for chicken pox, and perhaps also for other seasonal childhood infections. — CA

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1523941113 (2016).

PHYSICS

A partially protected surface state

A signature feature of topological insulators is conductive surface states that are immune to certain types of disorder. This "topological protection" appears to be at work in compounds such as Bi_2Se_3, in which electrons interact with one another only weakly. Whether these protected surface states exist in SmB_6, a material whose insulating bulk is caused by strong electronic correlations, is still a subject of debate. Park *et al.* used a tunneling technique to find states on the surface of SmB_6 that appeared to have the same linear dispersion as those in Bi_2Se_3 but were only partially protected. The loss of protection was caused by

EXTRASOLAR PLANETS

Can a red dwarf host a habitable planet?

The habitable zone is a region around a star where an Earth-mass planet with an Earth-like atmosphere would have a surface temperature of 0° to 100°C. Owen and Mohanty model planets in the habitable zone of red dwarfs, which are by far the most common type of star. These planets form with a hydrogen/helium envelope, and the greenhouse effect makes their surfaces too hot. Radiation from the star can strip away the envelope from a Venus-mass planet, causing it to fit the "habitable" criteria within a reasonable time. But the stronger gravity of an Earth-mass planet prevents it from ever losing enough of the envelope to cool down and become habitable. — KTS

Mon. Not. R. Astron. Soc. **459, 4088 (2016).**

A flaring red dwarf star in the nearby system DG Canum Venaticorum.

the interaction of the surface states with the magnetic excitations of the bulk. — JS

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1606042113 (2016).

BIOPHYSICS

From the green glow to the deep tunnel

Once green fluorescent protein has unleashed its eponymous green glow, a proton must journey back to the chromophore to reset the photophysical cycle. Salna *et al*. have now timed that journey over a temperature range from ambient temperature to down below –190 °C. Based on the large and temperature-dependent rate differences associated with isotopic substitution by deuterium, they conclude that quantum-mechanical tunneling plays a central role in the process. Specifically, the OH group on a serine residue participates in the proton transfer chain, despite its comparatively low acidity. Deep tunneling by serine's proton, at energies well below the threshold for classical deprotonation, helps bias overall transport in the right direction. — JSY

Nature Chem. 10.1038/NCHEM.2527 (2016).

CELL BIOLOGY

Exploring the human proteome

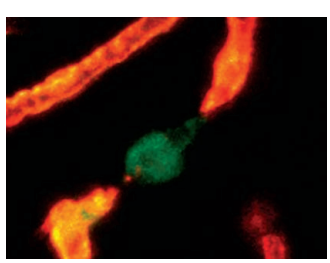
Although we know the sequence of the human genome, a large fraction of the human proteome remains poorly characterized. To overcome this, Leonetti *et al*. combine two methods to achieve high-throughput tagging of human proteins. First, they use the CRISPR/Cas9 system to insert DNA that includes a sequence encoding the tag, a short piece of green fluorescent protein (GFP), as well as sequences homologous to targeted genes. Second, they coexpress the remaining part of GFP in the same cell, which binds to the tag to give fluorescent GFP. Such tagging will probably provide new insights into the functions of proteins and pave the way for proteome-wide analysis of human cells. — VV

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1606731113 (2016).

VASCULAR REPAIR

Macrophages moonlight in brain bleeds

Microbleeds, which occur when microvessels in the brain rupture, are associated with cerebrovascular disease, dementia, and normal aging. Their rapid repair helps the body avoid more serious damage. To better understand this process, Liu *et al*. used a high-energy laser to generate endothelial lesions in the brains of zebrafish and discovered that macrophages, better known for their role in inflammation in phagocytosis, help to repair ruptured cells. As observed through time-lapse imaging in live fish, a macrophage arrives at the lesion and extends a cellular appendage to each of the lesion's ends.



Macrophages (green) help repair ruptured blood vessels (red/yellow) in the brain.

The macrophage then generates mechanical traction forces that bring the two ruptured ends together for lesion repair. — BAP

Immunity 17, 1162 (2016).

CANCER

Tumor cells fatten up to adapt

How do cancer cells adapt to the low-oxygen and acidic conditions of the tumor microenvironment and then proliferate and spread? Menard *et al*. propose that they overcome these stressful conditions by storing up energy in the form of fat droplets. Cancer cells, such as glioblastoma, boosted their uptake of certain lipoproteins under these harsh conditions. In a mouse model of metastasis, this uptake increased the spread of cancer cells. Tumor cells internalized fluorescently labeled lipids by endocytosis, which required them to express heparin sulfate proteoglycans and larger amounts of lipoprotein receptors on their surface. A potential therapeutic route might be to block tumor cells from accumulating these fat reserves. — LDC

Cancer Res. 10.1158/0008-5472.CAN-15-2831 (2016).