



[Advanced manufacturing \(1\)](#)

[Advanced materials \(7\)](#)

[Autonomous systems & robotics \(2\)](#)

[Biotechnology \(1\)](#)

[Counter WMD \(1\)](#)

[Energy \(4\)](#)

[Imaging technology \(1\)](#)

[Information technology \(3\)](#)

[Materials science \(1\)](#)

[Medical sciences \(1\)](#)

[Microelectronics \(1\)](#)

[Neuroscience \(1\)](#)

[Photonics \(3\)](#)

[Quantum science \(3\)](#)

[S&T policy \(1\)](#)

[Sensors \(1\)](#)

FEATURE ARTICLES

[Wireless power could enable ingestible electronics](#)

[MIT News, 27APR2017](#)

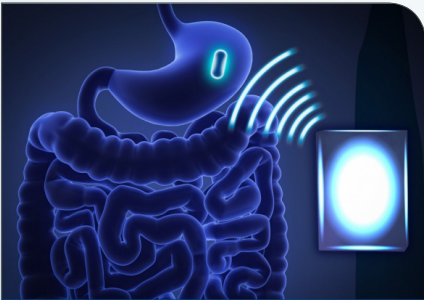


Image: MIT News. Battery image courtesy of Ella Maru Studio / Giovanni Traverso / Abubakar Abid

A team of researchers in the US (MIT, Brigham and Women's Hospital, Charles Stark Draper Laboratory) used midfield transmission, which can transfer power across longer distances, to wirelessly power small electronic devices that can linger in the digestive tract indefinitely after being swallowed. They were able to deliver 100 to 200 microwatts of power to their device, which is more than enough to run sensors that could monitor heart rate, temperature, or levels of particular nutrients or gases in the stomach. It is based on the wireless transfer of power from an antenna outside the body to another one inside the digestive tract. They are developing a whole series of other devices that can stay in the stomach for a long time, and looking at different timescales of how long we want to keep them in. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Biotechnology, Medical sciences, Featured Article

[2-D materials can conduct electricity at almost the speed of light](#)

[Science Daily, 26APR2017](#)

An international team of researchers (USA - UC Berkeley, UC Irvine, Lawrence Berkeley National Laboratory, Kent State University, University of Maryland, China) has fabricated new two-dimensional quantum materials with electrical and magnetic attributes. They found that when bismuth and nickel are brought into contact, at the interface between the two metals, it behaves like an exotic superconductor that breaks time-reversal symmetry. They have stabilized the new material at minus 27

degrees Fahrenheit. The new material could make building blocks of future quantum computers and other advanced electronics. [TECHNICAL ARTICLE 1](#), [OPEN ACCESS 2](#), [OPEN ACCESS 3](#).

Tags: Advanced materials, Featured Article

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

[Robotic Construction Platform Creates Large Buildings on Demand](#)

[IEEE Spectrum, 26APR2017](#)

Researchers at MIT introduced the Digital Construction Platform (DCP) which is mobile (with a top speed of 0.5 meters per second) and self-contained. It is battery powered (with a few solar panels), so it can potentially run forever. The DCP mimics much of the functionality of a 3D building printer. The construction technique that the DCP uses is straightforward. Robots like these would be most valuable after natural disasters or during refugee crises, when you need to create an enormous amount of housing quickly and cheaply. [TECHNICAL ARTICLE](#)

Tags: Advanced manufacturing, Autonomous systems & robotics

ADVANCED MATERIALS

[Controlling proton conduction with light](#)

[Science Daily, 29APR2017](#)

Coordination polymer (CP) crystals are inorganic and organic hybrid materials known for their proton conduction. An international team of researchers (Japan, France) synthesized a CP and enhanced its proton conduction by acid doping. They doped it again with 'photoacid' pyranine. They found that the conductivity of the resulting CP could be switched on and off over several consecutive cycles of light exposure. Doping resulted in minimal structural change in CP and gave the researchers on-demand external control of the ionic current in the material. The technique could be used to synthesize a new class of proton-conducting solids that

continued...

[BACK TO TOP](#)

can be used in non-volatile memory technologies, ionics-based transistors, and light-induced ionic/electric current circuits. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Photonics, S&T Japan

[Diamond-like crystal reflects many-coloured light in all directions](#)

[Nanotechweb, 28APR2017](#)

The efficiency of solar cells depends on how well they trap and absorb sunlight and it can be improved by adding a back reflector. Researchers in the Netherlands report that cubic diamond-like “inverse woodpile” nanostructures, based on silicon, strongly reflect a surprisingly broad range of colours in all directions, whatever the angle of incident light. They show great promise as back reflectors for solar cells and could also be used to make tiny on-chip light sources and lasers, “invisibility cloaks” and non-linear devices for ultrafast all-optical switching. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Solar energy

[Interfering with graphene](#)

[Nanowerk, 28APR2017](#)

To make high-quality graphene, researchers need to pinpoint the positions of graphene’s carbon atoms relative to the metal atoms beneath and measure the strain in the graphene sheet. An international team of researchers (Japan, South Korea) has developed mathematical tools that allow them to extract moiré patterns from scanning tunneling microscopy images, from which the relative positions of carbon and metal atoms can be determined and strains in graphene sheets can be calculated. The tools help to control the synthesis parameters to improve graphene quality. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

[Control of molecular motion by metal-plated 3-D printed plastic pieces](#)

[Science Daily, 27APR2017](#)

Researchers in Switzerland have developed a new fabrication method, and demonstrated it by constructing electrically independent high-voltage electrodes from a single printed plastic piece to guide and split beams of molecules. The procedure allows an almost free choice of the coating metal, including some that would be very hard to machine. The production method not only allows complex shapes to be made but, in addition, speeds up production by a factor of 50-100. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, S&T Switzerland

[For first time, researchers measure forces that align crystals and help them snap together](#)

[Nanowerk, 27APR2017](#)

A team of researchers in the US (Pacific Northwest National Laboratory, University of Pittsburgh) developed

a technique to measure van der Waals forces in titanium oxide crystals. With these measurements one can build a model of 3-D assembly, with particles attaching to each other in select ways like Lego bricks. This work will help us take advantage of the van der Waals forces when designing new materials. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

[From abundant hydrocarbons to rare spin liquids](#)

[Science Daily, 24APR2017](#)

An international team of researchers (Japan, UK, Slovenia) has developed a new chemistry needed to make high-purity crystalline materials from the reaction of polyaromatic hydrocarbons with alkali metals. They discovered that some structures of the new materials, made entirely of carbon and hydrogen, show unprecedented magnetic properties—spin liquid behavior—with potential applications in superconductivity and quantum computing. [TECHNICAL ARTICLE 1, 2](#)

Tags: Advanced materials, Quantum science

AUTONOMOUS SYSTEMS & ROBOTICS

[AI will upload and access our memories, predicts Siri co-inventor](#)

[Kurzweil AI, 26APR2017](#)

According to AI researchers and visionaries, once we have achieved complete models of human intelligence, machines can combine the flexible, subtle human levels of pattern recognition with the natural advantages of machine intelligence, in speed, memory capacity, and, most importantly, the ability to quickly share knowledge and skills. Two projects announced last week aim in that direction: Facebook’s plan to develop a non-invasive brain-computer interface that will let you type at 100 words per minute and Elon Musks’ proposal that we become superhuman cyborgs to deal with super intelligent AI. But trusting machines also raises security concerns.

Tags: Autonomous systems & robotics, Artificial intelligence

[Can DJI’s No-Fly Zone Software Stop ISIS from Weaponizing Drones?](#)

[MIT Technology Review, 26APR2017](#)

A recent trend among terrorists in the Middle East has been to equip off-the-shelf drones with rudimentary explosives to turn them into miniature bombers. Software developed by a company in China can define no-fly zones that the aircraft are forbidden from entering. The company appears to have added a series of locations across Syria and Iraq. It’s not clear how constructive the move will be, because it is possible to circumvent the no-fly zones by tweaking the drones.

Tags: Autonomous systems & robotics, Military technology

“Deep inside the chaos lurks an even eerier type of order.”

DOUGLAS HOFSTADTER

COUNTER WMD

[The World Needs a DARPA-Style Project to Prevent Pandemics](#)

Harvard Business Review, 24APR2017

According to the [Blue Ribbon Study Panel on Biodefense](#), U.S. levels of readiness and global coordination are woefully inadequate. According to the authors, an important first step in this effort is for the U.S. and governments around the world to develop an organization equivalent to the Defense Advanced Research Projects Agency that focuses cross-sector efforts on advancing biological and pandemic risk readiness. They make recommendations for the public sector, private sector, and research/science communities to work better together.

Tags: Counter WMD, S&T Policy

ENERGY

[Discovery of a facile process for hydrogen production using ammonia as a carrier](#)

Science Daily, 29APR2017

Researchers in Japan found that H_2 can be produced by supplying ammonia and oxygen at room temperature to a pre-treated $RuO_2A_{12}O_3$ catalyst, without external heating. The heat evolves by ammonia adsorption onto this catalyst, increasing it to the catalytic auto-ignition, initiating H_2 production. In this process, once the reaction is initiated, it can start again repeatedly even if there is no external heat supply because adsorbed ammonia is desorbed during the reaction. The discovery contributes to the development of efficient, carbon-free energy production and global solutions for energy and climate crises. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, S&T Japan

[Metal nanoparticles induced visible-light photocatalysis](#)

Nanowerk, 27APR2017

In this review article, researchers in China introduce the light absorption of metal nanoparticles and the mechanisms proposed in metal-induced photocatalysis (MIP). Its applications in water splitting, artificial photosynthesis and inert molecular activation are summarized. Strategies for improving efficiency of catalytic activity are reviewed. They address the challenges and discuss possible future directions for MIP. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Materials science, S&T China

[NRL breakthrough enables safer alternative to lithium-ion batteries](#)

EurekaAlert, 27APR2017

Although lithium-based batteries are ubiquitous, there are still challenges related to their longevity and safety, as well as concerns about material availability. A team of researchers in the US (Naval Research Laboratory, industry partner) has demonstrated that when zinc is formed into three-dimensional sponges, it can be used with nickel to form primary batteries that allow for deep discharge. Alternatively, the sponges can be used to produce secondary batteries that can be cycled thousands of times and can compete with lithium ion cells. [TECHNICAL ARTICLE](#)

Tags: Energy, Battery, Government S&T

[Stabilizing molecule could pave way for lithium-air fuel cell](#)

Science Daily, 26APR2017

In lithium batteries, the loss of battery power occurs when the electrolyte reacts with the electrodes. Researchers at Cornell University have developed an artificial solid-electrolyte interphase (SEI), a material that protects the electrodes while promoting the flow of electrons from one end of the cell to the other. The interphase is based on bromide-containing ionic polymers (ionomers) that selectively tether to the lithium anode to form a few-nanometers-thick conductive coating that protects the electrode from degradation. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Advanced materials

IMAGING TECHNOLOGY

[The world's fastest film camera: When light practically stands still](#)

Science Daily, 28APR2017

Researchers in Sweden use “coded” light flashes as a form of encryption. Every time a coded light flash hits the object, the object emits an image signal (response) with the exact same coding. The light flashes have different codes, and the image signals are captured in one single photograph. The coded image signals are subsequently separated using an encryption key on the computer. The camera can film at a rate equivalent to five trillion images per second. The technology has applications in the study of plasma discharges, the lifetime of quantum states in combustion environments, biological tissue and how chemical reactions are initiated. [VIDEO OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Imaging technology, S&T Sweden

continued...

INFORMATION TECHNOLOGY

Hybrid circuits can increase computational power of chaos-based systems

Physorg.com, 28APR2017

Noise has always been a big problem in computing devices and communications. A team of researchers in the US (North Carolina State University, State College of Wooster) created a hybrid system which uses a digital block of AND gates and an analog nonlinear circuit to distribute the computation between the digital and analog circuits. The computations are performed so quickly that noise doesn't have time to affect their accuracy. They coupled multiple systems reducing the effect of noise-based deviations at the final stage. The research could lead to circuits that can perform more computations without increasing their physical size. [OPEN](#)

[ACCESS TECHNICAL ARTICLE](#)

Tags: Information technology

FEATURED RESOURCE

Nature Podcast

Every show features highlighted content from the week's edition of Nature including interviews with the people behind the science, and in-depth commentary and analysis from journalists covering science around the world. [RSS](#)

How state-of-the-art camera that behaves like the human eye could benefit robots and smart devices

Science Daily, 27APR2017

Researchers in the UK, with industry partners will examine how data from the state-of-the-art cameras could be captured, compressed and transmitted between machines at a fraction of the current energy cost. The neuromorphic sensors mimic how mammals' eyes process information, quickly and efficiently detecting light changes in their field of vision. The sensors drastically reduce computing power and data storage requirements by only updating the parts of an image where movement occurs. This energy saving opens a world of new possibilities for surveillance and other uses, from robots and drones to the next generation of retinal implants. The team will be looking at how these sensors could work together as part of IoT.

Tags: Information technology, S&T UK

Supercomputing: Probing the Future

NIST, 25APR2017

The aim of IARPA's Cryogenic Computing Complexity (C3) program is to enable a new generation of low-power superconducting supercomputers that operate at liquid-helium temperatures and use ultra-fast switching of Josephson junctions. Researchers at NIST have developed a novel automated probe system for evaluating the performance of computer components designed to run 100 times faster than today's best supercomputers and consume as little as 1/1000th the energy to support C3.

Tags: Information technology, Government S&T

MATERIALS SCIENCE

Scientists set record resolution for drawing at the one-nanometer length scale

Science Daily, 28APR2017

Researchers at the Brookhaven National Laboratory pushed the resolution limits of Electron Beam Lithography by installing a pattern generator that provides a focused electron beam at the atomic scale. They patterned polymer poly(methyl methacrylate) (PMMA) films to use as a stencil and used it to create structures smaller than 5 nm in both metallic (gold palladium) and semiconducting (zinc oxide) materials. This technique opens many materials engineering possibilities, tailoring properties if not atom by atom, then closer than ever before. [TECHNICAL ARTICLE](#)

Tags: Materials science, Government S&T, Microelectronics

MEDICAL SCIENCES

Possible new tool for first responders: An ice bag to the face

Science Daily, 26APR2017

Decompensation, a sudden precipitous drop in blood pressure that limits oxygen delivery to the heart, brain and other vital organs, is a significant risk after blood loss, even after the person is no longer actively bleeding. Researchers at the University at Buffalo report that a simple bag of ice water applied to the face could help maintain adequate blood pressure in people who have suffered significant blood loss. This technique could be used by first responders or combat medics on the battlefield to give additional time for transportation or evacuation.

Tags: Medical Sciences, Biotechnology

MICROELECTRONICS

NIST invents fundamental component for 'spintronic' computing

Physorg.com, 27APR2017

Researchers at NIST combined spin valves and memristors to develop a device which is designed to provide one key component in spintronic systems. It's a very simple, fundamental building block that can be used in a variety of different ways. It can serve as an on-off switch for spin

continued...

currents, as an interconnect between different spintronic components, and as an interface between magnetic and electronic features to realize multifunctional devices. The research removes a significant technological barrier for spintronics to become a strong contender for beyond-CMOS microelectronics.

Tags: Microelectronics, Government S&T

NEUROSCIENCE

[TNT Researchers Set Out to Advance Pace and Effectiveness of Cognitive Skills Training](#)

[DARPA News](#), 26APR2017

In March 2016, DARPA announced the Targeted Neuroplasticity Training (TNT) program which is approaching the study of synaptic plasticity from multiple angles to determine whether there are safe and responsible ways to enhance learning and accelerate training for skills relevant to national security missions. It is funding eight efforts at seven institutions in a coordinated research program that focuses initially on the fundamental science of brain plasticity and aims to conclude with human trials in healthy volunteers. The program will also compare the efficacy of invasive versus non-invasive stimulation, investigate how to avoid potential risks and side effects of stimulation, and hold a workshop on the ethics of using neurostimulation to enhance learning.

Tags: Neuroscience, DARPA

PHOTONICS

[New organic lasers one step closer to reality](#)

[Physorg.com](#), 28APR2017

Researchers in Japan have developed an optically pumped organic thin-film laser that can continuously emit light for 30 ms. A very promising feature of organic thin-film lasers is the possibility to more easily achieve colors that are difficult with inorganic lasers. By designing and synthesizing molecules with new structures, emission of any color of the rainbow is possible. They developed strategies for extending the duration of lasing by combining three strategies. The technology has applications in spectroscopy, communications, displays, and sensors.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Photonics

[Hybrid nanolaser diode goes ultra-compact](#)

[Nanotechweb](#), 27APR2017

Researchers in France have made the first ultra-compact laser diode that can be integrated with silicon photonic waveguides without losing its light-emitting efficiency. The device, which works at the important telecommunications wavelength of 1.56 μm , could be used for constructing optical networks at the sub-millimetre scale for intra-chip optical interconnects and signal processing.

[TECHNICAL ARTICLE](#)

Tags: Photonics, S&T France

[Light has new capacity for electronics](#)

[Nanowerk](#), 27APR2017

Researchers in Japan have experimentally demonstrated the existence of the intrinsic photodielectric effect in a ceramic with the composition $\text{LaAl}_{0.99}\text{Zn}_{0.01}\text{O}_{3-\delta}$. In their experiments, they shined an LED onto the ceramic and measured its dielectric permittivity which increased even at high frequencies. The material remained a good insulator. The lack of a significant loss means the LED is directly altering the dielectric permittivity of the material, and not increasing conductance. It is still unclear how the intrinsic photodielectric effect works, but it may have to do with defects in the material. The research could lead to laser-controlled touch displays. [TECHNICAL ARTICLE](#)

Tags: Photonics, S&T Japan

QUANTUM SCIENCE

[Unexpected damage found rippling through promising exotic nanomaterials](#)

[Science Daily](#), 28APR2017

A team of researchers in the US (Yale University, Harvard University, Brookhaven National Laboratory) developed a technique that revealed why helium-ion beam lithography failed to create superconducting nanowires predicted by both theory and simulation. The new study revealed that the beam used to carve 10-nm-wide channels, induced damage rippling out over 50 times that distance. At this scale, that difference was both imperceptible and functionally catastrophic. This directly addresses the challenge of quantum computing. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science, Advanced materials, Government S&T, Materials science

[Beyond classical computing without fault-tolerance: Looking for the quantum frontier](#)

[Science Daily](#), 27APR2017

An international team of researchers (Australia, UK) developed a new theoretical framework to identify computations that occupy the 'quantum frontier', the boundary at which problems become impossible for today's computers to solve. The team has identified quantum computations that require the least known physical resources required to go beyond the capabilities of classical computers. The results indicate that full fault-tolerance may not be required to outperform classical computers. The research could lead to useful 'intermediate' quantum computers in the medium term, while we continue to pursue the goal of a full-scale universal quantum computer. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science

[NV-quantum probes measure electron flow in graphene](#)

Nanotechweb, 27APR2017

Researchers in Australia have developed a technique based on quantum probes made from nitrogen-vacancy centres to image the flow of electric current in 2D nanomaterials like a carbon sheet, and has found that it is indeed disrupted by minute cracks and defects. The technique is non-invasive, offers high sub-micron spatial resolution and works under ambient conditions. It could be used to study electron transport in any atomically-thin materials and structures. Research could help in understanding the effect of imperfections on a device's performance and in the study of exotic electric phenomena such as the quantum Hall effect which are important for developing next-generation electronics and quantum computers. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science, S&T Australia*

S&T POLICY

[A Century of Science: Globalization of Scientific Collaborations, Citations, and Innovations](#)

ArXiv, 17APR2017

From their study, researchers at Microsoft, found that science has benefited from the shift from individual work to collaborative effort, with over 90% of the world-leading innovations generated by collaborations in this century; modern scientists tend to look for literature further back and farther around. According to the researchers, the findings are meant to serve as a starter for generating insight into and an impact upon the current scientific innovations and funding policies. Open Access [TECHNICAL ARTICLE](#)

Tags: *S&T policy, Science without borders*

SENSORS

['Spectral Fingerprinting' Sees Through Concrete to Detect Early Corrosion](#)

R&D Magazine, 24APR2017

When iron corrodes, goethite and hematite are the most commonly produced products. A team of researchers in the US (NIST, USFDA, Maryland Department of Transportation) has shown that terahertz radiation can detect both corrosion products in the early stages of formation, yielding 'spectral fingerprints' unique to goethite and hematite, and in turn corrosion. They predict that the technology should be able to penetrate 50 millimeters, the thickness of the concrete covering the first layer of rebar used in most steel-reinforced concrete structures. [TECHNICAL ARTICLE](#)

Tags: *Sensors* ■

ABOUT THIS PUBLICATION

The appearance of external hyperlinks in this publication does not constitute endorsement by the United States Department of Defense (DoD) of the linked web sites, nor the information, products or services contained therein. In addition, the content featured does not necessarily reflect DoD's views or priorities.

To **SUBSCRIBE or UNSUBSCRIBE**, visit <https://tin-ly.sainc.com/ASDRE/Subscription>. To provide feedback or ask questions, contact us at asdre-st-bulletin-reply@sainc.com. This publication is authored and distributed by:

Ryan Zelnio, Ph.D., Associate Director - Tech Watch / Horizon Scans, Office of Net Technical Assessments, OSD AT&L/OASD(R&E)

Ms. Hema Viswanath, TW/HS, ONTA Corporate Librarian