

[Advanced materials \(5\)](#)[Communications technology \(1\)](#)[Cyber security \(2\)](#)[Energy \(3\)](#)[Environmental science \(1\)](#)[Forecasting \(2\)](#)[Imaging technology \(1\)](#)[Information technology \(3\)](#)[Materials science \(2\)](#)[Microelectronics \(3\)](#)[Photonics \(1\)](#)[Quantum science \(3\)](#)[S&T policy \(2\)](#)[Science without borders \(1\)](#)[Sensors \(2\)](#)

FEATURE ARTICLES

[Artificial intelligence in quantum systems, too](#)

[Physorg.com](#), 22FEB2017

Using quantum simulators, researchers in Spain developed the concept of quantum biomimetics by imitating natural selection, memory and intelligence. They recreated a natural selection environment in which there were individuals, replication, mutation, interaction with other individuals and the environment, and a state equivalent to death. The mechanism to simulate memory consists of a system governed by equations. In the quantum algorithms relating to learning processes, they developed mechanisms to optimize well-defined tasks and to improve the error margins and reliability of operations. According to the researchers, the memory method can be used to resolve highly complex systems. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science, Biomimetics, Featured Article

[Cameras can steal data from computer hard drive LED lights -- Ben-Gurion U. study](#)

[Eurekalert](#), 22FEB2017

Researchers in Israel utilized the hard-drive activity LED lights that are found on most desktop PCs and laptops to show that once malware is on a computer, it can indirectly control the HDD LED, turning it on and off rapidly (thousands of flickers per second) -- a rate that exceeds the human visual perception capabilities. As a result, highly sensitive information can be encoded and leaked over the fast LED signals, which are received and recorded by remote cameras or light sensors. They demonstrated that data can be stolen from air-gapped computers which are isolated both logically and physically from public networks.

Tags: Cyber security, Featured article

[Physicists investigate erasing information at zero energy cost](#)

[Physorg.com](#), 22FEB2017



Credit: CC0 Public Domain

A few years ago, physicists showed that it is possible to erase information without using any energy - instead it could be paid in terms of spin angular momentum.

Researchers in Australia

found that the discrete fluctuations are suppressed even more quickly which means that the fluctuations have an extremely low probability of using less than the minimal cost required to erase information using spin. The new results reveal insight into the thermodynamics of spin and could also guide the development of future applications, such as heat engines and information processing devices. [TECHNICAL ARTICLE](#)

Tags: Information technology, Quantum science, S&T Australia, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Three layers of graphene reveals a new kind of magnet](#)

[Science Daily](#), 23FEB2017

An international team of researchers (India, Japan) sandwiched graphene between layers of boron nitride. As they have few imperfections to impede the flow of electrons in graphene, the electrons can travel much longer distances, up to 10 micrometers. The team observed faint whispers of electrons "talking to each other" which gives rise to magnetism. The study provides insight into how electronic devices using graphene could be fabricated to study basic science as well as other applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

continued...

[BACK TO TOP](#)

[Improved polymer and new assembly method for ultra-conformable 'electronic tattoo' devices](#)

Physorg.com, 22FEB2017

Researchers in Japan have established a method of joining electronic components without soldering, allowing thinner and more flexible elastomer films. Conductive lines and elements such as chips and LEDs are connected by adhesive sandwiching between two elastomeric nanosheets, without using chemical bonding by soldering or special conductive adhesives. The resulting ultrathin structures achieve better adhesion and comfort for skin-contact applications. The new system was proven functional for several days on an artificial skin model.

[TECHNICAL ARTICLE](#)

Tags: Advanced materials, Flexible electronics, S&T Japan

[Engineers overcome a hurdle in growing a revolutionary optical metamaterial](#)

Nanowerk, 21FEB2017

Researchers at the University of Pennsylvania have demonstrated a simple approach for spontaneously growing double-diamond crystals that contain a suitable diamond structure, using DNA to direct the self-assembly process. They used DNA-covered opal microspheres in two slightly different sizes which spontaneously form colloidal crystals when incubated at the correct temperature. Due to the DNA forming bridges between the particles, the crystals are crosslinked together into a solid. Research could lead to new materials with a very high index of refraction or even a negative index of refraction. [OPEN ACCESS TECHNICAL ARTICLE](#)

[TECHNICAL ARTICLE](#)

Tags: Advanced materials

[In great shape: Metamaterial is world's first to achieve performance predicted by theoretical bounds](#)

Science Daily, 21FEB2017

An international team of researchers (USA - UCSD, University of Virginia, UK) has demonstrated that the three-dimensional pyramid-and-cross cell geometry of solid foam, they call Isomax, lies in the geometry within. The Isomax geometry is maximally stiff in all directions, its cell structure makes it possible for the material to resist crushing and shearing forces without the need to make it heavier or denser. Potential applications for this ultralight material are likely to emerge in aerospace structures, lightweight automobiles and robotic machines. The material can be used for thermal insulation and sound absorption. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

[Using kinetics, not temperature, to make nanocrystalline ceramic coatings](#)

Nanowerk, 21FEB2017

Researchers at Sandia National Laboratory have developed a process to deposit submicron particles suspended in a gas slam onto surfaces at high velocity. Particles impact and stick, building up a coating layer by layer. The process takes place at room temperature. The process also spans the microscale gap between two established technologies, thin films and thermal spray technology. They have successfully deposited copper, nickel, aluminum oxide, titanium dioxide, barium titanate and carbide compounds using this process. Research could make microelectronics design and fabrication more flexible and less expensive.

Tags: Advanced materials, Government S&T

COMMUNICATIONS TECHNOLOGY

[Researchers use holography to improve nanophotonic circuits](#)

Physorg.com, 24FEB2017

Nanophotonic circuits suffer from small random variations which degrade transmission of light. An international team of researchers (the Netherlands, Turkey, France) has proposed and experimentally demonstrated an optical method to control photonic crystal nanoresonators. They employ digital holography techniques to focus several spots of laser light at definite positions. The laser light locally heats the nanophotonic chip and undoes the random variations. In addition, this method enables the researchers to program photonic circuits by switching them into and out of resonance. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Communications technology, Optical communication

CYBER SECURITY

[Google rolls out AI tool to combat online trolls](#)

Physorg.com, 24FEB2017

The programming tool, called Perspective, is an application programming interface (API) that uses machine learning to rate how comments might be regarded by other users. The system, which will be provided free to media groups including social media sites, is being tested by The Economist, The Guardian, The New York Times and Wikipedia. Perspective's initial task is to spot toxic language in English, but the goal is to build tools for other languages that could identify when comments are unsubstantial or off-topic.

Tags: Cyber security

“I like to be challenged. I welcome the hard questions and having to come up with good explanations on the spot.” **PROF. MILDRED S. DRESSELHAUS**

ENERGY

[Nano-sized hydrogen storage system increases efficiency](#)

Science Daily, 24FEB2017

Complex metal hydrides are a promising class of hydrogen storage materials, but their viability is usually limited by slow hydrogen uptake and release. To get rid of the undesirable intermediate phases, which slow down the material's performance, an international team of researchers (Lawrence Livermore National Laboratory, Sandia National Laboratory, NIST, Thailand) used a thermodynamic modeling method. They examined the high-capacity lithium nitride hydrogen storage system under nanoconfinement and showed that the presence of internal “nano-interfaces” within nanoconfined hydrides can alter which phases appear when the material is cycled leading to dramatically faster performance and reversibility.

[TECHNICAL ARTICLE](#)

Tags: *Energy, Materials science*

[Holes in the electrode](#)

Nanowerk, 22FEB2017

Rechargeable lithium batteries with cathodes comprising nickel, manganese, and cobalt have limited lifespan. Less than 50 % of the lithium atoms contribute to actual capacity. Researchers in Germany have shown that the underlying cause is annihilation of positrons when they meet an electron. When positrons find a vacancy in the crystal lattice, they survive significantly longer. The study clearly shows that lingering “voids” in the lattice of the cathode material accompany the irreversible loss of capacity. Using targeted modifications of the cathode material, we can search for possibilities to circumvent this barrier. [TECHNICAL ARTICLE](#)

Tags: *Energy, Battery, S&T Germany*

[Stabilizing energy storage](#)

Science Daily, 21FEB2017

Redox flow batteries use two tanks, to hold anolytes and catholytes, which store and release charge as the solution “flows” past the electrodes. More material in the tanks increases the capacity and the rate of charge or discharge increases with the number of cells. A team of researchers in the US (University of Michigan, University of Utah, industry partners) developed and tested potential electrolyte molecules and sought to use predictive technology to help design better battery compounds. Through their model, they demonstrated that key parameters of the molecules can be tuned to prevent them from decomposing when they interact with each other. [TECHNICAL ARTICLE](#)

Tags: *Energy, Battery*

ENVIRONMENTAL SCIENCE

[Light-driven reaction converts carbon dioxide into fuel](#)

Science Daily, 23FEB2017

A team of researchers in the US (Duke University, Army Aviation & Missile RD&E Center) synthesized rhodium nanocubes that were the optimal size for absorbing near-ultraviolet light. They placed a few nanoparticles in a reaction chamber and passed mixtures of carbon dioxide and hydrogen through the material. When the nanoparticles were heated to 300 degrees Celsius, the reaction between carbon dioxide and hydrogen generated an equal mix of methane and carbon monoxide. However, when illuminated with an ultraviolet LED lamp, the reaction almost exclusively produced methane. By tweaking the size of the rhodium nanoparticles, they hope to develop a version of the catalyst that is powered by sunlight, creating a solar-powered reaction that could be integrated into renewable energy systems. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Environmental science, Climatology*

FORECASTING

[U.S. Army SciTech Futures Crowdsourcing Exercise: The Deep Future of Robotics, Artificial Intelligence, and the U.S. Army, 6-17 March 2017](#)

US Army, 27FEB2017

Through this game, you can join fellow thought leaders in exploring how advances in robotics, artificial intelligence, autonomous systems, and related technologies might transform the world and what that means for the Army. You will be able to share your ideas about the future, collaborate with (and challenge) other players, and bid on the most compelling concepts in an online marketplace.

Tags: *Forecasting, Government S&T, S&T Policy*

[10 Breakthrough Technologies 2017](#)

MIT Technology Review, 22FEB2017

According to MIT Technology Review these ten most important technologies that are emerging this year will shape the world—by affecting the economy and our politics, improving medicine, and influencing culture. Some, such as 360-degree selfies and facial recognition payments, are available right now. Others, like hot solar cells and brain implants to reverse paralysis, will make their impact over the coming years. The botnet of things— isn't even a positive force. But they are all, in their own way, vitally important.

Tags: *Forecasting*

continued...

IMAGING TECHNOLOGY

New design for longer lasting night-vision cameras

Physorg.com, 21FEB2017

The materials and technology embodied in current cameras tend to degrade under temperature causing night-vision devices to frequently break. Researchers at Northwestern University developed a design of strained-layer indium arsenide/indium arsenide antimonide type-II superlattices, for making high-performance, long-wavelength infrared photodetectors for different applications, including night-vision cameras. It limits the obstructing dark current density, while raising the background-limited infrared photodetection temperature, reducing the need for cryogenic cooling power inside the camera. Indium arsenide/indium arsenide antimonide is safer and more durable than mercury. [OPEN ACCESS](#)

TECHNICAL ARTICLE*Tags: Imaging technology, Military technology*

FEATURED RESOURCE

Inside Science (AIP)

Inside Science provides editorially independent science news for mainstream audiences. [RSS](#)

INFORMATION TECHNOLOGY

Computing with biochemical circuits made easy

Science Daily, 23FEB2017

Researchers at Caltech have developed and demonstrated a software tool called Seesaw Compiler that can be used to quickly design DNA circuits. Circuits can be built out of cheap “unpurified” DNA strands following a systematic wet-lab procedure. Their software is a step toward enabling researchers to just type in what they want to do or compute and having the software figure out all the DNA strands needed to perform the computation, together with simulations to predict the DNA circuit’s behavior in a test tube. [OPEN ACCESS](#) **TECHNICAL ARTICLE**

*Tags: Information technology***Earbuds That Give You More Selective Hearing**

MIT Technology Review, 21FEB2017

A company in the US has launched wireless earbuds called Here One that let you manipulate the world around you by filtering all kinds of sounds and helping you home in on the ones you want to enhance. There are three microphones within each earbud to help you do things like amplify just the voices behind you or in front of you,

and you can also take phone calls, listen to music. It still has plenty of kinks to work out but its capabilities offer a fascinating look at where wearable technology is heading. The company plans to enhance and improve the product.

Tags: Information technology

MATERIALS SCIENCE

Insight into a physical phenomenon that leads to earthquakes

Science Daily, 21FEB2017

The longer something, such as a fault, is sitting still, (called ageing phenomenon) the more static friction builds up and the stronger the fault gets. A team of researchers in the US (University of Pennsylvania, Harvard University, University of Wisconsin -Madison) found that when the normal force is doubled, the friction force required also doubled because chemical bonds forming at the interface and the number of bonds increase with time. Understanding friction is key to providing a better understanding of earthquakes, and designing more efficient micro- and nano-devices.

TECHNICAL ARTICLE*Tags: Materials science***Scientists combine the ultra-fast with the ultra-small to pioneer microscopy at terahertz frequencies**

Physorg.com, 21FEB2017

Using terahertz scanning tunneling microscopy, an international team of researchers (Canada, Denmark, Germany) has captured images of terahertz electron dynamics of a semiconductor surface on the atomic scale. They were able to drive their microscope using pulses of light. The pulses occur over fast timescales and the microscope is able to see the fast events. Imaging a variety of new surfaces on the nanoscale may revolutionize the speed and efficiency of current technology, ranging from solar cells to computer processing. **TECHNICAL ARTICLE**

Tags: Materials science, Terahertz technology

MICROELECTRONICS

Paving the way for ionotronic nanodevices

Science Daily, 23FEB2017

Ionotronic devices rely on charge effects based on ions, instead of electrons or in addition to electrons. These devices open new opportunities for creating electrically switchable memories. Researchers in Finland investigated a complex oxide and found that migration of oxygen ions away from the contact area results in an abrupt change in the oxide lattice structure and an increase of electrical resistance. Reversal of the voltage polarity fully restores the original material properties. Electro-thermal simulations showed that a combination of current-induced sample heating and electric-field-directed ion migration causes the switching effect. [OPEN ACCESS](#) **TECHNICAL ARTICLE**

*Tags: Microelectronics, S&T Finland**continued...*

Rogue Cosmic Rays From Outer Space Are Causing Havoc With Our Smartphones

Science Alert, 21FEB2017

New research shows that even ordinary levels of cosmic radiation can have a disruptive effect on our personal devices, they can alter or 'flip' individual bits of data stored in memory – a phenomenon called a single-event upset (SEU). According to researchers at Vanderbilt University, as technology advances and transistors get ever smaller and as computer chips include significantly higher numbers of smaller transistors overall, at the device level, the risk of an SEU occurring is greater than ever. They recommend device manufacturers to design systems that include three processors in place of one. In rare cases where two chips tell you one thing, and the third tells you another, majority rules—as the errant third result would likely be due to an SEU. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics, Information technology*

New resource for optical chips

MIT News, 20FEB2017

The Semiconductor Industry Association has estimated that at current rates of increase, computers' energy requirements will exceed the world's total power output by 2040. The telecom devices exploit so-called second-order nonlinearities, which make optical signal processing more efficient and reliable. Researchers at MIT present a practical way to introduce second-order nonlinearities into silicon photonics. With second-order nonlinearity, phase and amplitude coupling can be broken, resulting in a pure phase modulator. They also report prototypes of a modulator and a frequency doubler. The research could lead to a new class of complex integrated devices such as carrier-envelope offset frequency stabilizers, terahertz generators, optical parametric oscillators and chirp-free modulators. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics*

PHOTONICS

Miniature device is 3 times more efficient in generating new colors of laser pulses

Eurekalert, 24FEB2017

An international team of researchers (Poland, Switzerland) has built a miniature device for generating femtosecond laser pulses in the UV using a software package they developed. The open-source simulation package, called Hussar, allows building a complex, 3-dimensional device by accurately simulating multiple pulse propagation and interaction using simple blocks: input pulse parameters, material properties of the media and the processes involved. They built the device based on the optimum values and measured its performance. The output UV pulses were exactly as simulated. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Photonics*

QUANTUM SCIENCE

Scientists create a nano-trampoline to probe quantum behavior

Science Daily, 22FEB2017

In normal phase transitions, there is a unique measurable quantity which is used to detect a critical point. However, for measuring specific heat of a system close to a quantum critical point, the measurements must be carried out at low temperatures and require extremely sensitive measurements. An international team of researchers (Israel, France) has measured quantum criticality by developing a thin membrane suspended in air by very narrow bridges which enabled specific heat measurements of thin films through a quantum phase transition from a superconducting state to an electrically insulating state close to absolute zero temperature. The research helps in understanding the physical processes that governs the behavior of ultrathin systems at ultralow temperatures. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science, Materials science*

Quantum Computers Finally Go Head-to-Head

MIT Technology Review, 21FEB2017

A team of researchers in the US (University of Maryland, NSF, industry partners) describes experiments comparing the performance of an IBM chip made from superconducting metals and the University of Maryland chip that uses electromagnetic fields to trap ytterbium ions. While using different underlying physics, both run algorithms in the same way. The IBM device was faster but it was also less reliable. The chips are still modest in power, and the results don't yet prove that one of the two technologies will win out. But the ability to directly compare two quantum computing devices will be useful in developing quantum computers. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science*

S&T POLICY

Russia military acknowledges new branch: info warfare troops

Physorg.com, 22FEB2017

Russia announced the formation of the dedicated information warfare troops, but the troops' mission was not described. According to their statement, the information warfare troops' task is to "protect the national defense interests and engage in information warfare," and fend off enemy cyberattacks. The information troops will protect Russia's data systems from enemy attacks, and not wage any hacking attacks abroad.

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

Researchers helping intelligence analysts make smart decisions

Physorg.com, 21FEB2017

Researchers at George Mason University are working on an IARPA sponsored program Aggregative Contingent Estimation (ACE) to develop and evaluate an intelligent analytical tool called Co-Arg with crowd elicitation. The software can test hypotheses, evaluate evidence, sort facts from deception and provide intelligent reasoning about quickly evolving situations that may have devastating consequences. The cognitive assistant approach can be put to work in other fields, including cybersecurity, science education, medicine, law, history and finance by applying similar techniques used for national security analysis.

Tags: *S&T policy, Artificial intelligence*

SCIENCE WITHOUT BORDERS

AAAS 2017 Annual Meeting, Feb. 16 -20, 2017, Boston

AAAS, 16FEB2017

Abstracts of the presentations may be viewed at this site, browse by topic, or search by author, title or key words.

Tags: *Science without borders*

SENSORS

Deep ocean GPS would revolutionize submarine and naval warfare

Next Big Future, 26FEB2017

DARPA's Positioning System for Deep Ocean Navigation (POSYDON) program aims to develop an undersea system that provides omnipresent, robust positioning across ocean basins. The platform would be able to obtain continuous, accurate positioning without surfacing for a GPS fix. Phase I of the program focuses on accurately modeling the signal propagation channel and Phase II focuses on developing the signal waveform. A complete positioning system is scheduled to be demonstrated in Phase III.

Tags: *Sensors, DARPA, S&T Policy*

Breakthrough wireless sensing system attracts industry and government agency interest

Physorg.com, 21FEB2017

Researchers at Argonne National Laboratory have developed a platform called Waggle which combines environmental lightweight sensors with computer hardware and software for "edge computing" within a portable node, or device. Each node collects and transmits environmental data wirelessly via the cloud. Edge computing allows Waggle nodes to process image and audio data directly inside the sensor node using machine learning technologies. Researchers can access environmental data in near real time, helping improve the efficiency of research and discovery. This capability will be the future of intelligent sensing platforms.

Tags: *Sensors, Government S&T* ■

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