



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Researchers show that enzyme function inhibits battery ageing](#)

[Physorg.com, 20MAR2017](#)

To counter ageing in cells caused by excited oxygen molecules, nature uses an enzyme called superoxide dismutase. An international team of researchers (Austria, France, UK) has found parallels of oxygen chemistry in battery systems. They have developed detection methods to show that singlet oxygen is mainly responsible for ageing in non-aqueous oxygen batteries. They identified a class of molecules which can act as “enzymes.” The “enzyme” can be introduced into the battery system—either through the electrolyte itself or an additive which dissolves in the electrolyte. [TECHNICAL ARTICLE](#)

*Tags: Energy, Battery, Materials science, Featured Article*

### [A multi-channel nano-optical device dramatically increases the parallel processing speed](#)

[Nanowerk, 17MAR2017](#)

Many microprocessors are used in parallel to increase the speed of information processing. To solve the problem of bottleneck in data transfer, researchers in South Korea used surface plasmons to mediate optoelectronic signaling. Nano antennas convert optical signals to surface plasmons which propagate through the metal surface as electric signals. An increase in the number of antennas means an increase in the number of multiple input channels in the MIMO communication, which leads to an increase in the information transmission bandwidth.

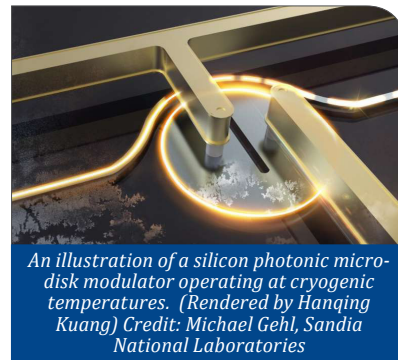
[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Communications technology, Information technology, Featured Article*

### [Electro-optical switch transmits data at record-low temperatures](#)

[Physorg.com, 16MAR2017](#)

Researchers at Sandia National Laboratory have developed a silicon optical switch that transmits up to 10



An illustration of a silicon photonic micro-disk modulator operating at cryogenic temperatures. (Rendered by Hanqing Kuang) Credit: Michael Gehl, Sandia National Laboratories

gigabits per second of data at temperatures just a few degrees above absolute zero. They optimized the amount of impurities used and the exact placement of those impurities to allow the micro-disk modu-

lator to operate at low temperatures. Their approach could be used to make other electro-optical devices that work at low temperatures. The device was fabricated with standard techniques used to make CMOS computer chips, which means it can be easily integrated onto chips containing electronic components. The supercomputers could potentially offer computing speeds ten times faster than today’s computers while significantly decreasing power usage. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Information technology, Government S&T, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [How fullerite becomes harder than diamond](#) [Eurekalert, 20MAR2017](#)

Fullerite is a molecular crystal with fullerene molecules at its lattice nodes. Researchers in Russia developed a model to understand the nature of its unique properties and systematically synthesize the new ultra-hard carbon materials. Fullerite itself is not very hard; its bulk modulus is 1.5 times less than that of diamond. But when it’s compressed, its bulk modulus increases dramatically. To preserve this enhanced bulk modulus, the fullerite should always remain in such a compressed state.

[TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science, S&T Russia*

*continued...*

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## **European team announces superconductivity breakthrough**

Physorg.com, 15MAR2017

An international team of researchers (Austria, Belgium, Britain, France, Germany, Italy, Romania, Slovakia, Spain) working on Eurotapes, an EU sponsored project on superconductivity, has produced 600 metres of tape made of copper oxide that conducts 100 times more electricity than copper and generates more intense magnetic fields. The new material could be used to make more potent and lighter wind turbines.

Tags: *Advanced materials, S&T EU*

## **Two-dimensional polymer breakthrough that could revolutionize energy storage**

Science Daily, 13MAR2017

Researchers in Singapore used planar molecules that have several aromatic rings consisting of a series of connected carbon double bonds through which electrons can move. When it is used as the anode material in sodium ion batteries, it can be charged and discharged quickly at room temperature. It retained 70 per cent of its capacity after 7,700 charge cycles. The thermal annealing method, without the use of solvents, initiators or catalysts enables fabricating the polymer on a large scale at comparable cost. The use of an organic-based material provides a safer storage medium for sodium ions. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials, Energy*

## **AUTONOMOUS SYSTEMS & ROBOTICS**

### **How DeepMind's Memory Trick Helps AI Learn Faster**

MIT Technology Review, 16MAR2017

While AI systems can match many human capabilities, they take 10 times longer to learn. To close this gap researchers at Google have built a system that has both a conventional deep-learning system that mimics the behavior of the prefrontal cortex and an episodic approach using the hippocampus. It doesn't try to learn what to remember. Instead, it remembers everything. They use a set of strategies to read from this large memory quickly. The result is a system that can latch onto successful strategies much more quickly than conventional deep-learning systems. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Autonomous systems & robotics, Artificial intelligence*

### **Is reliable artificial intelligence possible?**

Physorg.com, 15MAR2017

Researchers in France argue that AI technology should be openly available. On a practical level, AI is implemented through "machine learning", which means using a computer to run specifically designed software that can be "trained" with the help of algorithms and

to correctly identify certain features from that data set. But visual data sets can be perturbed that can result in mis-classifying images. Such perturbations pose a serious threat in AI-assisted medical diagnostic tools and filtered information that reaches us every day. This underscores the importance of certifying AI technology and monitoring its reliability.

Tags: *Autonomous systems & robotics, Artificial intelligence*

## **BIOTECHNOLOGY**

### **Engineers design "tree-on-a-chip"**

MIT News, 20MAR2017

An international team of researchers (USA- MIT, Cornell University, Denmark) has designed a microfluidic device they call a "tree-on-a-chip," which mimics the pumping mechanism of trees and plants. Like its natural counterparts, the chip operates passively, requiring no moving parts or external pumps. It can pump water and sugars through the chip at a steady flow rate for several days. The technology can be leveraged as a simple hydraulic actuator for small robots. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Biotechnology*

## **CYBER SECURITY**

### **A New Way to Spot Malicious Apps**

MIT Technology Review, 17MAR2017

A team of researchers in the US (Florida International University, Georgia Institute of Technology) has developed FairPlay, a system that uncovers both malware and search rank fraud apps by picking out trails that fraudsters leave behind when fraudulently boosting their ratings, instead of scanning the code for malicious software. It can spot malicious activity that otherwise slips through Google's security system. They used a set of 400 fraudulent reviews to train a machine-learning algorithm to spot others like them. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Cyber security*

### **Is fog more secure than cloud?**

Physorg.com, 17MAR2017

Researchers in Italy propose a solution based on a distributed service which they call "fog". The protocol uses the network in an unconventional way to make a document fully immaterial, that is the document is not localisable anywhere in its entirety. The files are distributed on a public or private network and only the injectors and extractors can access them. The inaccessibility by others, the non-location, and the dynamics of the system offer significant advantages in terms of security but raise some legal problems. [TECHNICAL ARTICLE](#)

Tags: *Cyber security, Information technology, S&T Italy*



“It has become clear beyond all doubt that scientific research is absolutely essential to national security.” VANNEVAR BUSH

### Smartphone Accelerometers Can Be Fooled by Sound Waves

IEEE Spectrum, 17MAR2017

A team of researchers in the US (University of Michigan, University of South Carolina) reports that they could fool accelerometers using sound waves—in particular, a single tone played at an accelerometer’s resonant frequency. Any device that relies on data from a sensor to make a critical decision can potentially be led astray by that sensor. In tests 75 percent of the accelerometers could be fooled by an attack that allowed them to slightly alter the sensors’ signals for a moment, and 65 percent were vulnerable to a more severe attack that allowed the team to control their signals indefinitely. Entrepreneurs and consumers should be wary of turning too many decisions and responsibilities over to any devices that rely on sensor data, until the industry figures out how to better validate that data.

Tags: Cyber security

### Security for multirobot systems

MIT News, 16MAR2017

Multi-robot networks can be gravely disrupted by the Sybil attack, where even a single malicious robot can spoof many fake clients. A team of researchers in the US (MIT, Carnegie Mellon University, MIT Lincoln Laboratory) has developed an algorithm that can “sense” spoofers using the physics of wireless signals, if it is implemented on commercial Wi-Fi radios. They have demonstrated spoofer detection rates of over 96%. The work has important implications for networked autonomous driving cars and delivery drones.

TECHNICAL ARTICLE

Tags: Cyber security, Autonomous systems & robotics

### Researchers present early warning system for mass cyber attacks

Physorg.com, 15MAR2017

A new type of DDoS attack, called amplification attack, was found to be the source of many outages. An international team of researchers (Germany, Japan) has developed a special kind of digital bait for distributed attacks where 21 honeypot traps were laid out in the more obscure corners of the Internet, enabling the researchers to document more than 1.5 million attacks. They attached secret digital markers to the attack codes they discovered in the digital wilderness, and could trace the source of the attacks. The different phases of attacks helped develop an early warning system from the data.

Tags: Cyber security

## ENERGY

### Liquid fuel for future computers

Nanowerk, 15MAR2017

Researchers in Switzerland used two liquids that are known to be suitable both as flow-battery electrolytes and cooling medium dissipating excess heat from the chip stack via the same circuit. The electrochemical reactions in the battery occur in two thin and porous electrode layers that are separated by a membrane. They stacked chips layer by layer to build a battery that is approximately 1.5 millimetres thick with 1 watt per square centimetre density.

TECHNICAL ARTICLE

Tags: Energy, Battery, S&T Switzerland

## GOVERNMENT S&T

### Taking Animal Magnetism to the Extreme

DARPA News, 17MAR2017

DARPA’s Atomic Magnetometer for Biological Imaging In Earth’s Native Terrain (AMBIENT) program is challenging the research community to devise new types of magnetic gradiometers that can detect picoTesla- and femtoTesla magnetic signatures out in the open, without shielding and with whatever the ambient magnetic field environment might be. The technology will offer a powerful new tool for medical research and clinical diagnosis of neurological and cardiac activity, the capability of high-sensitivity magnetic sensing in a low-cost device that can operate in common environments, and magnetic navigation (MagNav) as a backup, alternative, or supplement to GPS-based navigation.

Solicitation

Tags: Government S&T, DARPA

## MATERIALS SCIENCE

### Better nanoimages ‘spin’ the path to improved magnetic memory

Nanowerk, 17MAR2017

Nanoscale variations of magnetization direction could affect the ability of electron spin to flip magnetization. A team of researchers in the US (NIST, University of Maryland, Los Alamos National Laboratory) reports that instead of flipping magnetization up or down, the spin current flips the magnetization along whatever its preferred local [spin] axis happens to be. This suggests that materials used for magnetic memory devices may need to be gently heated, a process that aligns nanoscale magnetic domains. By controlling when and how quickly the magnetization can be flipped without expending significant electrical power, scientists hope to improve MRAM. TECHNICAL ARTICLE 1, TECHNICAL ARTICLE 2, TECHNICAL ARTICLE 3

Tags: Materials science, Microelectronics

continued...

## [Study sheds light on interactions that change the way heat and electricity move through microchips](#)

Physorg.com, 15MAR2017

Dislocations in crystals have a strong effect on phonons. A team of researchers in the US (MIT, Brookhaven National Laboratory, Boston College) has found a new mathematical approach based on rigorous quantum field theory that resolves a number of issues, including dynamic and static scattering and works well at nanoscale. Combining this with the quantum mechanical treatment of the dislon-electron interaction could lead to new strategies to optimize materials by using metallurgical approaches to engineer the structure, type, and location of dislocations within a material. [TECHNICAL ARTICLE 1](#), [OPEN ACCESS TECHNICAL ARTICLE 2](#)

Tags: *Materials science, Microelectronics*

## [Switching oxygen on and off](#)

Science Daily, 14MAR2017

A non-reactive oxygen molecule can be turned into reactive state by increasing the temperature or adding an additional electron to the molecules. Researchers in Austria show that activation occurs when electrons are injected or removed into/from the O<sub>2</sub> molecule. Two different charge states of O<sub>2</sub> can be easily distinguished by atomic force microscopy. This catalytic step plays a major role in applications such as heterogeneous catalysis and fuel cells. The research opens new possibilities for studying catalytic and photocatalytic processes.

[TECHNICAL ARTICLE](#)

Tags: *Materials science, Energy*

## FEATURED RESOURCE

### [EurekaAlert](#)

EurekaAlert is an online, global news service operated by AAAS, featuring news and resources focused on all areas of science, medicine and technology. [RSS](#)

## NEUROSCIENCE

### [A radical rethink is needed to understand the brain](#)

Medical Express, 16MAR2017

The idea that the brain is made up of numerous regions that perform specific tasks is known as “modularity”. Now researchers believe the brain and its diseases in general can only be understood as an interplay between tremendous numbers of neurons distributed across the central nervous system. The function of any one neuron is dependent on the functions of all the thousands of

neurons it is connected to. The same region or the same neuron may be used across a huge number of contexts, but have different specific functions depending on the context. The way forward for neuroscience may be to focus more on general neural recordings without aiming to hold each neuron or brain region responsible for any particular function.

Tags: *Neuroscience*

### [Brain Scans can Distinguish between Criminal Intent and Reckless Behaviour](#)

Technology Org, 15MAR2017

Because criminal statutes demand it, often juries must assess criminal intent by determining which of two legally defined mental states a defendant was in when committing a crime. An international team of researchers (UK, USA - Virginia Tech, University of Kentucky, Ohio State University, Vanderbilt University, University of Pennsylvania) uses neuroimaging and machine-learning techniques to reveal different brain activities correlated with these two mental states to provide a proof of principle that brain imaging can determine, with high accuracy, on which side of a legally defined boundary a person’s mental state lies. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Neuroscience*

## PHOTONICS

### [Combining Twisted Light and Plasmons Could Supercharge Data Storage](#)

IEEE Spectrum, 16MAR2017

An international team of researchers (Israel, Germany, Ireland) has developed a way to exploit the orbital angular momentum of light in a confined device using plasmonics, making it possible to use it in chip-scale devices. It would dramatically enhance information transfer capability and the ability to entangle photons for quantum encryption. While the engineering of data storage devices may be a long way off, the research is opening an entirely new way of modifying light-matter interaction. [TECHNICAL ARTICLE](#)

Tags: *Photonics*

## QUANTUM SCIENCE

### [‘Flying saucer’ quantum dots hold secret to brighter, better lasers](#)

Science Daily, 20MAR2017

An international team of researchers (Canada, USA - Vanderbilt University, Los Alamos National Laboratory, University of New Mexico) created quantum dots with a spherical core and a shell shaped like an oblate spheroid. The mismatch between the shape of the core and the shell introduces a tension that affects the electronic states of the quantum dot, lowering the amount of energy needed to trigger the laser. The quantum dots are no longer in danger of overheating, so the resulting laser can fire continuously. The technology has applications in the study of diseases at

*continued...*



the level of tissues or individual cells, and more energy efficient display projectors. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

### [One Photon, a Trillion Atoms](#)

[Optics and Photonics, 16MAR2017](#)

Researchers in Poland have demonstrated robust, 12-dimensional entanglement between a single photon and a suite of a trillion hot rubidium atoms, storing the entangled state for 6 microseconds. This state allows them to demonstrate the original Einstein–Podolsky–Rosen paradox with two different entities with an unprecedented delay time of 6  $\mu$ s between generation of entanglement and detection of the atomic state. Entanglement of light and matter is an essential resource for effective quantum engineering. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science, Foreign S&T*

### [Researchers beat the quantum limit of microwave measurements](#)

[Physorg.com, 16MAR2017](#)

Researchers in Finland combined microwave resonators with vibrating nanodrums and developed a technique to drive the nanodrums to realize a measurement that even goes beyond the quantum limit. For the particle this would be possible by measuring only either the position or momentum, and completely discarding the information about the other property. The new method can potentially be used in quantum computing and the measurement of gravitational waves. [TECHNICAL ARTICLE](#)

Tags: *Quantum science, S&T Finland*

## S&T POLICY

### [Fundamental scientific research helps build a strong defense](#)

[NSF News, 20MAR2017](#)

The NSF has ties to national defense that go back to its beginnings, as a product of the U.S. government working to enhance security during and after World War II. The National Science Foundation Act of 1950 called for the creation of an agency to “promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense.” The following is a list of eight ways NSF-funded research supports the military: Building a stronger bulletproof vest, Countering violent extremism, Fundamental physics for better GPS, Improving prosthetics with brain-computer interface, Minimizing blood loss in battle wounds, Software that helps military veterans with PTSD, depression and other issues, Detecting explosives using a tip from nature, and Predicting conflict.

Tags: *S&T policy*

### [Top 10 tech trends for feds to watch](#)

[Federal Computer Week, 16MAR2017](#)

Some of the IT and management issues that will be the focus of government time and attention in the months ahead are Convergence in the marketplace, IT modernization, Cybersecurity, Mobility, Big data, Access to innovation and Increasing speed and improving outcomes in IT contracting.

Tags: *S&T policy*

### [Italy Transforms Itself into a High-Tech Hotbed](#)

[MIT Technology Review, 15MAR2017](#)

Italy is going through a very important and radical transformation from traditional manufacturing to advanced, flexible manufacturing. Their leaders are staking their future on digitalization, education, and strategic collaboration. Small and midsize enterprises are nimble and flexible and very fast to adopt new technologies. Italy is also among the world leaders in industrial machinery more than 70 percent of which is exported to other markets worldwide. They emphasize that their nation’s future depends on collaborating with companies, agencies, and universities from beyond their own borders. The plan also includes a strong educational component.

Tags: *S&T policy, S&T Italy*

### [UN agency: China has explosive growth in patent applications](#)

[Physorg.com, 15MAR2017](#)

Overall, the United States was first for the 39th straight year and accounted for nearly 56,600 applications under the Patent Cooperation Treaty, followed by Japan at over 45,200 and China at nearly 43,200. The U.N.’s intellectual property agency says China is showing “quite extraordinary” growth in international patent applications, putting Chinese applicants on track to outpace their U.S. counterparts within two to three years.

Tags: *S&T policy, S&T China*

### [China’s First Overseas Military Base Nearing Completion](#)

[Next Big Future, 13MAR2017](#)

The Chinese base [in Djibouti] would be about four miles from the U.S. base at Camp Lemonnier, one of the Pentagon’s largest and most important foreign military installations, where about 3,000 U.S. military personnel and contractors are assigned to Combined Joint Task Force-Horn of Africa. The Chinese military base will be part of a major Chinese port development project in Djibouti. The Chinese Merchants Group, a Hong Kong conglomerate, announced a \$400 million investment in Djibouti last November to develop a free trade zone.

Tags: *S&T policy, Military technology, S&T China*

## SENSORS

**Silk sensor could speed development of new infrastructure, aerospace and consumer materials**

[Physorg.com](#), 17MAR2017

An international team of researchers (USA - NIST, UK) has developed a nanoscale probe for observation of interactions at the interface of composite materials. They use fluorescence lifetime imaging and hyperspectral imaging to observe activation of a fluorogenic dye at the composite interface as a result of applied stress. It is monitored through emission wavelength shifts and fluorescence lifetime variations. Interfacial mechano-responsive dyes have potential for both fundamental studies as well as industrial use as a structural health monitoring tool. TECHNICAL ARTICLE

*Tags: Sensors, Advanced materials*

**New Eyes Seeking Targets in Forests**

[Defense Update](#), 14MAR2017

Researchers in Israel have developed a foliage penetrating radar ELM-2112FP, operating in the L-band, that can penetrate 'few tens of meters' into dense vegetation, to detect moving targets hidden in dense shrubs, forests, and jungles, from a distance of several kilometers away. Based on Frequency Modulated Continuous Wave (FMCW) technology the radar uses a single emitter and simultaneous, electronically scanned multi-beam array to cover a wide area. Each pair (emitter and receiver array) covers 90 degrees. Multiple sets can be stacked to achieve wider coverage.

*Tags: Sensors, Military technology* ■

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