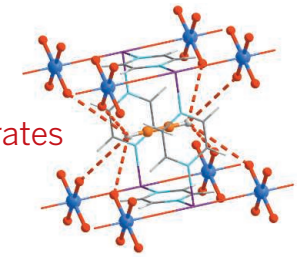
RESEARCH

A copper-based metal-organic framework separates acetylene and ethylene

Cui et al., *p. 141*



IN *SCIENCE* JOURNALS

Edited by **Stella Hurtley**

Kelp forest, Goat Island, New Zealand

CLIMATE CHANGE

No turning back?

Ecosystems over time have endured much disturbance, yet they tend to remain intact, a characteristic we call resilience. Though many systems have been lost and destroyed, for systems that remain physically intact, there is debate as to whether changing temperatures will result in shifts or collapses. Wernburg *et al*. show that extreme warming of a temperate kelp forest off Australia resulted not only in its collapse, but also in a shift in community composition that brought about an increase in herbivorous tropical fishes that prevent the reestablishment of kelp. Thus, many systems may not be resilient to the rapid climate change that we face. —SNV

Science, this issue p. 169

STRUCTURAL BIOLOGY

Env's transmembrane domain revealed

HIV-1's envelope protein (Env) spans the viral membrane and grants the virus entry into host cells. Env is also the sole protein of HIV-1 that is targeted by antibodies, making it a key target for vaccine design. Dev *et al*. used nuclear magnetic resonance to determine an atomic-level structure of the membrane-spanning region of Env in a lipid bicelle. Env's transmembrane domain forms a well-ordered trimer, which includes a stabilizing C-terminal hydrophilic core. Disrupting this core alters the sensitivity of Env to broadly neutralizing antibodies, suggesting the potential importance of this region to vaccine design. —KLM

Science, this issue p.172

CATALYSIS

Hot single-atom catalysts

For heterogeneous catalysts made from precious metal nanoparticles adsorbed on metal oxides, high temperatures are the enemy. The metal atoms become mobile and the small particles grow larger, causing a loss in surface area and hence in activity. Jones *et al*. turned this process to their advantage and used these mobile species to create single-atom platinum catalysts. The platinum on alumina supported transfers in air at 800°C to ceria supports to form highly active catalysts with isolated metal cations.—PDS

Science, this issue p. 150

PHYSIOLOGY

Sparking greater blood loss

Certain anesthetics trigger life-threatening symptoms in individuals with malignant hyperthermia. The symptoms are caused by hyperactive type 1 ryanodine receptors (RyR1s) and excessively high Ca^{2+} concentrations in skeletal muscle. Lopez *et al.* found that a *RYR1* mutation in patients with malignant hyperthermia could also underlie common mild bleeding disorders lacking a clear genetic basis. Some patients with malignant hyperthermia bled for longer than their normal relatives, and mice engineered with a *RYR1* mutation that is found in some patients also bled for longer. Local spikes in Ca^{2+} concentrations were more frequent in vascular smooth muscle cells from mice with the *RYR1* mutation. —WW

Sci. Signal. **9**, ra68 (2016).

IMMUNOTHERAPY

Engineering T cells to treat autoimmunity

Autoimmune diseases such as lupus and rheumatoid arthritis lack therapies that specifically target only the disease-causing cells. Inspired by the clinical success of using chimeric antigen receptor T cells to treat certain types of cancers, Ellebrecht *et al*. asked whether a similar approach might also work against antibody-driven autoimmune diseases. They engineered T cells to express chimeric receptors consisting of the disease-causing autoantigen desmoglein 3 fused to signaling domains that activate T cells. When given to diseased mice, the engineered T cells targeted and killed B cells that express antibodies targeting desmoglein 3, hinting that such a strategy may be an effective way to treat antibody-driven autoimmune diseases. —KLM

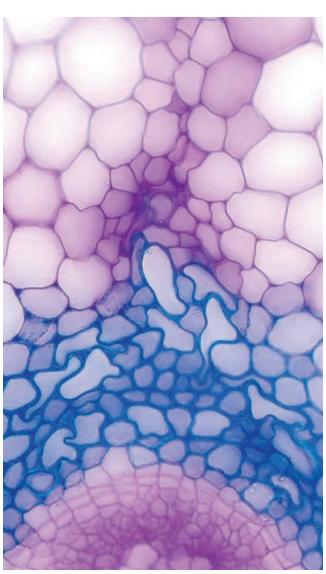
Science, this issue p. 179

PLANT SCIENCE

Location, location, S-acylation

Cellulose synthase is a large, multisubunit machine that "swims" along the plant cell membrane as it spins out cellulose fibers. Kumar *et al*. show that the cellulose synthase complex is heavily modified through S-acylation. Subsets of the acylation sites were required for the complex to integrate into the plasma membrane. A single functional complex could bear as many as 100 modification sites, potentially changing its biophysical characteristics and helping it to associate with the membrane. —PJH

Science, this issue p. 166



The stems of cellulose-deficient plants display collapsing xylem (blue).

BONE

Cartilage claims a permanent home

It is unclear whether certain tissues in our bodies are permanent or refreshed over time. Nuclear bomb testing more than 50 years ago released the carbon-14 isotope into the atmosphere, which allows researchers to determine the turnover of human tissues in people over 50 years old. Heinemeier *et al.* used this "^{14}C bomb pulse" method to determine the regenerative potential of cartilage. They examined human knee joints in both healthy individuals and those with osteoarthritis, taking cartilage samples from both high- and moderate-load areas. The collagen matrix of cartilage was essentially permanent, even in disease. Thus, tissue engineering and regenerative medicine need to take this structural stability of collagen into account when designing cartilage repair strategies. —MLF

Sci. Transl. Med. **8**, 346ra90 (2016).

NEUROPHYSIOLOGY

Going with the flow

The interstitial spaces of the brain are filled with cerebrospinal fluid (CSF). Faubel *et al*. studied fluid transport in the third ventricle of the brain of mice, rats, and pigs. Sophisticated, state-of-the-art fluid dynamic studies revealed a complex pattern of cilia beating that leads to an intricate network of "highways" of CSF flow. This flow rapidly and efficiently transports and partitions CSF. —SMH

Science, this issue p. 176

IN OTHER JOURNALS

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

THERMAL MANAGEMENT

Silica surfaces send the heat away

Dissipating the ever-increasing heat from electronics requires developing materials with high thermal conductivities. Tervo *et al.* found, through a series of experiments, that packed silica nanoparticle beds coated with different coolant fluids have greatly enhanced thermal conductivity. The increase may be due to the surface properties of the nanoparticles, which are driven by strong surface electrical polarization. This new approach for modulating thermal conductivity presents new opportunities for thermal management. —BG

Mater. Horiz. 10.1039/c6mh00098c (2016).

NEUROBIOLOGY

Even more pain in opioid treatment

Amid heightened concern about the addictive properties of opiates used to manage pain, new results from Grace *et al*. reveal that morphine can actually promote chronic pain. Rats with nerve damage treated for 5 days with morphine showed a sensitization to pain that persisted for months after opioid treatment was stopped. Neuronal opioid receptors did not contribute to this effect. Rather, opioids caused the increased pain by heightening inflammatory signaling in macrophage-like cells called microglia that reside in the spinal cord and brain. On the positive side, specific targeting of the inflammatory signaling in microglia may block the long-term pain-inducing effects of opioids, while still allowing their short-term analgesic effects. —LBR

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1602070113 (2016).

ORGANIC CHEMISTRY

Carboxylating stubborn alkyl chlorides

The utility of alkyl chlorides and carbon dioxide (CO_2) as reagents in organic synthesis is often limited by the difficulty of activating these molecules. Börjesson *et al*. have overcome both these challenges with a nickel catalyst that adds CO_2 at ambient pressures to unactivated alkyl chlorides (primary, secondary, and even tertiary). The nickel catalyst ligands that were most effective

PHOTOS: (LEFT TO RIGHT) SIMON TURNER; STEVE GSCHMEISSNER/SCIENCE SOURCE

ALSO IN *SCIENCE* JOURNALS

Edited by **Stella Hurtley**

REGENERATION

Dividing asymmetrically to fix muscle

Resident tissue stem cells called satellite cells repair muscle after injury. However, how satellite cells operate inside living tissue is unclear. Gurevich *et al*. exploited the optical clarity of zebrafish larvae and used a series of genetic approaches to study muscle injury. After injury, satellite cells divide asymmetrically to generate a progenitor pool for muscle replacement and at the same time "self-renew" the satellite stem cell. This results in regeneration that is highly clonal in nature, validating many decades of in vitro analyses examining the regenerative capacity of skeletal muscle. —BAP

Science, this issue p. 136

MICROPOROUS NETWORKS

Separating one organic from another

Separating closely related organic molecules is a challenge (see the Perspective by Lin).The separation of acetylene from ethylene is needed in high-purity polymer production. Cui et al. developed a copper-based metal-organic framework with hexafluorosilicate and organic linkers designed to have a high affinity for acetylene. These materials, which capture four acetylene molecules in each pore, successfully separated acetylene from mixtures with ethylene. Propane and propylene are both important feedstock chemicals. Their physical and chemical similarity, however, requires energy-intense processes to separate them. Cadiau et al. designed a fluorinated porous metal-organic framework material that selectively adsorbed propylene, with the complete exclusion of propane. —PDS and MSL

Science, this issue pp. 141 and 137; see also p. 121

ORGANIC CHEMISTRY

Olefins enlisted to attack ketones

The reaction of C=O groups in ketones with organometallic compounds is a common method to form carbon-carbon bonds. One drawback to this approach, however, is that the organometallics, such as magnesium-derived Grignard reagents, are difficult to handle and susceptible to side reactions. Yang *et al*. present an alternative method, whereby a copper catalyst activates stable olefins (C=C double bonds) to attack ketones at room temperature. An added silane functions as a reducing agent, and a chiral phosphine ligand renders the reaction highly enantioselective. —JSY

Science, this issue p. 144

ROBOTICS

Swim into the light

A bio-inspired swimming robot that mimics a ray fish can be guided by light. Park *et al.* built a 1/10th-scale version of a ray fish with a microfabricated gold skeleton and a rubber body powered by rat heart muscle cells. The cardiomyocytes were genetically engineered to respond to light cues, so that the undulatory movements propelling the robot through water would follow a light source. —PDS

Science, this issue p. 158

NETWORK SCIENCE

Resolving a network of hubs

Graphs are a pervasive tool for modeling and analyzing network data throughout the sciences. Benson *et al*. developed an algorithmic framework for studying how complex networks are organized by higher-order connectivity patterns (see the Perspective by Pržulj and Malod-Dognin). Motifs in transportation networks reveal hubs and geographical elements not readily achievable by other methods. A motif previously suggested as important for neuronal networks is part of a "rich club" of subnetworks. —BJ

Science, this issue p. 163; see also p. 123

VACCINATION

In situ vaccine production and delivery

We are potentially facing a post-antibiotic world of human disease management, so the need for alternative approaches is growing critical. Li *et al.* found value in a variation on a well-known theme in disease prevention: vaccination. They developed a hybrid antigen delivery vector, directed toward pneumococcal disease, based on a combination of biological and biomaterial components. The immune response in murine models was significantly enhanced over the response to standard vaccines. Protection from 11 *Streptococcus pneumoniae* strains was provided, without toxicity. —PLY

Sci. Adv. 10.1126.sciadv.1600264 (2016).