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## FEATURE ARTICLES

### [Practice makes perfect, and ‘overlearning’ locks it in](#)

[Medical Express, 30JAN2017](#)

An international team of researchers (USA - Brown University, Japan) shows that overlearning prevents against interference, cementing learning so well and quickly that the opposite kind of interference happens instead. For a time, overlearning the first task prevents effective learning of the second task. According to the researchers, the underlying mechanism appears to be a temporary shift in the balance of two neurotransmitters that control neural flexibility. The results suggest that just a short period of overlearning drastically changes a post-training plastic and unstable learning state to a hyperstabilized state that is resilient against, and even disrupts, new learning. [TECHNICAL ARTICLE](#)

*Tags: Neuroscience, Featured Article*

### [Fluctuating forces of flight captured by new, high-tech paint](#)

[Physorg.com, 27JAN2017](#)



Amber Favaregh of NASA's Langley Research Center prepares a model of the Space Launch System rocket for testing with pressure-sensitive paint in a wind tunnel at NASA's Ames Research Center. Credit: NASA/Dominic Hart

At high speeds, aircrafts and rockets experience an unsteady flow of air over their wings which creates considerable pressure forces that change rapidly in strength and direction. Researchers at NASA's Ames Research

Center have developed a technique using pressure-sensitive paint which emits a bright crimson glow in the presence of high-pressure airflow to capture measurements fast enough to keep up with rapidly changing pressure loads over the entire surface of the vehicle model. The measurement helps in understanding how a vehicle's structure will respond to buffet in flight and in minimizing the impacts through design.

*Tags: Materials science, Government S&T, Space technology, Featured article*

### [Metal monoxides for battery cathodes](#)

[Nanotechweb, 26JAN2017](#)

An international team of researchers (South Korea, USA - UC Berkeley) shows that transition metal oxides that contain neither intrinsic lithium nor lithium conduction paths in their structure can be converted into high-capacity positive electrode materials when they are blended with nano-sized lithium fluoride in the electrode. The results imply that a variety of other transition metal compounds could be used as positive electrode materials, regardless of their crystal structures. This opens up new opportunities for discovering novel high-performance electrode materials.

[TECHNICAL ARTICLE](#)

*Tags: Energy, Advanced materials, Battery, Featured Article*

### [Scientists unveil new form of matter: Time crystals](#)

[Science Daily, 26JAN2017](#)

Normal crystals are an atomic lattice that repeats in space, but physicists recently suggested making materials that repeat in time. A team of researchers in the US (UC Berkeley, UT Austin, MIT) describes exactly how to make and measure the properties of such a crystal, and even predicts what the various phases surrounding the time crystal should be—akin to the liquid and gas phases of ice. Two groups (University of Maryland, Harvard University) followed the blueprint and created the first-ever time crystals. We are just now starting to explore a whole new landscape of non-equilibrium matter. [TECHNICAL ARTICLE](#)

*Tags: Materials science, Advanced materials, Featured Article*

*continued...*

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## S&amp;T NEWS ARTICLES

## ADVANCED MATERIALS

**[A new material to unearth mysteries of magnetic fields](#)**[Physorg.com, 31JAN2017](#)

Researchers at Yale University have made an alloy of indium and gallium with various particles suspended within it. When flowing, its ability to generate or modify magnetic fields is up to five times greater than that of pure liquid metal. Its high electrical conductivity enables researchers to study the effects of magnetohydrodynamics. The discovery could hold benefits for geophysics, astrophysics, and other fields that explore the dynamics of the Earth's magnetic field.

*Tags: Advanced materials***[Graphene demonstrates remarkable potential as life-saving antioxidant](#)**[Nanowerk, 28JAN2017](#)

Researchers at Rice University have created new particles, called PEG-PDI, consisting polyethylene glycol and perylene diimide. They are true mimics of superoxide dismutase enzymes, antioxidants that break down toxic superoxide radicals into harmless molecular oxygen and hydrogen peroxide. Understanding the structure of PEG-PDI should allow researchers to customize the molecule for applications. According to the researchers, PEG-PDI may also be efficient metal- and protein-free catalysts for oxygen reduction reactions used in industry and essential to fuel cells. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials***[A chain reaction to spare the air](#)**[Physorg.com, 27JAN2017](#)

Researchers at UC Berkeley tweaked the composition of organic molecules made up of nitrogen atoms to create a new molecular configuration that prompts a burst of CO<sub>2</sub> uptake and release, accounting for the much greater yield. The arrangement of the atoms in the material naturally forms a pore in the center. Adjacent CO<sub>2</sub> molecules stick to the pore wall and link up to create a continuous chain running along the edges of the tunnel-like pores. This enables the CO<sub>2</sub> to make a quick exit when it is released—potentially into storage. The two unique traits capture and then release CO<sub>2</sub> with significantly less heat.

*Tags: Advanced materials, Climatology***[Absorbing electromagnetic energy while avoiding the heat](#)**[Physorg.com, 27JAN2017](#)

An international team of researchers (USA - Duke University, Australia) created a metamaterial with boron-doped silicon. Using computer simulations, they calculated how terahertz waves would interact with cylinders of the material of varying heights and widths.

They manufactured a prototype consisting of hundreds of optimized cylinders aligned in rows on a flat surface. Physical tests showed that the new “metasurface” absorbed 97.5 percent of the energy produced by waves at 1.011 terahertz. The device's ability to absorb electromagnetic energy without heating up has direct applications in thermal imaging in terahertz range, sensing and lighting.

[OPEN ACCESS TECHNICAL ARTICLE](#)*Tags: Advanced materials, Materials science***[For this metal, electricity flows, but not the heat](#)**[Nanowerk, 26JAN2017](#)

According to Wiedemann-Franz Law, good conductors of electricity are also good conductors of heat. However an international team of researchers (USA - UC Berkeley, Lawrence Berkeley National Laboratory, Stanford University, Duke University, South Korea, Singapore, China, Saudi Arabia) found that in vanadium dioxide the thermal conductivity attributed to the electrons is ten times smaller than what would be expected from the Wiedemann-Franz Law. By doping it with tungsten, they were able to control the amount of heat that vanadium dioxide can dissipate by switching its phase from insulator to metal and vice versa, at tunable temperatures. The material can be used to help dissipate the heat in engines and improve the efficient use of energy in buildings. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials***[Nanostructured coatings take a bite out of pollutants](#)**[Science Daily, 26JAN2017](#)

Iron hydroxides are used for removing heavy metals and bulky organic compounds from water. To remove iron hydroxide nanomaterials that bind to pollutants in water, researchers in Singapore attached them to nickel foam which traps and safely removes contaminants. They used a special technique to maximize the surface area of the nanoparticles. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## BIOTECHNOLOGY

**[3-D-Printed Skin Leads the Way Toward Artificial Organs](#)**[MIT Technology Review, 26JAN2017](#)

Researchers in Spain describe new hardware that's capable of printing functional human skin. The device creates individual layers of skin, such as the dermis and epidermis, one atop the other. It does that by depositing plasma containing skin cells into precise geometries that allow the cells to flourish. They claim that the end results will be suitable for both transplantation and lab testing of new products. Initial transplants into mice also suggest that it is safe. [TECHNICAL ARTICLE](#)

*Tags: Biotechnology, Advanced manufacturing**continued...*



“A nation which depends upon others for its new basic scientific knowledge will be slow in its industrial progress and weak in its competitive position in world trade, regardless of its mechanical skill.” VANNEVAR BUSH

### Sound waves create whirlpools to round up tiny signs of disease

Duke University, 26JAN2017

To pick out the first warning signs of a disease, scarce proteins, antibodies or other biomarkers must be concentrated from small samples. An international team of researchers (USA - Pennsylvania State University, University of West Virginia, Duke University, China) has developed a new technology calculating and manipulating the effects of the two forces associated with sound waves—acoustic radiation and acoustic streaming. A small acoustic transducer paired with a glass cylinder produces a whirlpool that can capture disease-signaling nanoparticles in its vortex while the acoustic radiation keeps them there.

#### TECHNICAL ARTICLE

Tags: *Biotechnology, Medical sciences*

## ENERGY

### 4 New Ways to Store Renewable Energy With Water

IEEE Spectrum, 25JAN2017

In 2017, a number of new pumped-hydro technologies should achieve milestones. They aim to bring the low cost of the technology to geographies that ordinarily wouldn't allow it. Here are four you might hear about: The Concrete Bunker, Compressed-Air Bags, Energy Island and Wind Turbines With Water Storage.

Tags: *Energy*

## ENVIRONMENTAL SCIENCE

### Why the Earth's magnetic poles could be about to swap places - and how it would affect us

Physorg.com, 27JAN2017

The interval between geomagnetic reversals is very irregular and can range up to tens of millions of years. The Earth's magnetic field is generated within the liquid core. A global network of ground-based observatories and orbiting satellites measure how the magnetic field is changing, which gives us insight into how the liquid core is moving. The recent discovery of a jet-stream within the core highlights our increasing ability to measure and infer the dynamics of the core. The simple fact that we are "overdue" for a full reversal and the fact that the Earth's field is currently decreasing at a rate of 5% per century, has led to suggestions that the field may reverse within the next 2,000 years.

Tags: *Environmental science*

## FOREIGN S&T

### Russia launching its quietest submarine

Next Big Future, 29JAN2017

The fourth Yasen-class submarine, the Krasnoyarsk, has passed critical tests of its structures and pressure hull. Further work is being planned for installation and assembly. The hull is built with low magnetic steel to help it avoid detection. Magnetic Anomaly Detectors were a large part of Cold War submarine hunting. It's supposed to be the most quiet nuclear-powered attack sub ever to enter the Russian fleet.

Tags: *Foreign S&T, Military technology, S&T Russia*

## INFORMATION TECHNOLOGY

### Optimizing code

MIT News, 30JAN2017

Researchers at MIT will present a new variation on a popular open-source compiler that optimizes before adding the code that is necessary for parallel execution. The improvement comes purely from optimization strategies that were already part of the compiler the researchers modified, which was designed to compile conventional, serial programs. The researchers' chief innovation is an intermediate representation that employs a fork-join model of parallelism. The approach should also make it much more straightforward to add optimizations specifically tailored to parallel programs. That will be crucial as computer chips add more and more parallel processing units.

Tags: *Information technology*

### Making distributed storage highly consistent

Science Daily, 24JAN2017

One of the major problems that distributed storage systems face is maintaining the consistency of data when they are accessed concurrently by multiple operations. Researchers in Spain are working on an EU sponsored project that developed algorithms to demonstrate that distributed storage systems can be highly reliable, consistent, collaborative, practical, and global. The algorithm also addresses convertability and data size reduction. [More information](#)

Tags: *Information technology*

## MATERIALS SCIENCE

### Scientists take the first step toward creating efficient electrolyte-free batteries

Eurekalert, 31JAN2017

Antiferroelectric lead zirconate is the key ingredient in modern ferroelectric and piezoelectric functional solid

solutions. An international team of researchers (Russia, Switzerland, France, Poland) shows that a highly useful and scientifically puzzling feature of this material is the competition between the ferro- and antiferroelectric phases due to their energetic proximity. The discovery is the first step toward creating efficient electrolyte-free batteries. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science*

### [The world's first heat-driven transistor](#)

[Physorg.com](#), 31JAN2017

Taking advantage of the Seebeck coefficient found in polymer electrolytes, researchers in Sweden introduce the concept of ionic thermoelectric gating a low-voltage organic transistor. The temperature sensing amplification of such devices is thousands of times superior to that of a single thermoelectric leg in traditional thermopiles. The ionic thermoelectric sensors offer a way to go beyond the limitations of traditional thermopiles and pyroelectric detectors. The findings pave the way for new infrared-gated electronic circuits with potential applications in photonics, thermography and electronic-skins. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science, S&T Sweden*

## FEATURED RESOURCE

### [Science 360 News \(NSF\)](#)

Breaking STEM news from scientists, colleges, universities, dozens of science and engineering centers and from peer-reviewed journals are presented. [RSS](#)

### [Boron atoms stretch out, gain new powers \(w/video\)](#)

[Nanowerk](#), 27JAN2017

Researchers at Rice University found that one-dimensional boron could be a unique material that incorporates both a semiconductor and a metallic conductor. One-dimensional boron forms two well-defined phases—chains and ribbons—which are linked by a “reversible phase transition,” meaning they can turn from one form to the other and back. When metallic ribbons of boron are stretched, they morph into antiferromagnetic semiconducting chains, and when released they fold back into ribbons. This property could be useful in nanoscale sensors to gauge very small forces. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

## MEDICAL SCIENCES

### [We Are Grossly Unprepared for Major Outbreaks Global Biodefense](#), 27JAN2017

An international team of researchers (Switzerland, USA - Harvard University, National Academy of Medicine, Georgetown University, industry, non-profit organizations, UK, Liberia) synthesized seven major post-Ebola reports and identified key problems and recommendations for action in three critical areas: strengthening compliance with the International Health Regulations; improving outbreak-related research and knowledge sharing; and reforming the World Health Organization (WHO) and broader humanitarian response system. [TECHNICAL ARTICLE](#)

*Tags: Medical Sciences, Counter WMD*

## MICROELECTRONICS

### [Self-Healing Transistors for Chip-Scale Starships](#) [IEEE Spectrum](#), 30JAN2017

Instead of selecting a route that minimizes exposure to radiation or shields from it, an international team of researchers (USA - Draper Laboratory, South Korea) are working to design chips that can heal themselves with heat after suffering radiation damage. The study uses “gate-all-around” nanowire transistors which have a high degree of immunity to cosmic rays.

*Tags: Microelectronics*

## NEUROSCIENCE

### [Nasty or nice? Study links personality to brain shape](#)

[Medical Express](#), 25JAN2017

According to an international team of researchers, the shape of our brain can itself provide surprising clues about how we behave and our risk of developing mental health disorders. Specifically, the study focused on combinations of thickness, surface area, and the number of folds in different people. They found that neuroticism was linked to a thicker cortex and a smaller area and folding in some brain regions. Conversely, openness, was associated with a thinner cortex and greater area and folding. Neuroticism, the team said, was a trait underlying mental illnesses such as anxiety disorders, whereas “openness” reflects curiosity and creativity. Brain shape, in itself, is determined by genetic as well as environmental factors.

*Tags: Neuroscience*

## PHOTONICS

### [Micro-bubbles and frequency combs](#) [Science Daily](#), 30JAN2017

An international team of researchers (Japan, USA - Washington University, China) created a frequency comb in the visible spectrum by combining four-wave mixing with a

micro-bubble resonator (MBR). It is microns in size and requires a low-power laser to pump the device. The wall thickness can be controlled precisely allowing an extra degree of freedom. This crucial difference allowed the researchers to tune the central frequency of the device to the visible regime. In future work, they expect to push the limit of the device with even thinner wall dimensions and hope to expand the range of this device to eventually span the gap between the lower wavelength blue light all the way to the near infrared region. The device has applications in medical imaging. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Biotechnology*

### [New 'needle-pulse' beam pattern packs a punch](#)

[Science Daily](#), 27JAN2017

Most traditional beam patterns maintain a persistent shape as long as the source is operating. Researchers at the University of Rochester have developed a mathematical solution that causes light or sound wave to collapse inward, forming an incredibly thin, intense beam before the wave expands outward again. The research has applications to laser materials processing, ultrasound and radar images. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Photonics*

## QUANTUM SCIENCE

### [Chiral quantum optics: A new research field with bright perspectives](#)

[Nanowerk](#), 27JAN2017

Surprising physical effects were observed using special microscopic waveguides for light. Such “photonic structures” are revolutionizing the fields of optics and photonics, and have opened up the new research area of “Chiral Quantum Optics”. In a review article, an international team of researchers (Denmark, Austria) provides an overview of the topic. Optical chips based on chiral quantum optics are not only useful for classical information processing, they are also suitable for processing single photons. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Quantum optical sensor for the first time tested in space](#)

[Physorg.com](#), 25JAN2017

Researchers in Germany working on the MAIUS (Matter-Wave Interferometry in Microgravity) mission, supported by the German Space Agency, demonstrated that quantum optical sensors can be operated even in harsh environments like space—a prerequisite for finding answers to the most challenging questions of fundamental physics and an important innovation driver for everyday applications. The mission launched on January 23, 2017 generated a cloud of nano-Kelvin cold

rubidium atoms in space. This cloud was cooled down with laser light and radio frequency electrical fields so that the atoms finally formed a single quantum object, a Bose-Einstein condensate.

*Tags: Quantum science, S&T Germany*

## S&T POLICY

### [US Navy will fire 150 kilowatt laser on a test ship in 2018 and then from carriers and destroyers in 2019](#)

[Next Big Future](#), 26JAN2017

The US Navy plans to fire a 150-kw weapon off a test ship within a year. That’s quite a jump from the kw AN/SEQ-3(XN-1) Laser Weapon System (LaWS), which deployed in 2014 on the amphibious transport dock USS Ponce. The Navy has contracted the development of a Li-Ion battery subsystem to power the weapon. Improvements of high power fiber lasers used to form the laser beam enable the increased 150 kilowatt power levels and extended range capabilities. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: S&T policy, Military technology*

## SENSORS

### [Low-cost, flexible terahertz radiation source for fast and non-invasive screening](#)

[Physorg.com](#), 31JAN2017

Using metallic thin film heterostructures that are 12-nanometre in thickness, an international team of researchers (Singapore, China) has developed radiation sources that emit broadband THz waves with a higher power output than a standard 500-micrometre thick rigid electro-optical crystal emitter. They can be powered by a low-power laser, hence lowering the operating cost substantially. The research team also devised a low-cost fabrication technique to produce the emitters. When tested on flexible surfaces, the device’s performance was not compromised despite being subjected to a large bending curvature. The device has applications in hand-held sensors, wearable sensors and non-invasive imaging. [TECHNICAL ARTICLE](#)

*Tags: Sensors, Terahertz technology*

### [Keeping antennas at peak performance](#)

[Physorg.com](#), 30JAN2017

Monitoring the antenna elements individually in an antenna system would require the integration of additional and complex electronics into an already complex system. Researchers in Saudi Arabia have developed a statistical technique that detects faults based on the change in the radiation pattern. They use a generalized-likelihood ratio test to construct a control chart that can then be used as reference to detect variations from the desired radiation pattern. The technique requires only one design



parameter and it can be implemented in real time. They have demonstrated the sensitivity of their approach in a number of simulated scenarios. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Sensors*

### [Tiny satellites poised to make big contributions to essential science](#)

[Physorg.com, 27JAN2017](#)

Nanosatellites are as small as a golf ball, weighing between one and 10 kilograms and averaging the size of a loaf of bread. Because they are cheap, more of them can be launched allowing for constellations of simultaneous measurements from different viewing locations multiple times a day. Researchers at the University of Maryland are working on a science-focused CubeSat spacecraft. Their payload called Hyper Angular Rainbow Polarimeter (HARP) is designed to observe interactions between clouds and aerosols suspended in Earth's atmosphere. HARP is poised to be the first U.S. imaging polarimeter in space.

*Tags: Sensors, Satellite technology*

### [Scientists collaborate to increase the accuracy of optical radar](#)

[Eurekalert, 26JAN2017](#)

An international team of researchers (Russia, Finland, Germany) established an international consortium to implement a new approach to increase the accuracy of optical radar's function. A device created by Russian researchers demonstrates 40V / 1 ns. This device might find applications in shipbuilding, automobile, aircraft manufacturing, optical detection and electronic equipment. The aim of scientific consortium is to continue the collaboration for improving the characteristics of the optical emitter, in particular, to increase the radiating power, the pulse repetition rate and the transition to subnanosecond area. [TECHNICAL ARTICLE](#)

*Tags: Sensors* ■

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