



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

[Advanced materials \(3\)](#)

[Autonomous systems & robotics \(4\)](#)

[Biotechnology \(2\)](#)

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

[Cyber security \(1\)](#)

[Energy \(3\)](#)

[Forecasting \(1\)](#)

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

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

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

[Materials science \(6\)](#)

[Microelectronics \(2\)](#)

[S&T policy \(3\)](#)

[Sensors \(2\)](#)

FEATURE ARTICLES

[Asia's AI Agenda - The Deep Dive Editions: Australia, China, Singapore, India](#)

[MIT Technology Review, 15SEP2017](#)



The Deep Dive Editions is a series of briefing papers by MIT Technology Review. It is a follow-on project to research published in October 2016, which surveyed business leaders from across the Asia-Pacific region. New insights were gained through in-depth interviews conducted between May and June of 2017. [OPEN](#)

[ACCESS TECHNICAL ARTICLES: Australia, China, India, Singapore](#)

Tags: S&T policy, Artificial intelligence, S&T Australia, S&T China, S&T India, Featured article

[‘The dark side’ of quantum computers](#)

[Science Daily, 13SEP2017](#)

An international team of researchers (University of Illinois at Chicago, the Netherlands) is leading a consortium called PQCRYPTO. It consists of eleven universities and companies and is funded by the European Commission. They are analyzing new cryptographic techniques for the post-quantum cryptography. Candidates can be roughly categorized into two types: they are either very well understood and confidence-inspiring but require a lot of bandwidth or they are more convenient to use but provide more questionable security. According to the researchers, commonly used cryptosystems will be completely broken once large quantum computers exist. The central challenge in post-quantum cryptography is to meet demands for cryptographic usability and flexibility without sacrificing confidence. [TECHNICAL ARTICLE](#)

Tags: Cyber security, Communications technology, Quantum science, Science without borders, Featured Article

[UW shatters long-range communication barrier for near-zero-power devices](#)

[EurekAlert, 13SEP2017](#)

Researchers at the University of Washington used a long-range back-scatter system, which uses reflected radio signals to transmit data up to two kilometers at extremely low power and low cost. The system has three components: a source that emits a radio signal, sensors that encode information in reflections of that signal and a receiver that decodes the information. According to the researchers, the technology can decode words spoken on the other side of a wall even when the conversation itself is hard to hear. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors, Communications technology, Featured Article

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

[Researchers achieve 4-D printed material](#)

[Physorg.com, 14SEP2017](#)

A team of researchers in the US (Lawrence Livermore National Laboratory, industry partner) engineered composite silicone materials by adding hollow, gas-filled “micro-balloons” into silicone-based ink so it can be compressed or “programmed” at an elevated temperature, remaining in that state as it cools. When reheated, the gas in the micro-balloons expands causing the structures to return to their original shape. The micro-balloons could be used to integrate shape memory into any polymeric base material, including stretchable materials such as elastomers, but the resulting material might not have the same compressibility as 3-D printed porous structures. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced manufacturing, Materials science

ADVANCED MATERIALS

Researchers develop solid-state, free-standing carbon nanofiber supercapacitor

Physorg.com, 20SEP2017

A team of researchers in the US (Drexel University, Temple University) has created a fabric-like material electrode using a thick ion-rich gel electrolyte absorbed in a freestanding mat of porous carbon nanofibers. The compact design is more durable and its energy storage capacity and charge-discharge lifespan are better than comparable devices currently being used. It can operate at temperatures as high as 300 degrees Celsius and it is free of binding agents that diminish performance. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials, Energy*

Physicists predict nonmetallic half-metallicity

Physorg.com, 15SEP2017

An international team of researchers (Russia, USA - University of Michigan) demonstrated a theoretical mechanism for achieving half-metallicity that requires no transition metal atoms. They show that doping a spin-density wave insulator in the weak-coupling regime may also stabilize half-metallic states. In the absence of doping, the spin-density wave is formed by four nested bands. Of these four bands, only two accumulate the charge carriers introduced by doping, forming a half-metallic two-valley Fermi surface. The research has a number of useful applications, including in implantable devices. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

Discovery could reduce nuclear waste with improved method to chemically engineer molecules

Science Daily, 14SEP2017

Engineered molecules are designed to function in isolation even though the molecules exist in combination. Hence it is nearly impossible to predict how efficiently an engineered molecule will perform in the real world. To address this, researchers at Indiana University developed a receptor molecule, cyanostar, consisting of a five-sided star-shaped lattice of carbon and nitrogen atoms with an empty center to catch molecules which break off from the host. They applied the new principle to triazolophane and could accurately predict the molecules' effectiveness. The new principle has the potential to revolutionize the creation of specially engineered molecules whose uses include the reduction of nuclear waste and the extraction of chemical pollutants from water and soil. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

AUTONOMOUS SYSTEMS & ROBOTICS

Clever Machines Learn How to Be Curious

Quanta Magazine, 19SEP2017

Researchers at UC Berkeley are studying how innate curiosity can make learning an unfamiliar task more efficient. Artificial curiosity has been a subject of AI research since at least the early 1990s. To become truly useful, AI must learn to cope with the ubiquitous pointless novelty. They engineered their Mario-playing agent to translate its visual input from raw pixels into an abstracted version of reality. This abstraction incorporates only features of the environment that have the potential to affect the agent. Using this stripped-down "feature space" (versus the unprocessed "pixel space") not only simplifies the agent's learning process, it also neatly sidesteps the novelty trap.

Tags: *Autonomous systems & robotics, Artificial intelligence*

Running roaches, flapping moths create a new physics of organisms

Physorg.com, 19SEP2017

Researchers at the Georgia Institute of Technology are analyzing the rules governing the locomotion of these creatures, "physics of living systems" to learn how animals successfully negotiate unstable surfaces like wet sand, maintain rapid motion on flat surfaces using the advantageous mechanics of their bodies, and fly in ways that would never work for modern aircraft. The knowledge these researchers develop could be useful to the designers of robots and flying vehicles of all kinds. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Autonomous systems & robotics, Biomimetics, Emerging technology*

A drone for last-centimeter delivery

Science Daily, 15SEP2017

Researchers in Switzerland have a design concept where the drone becomes the package that wraps around the cargo before flight, just like a mail package. The foldable carbon-fiber cage protects the drone and the cargo in case of a collision or fall. The recipient can catch the drone mid-flight without being injured by the propellers, which are located within the structure and have a safety system so that they stop when the cage is opened. The frame can be folded and unfolded in a single movement reducing the drone's volume by 92% so that it can easily be slipped inside a backpack. It can take off and land vertically, which enhances its accuracy. And it can carry a package weighing up to 500 grams two kilometers.

Tags: *Autonomous systems & robotics, S&T Switzerland*

“Our job in physics is to see things simply, to understand a great many complicated phenomena, in terms of a few simple principles.” STEVEN WEINBERG

Quantum machine learning

Science Daily, 14SEP2017

An international team of researchers (Russia, Canada, Spain, Germany, USA - MIT, Microsoft) reviewed the status of classical machine learning and quantum machine learning. They have considered different possible combinations: the conventional method of using classical machine learning to analyse classical data, using quantum machine learning to analyse both classical and quantum data, and finally, using classical machine learning to analyse quantum data. The goal is to find the most optimized method that can read, comprehend and obtain the best outcomes of a data set, be it classical or quantum. [TECHNICAL ARTICLE](#)

Tags: *Autonomous systems & robotics, Artificial intelligence, Quantum science*

BIOTECHNOLOGY

Slowing the clockwork

Physorg.com, 19SEP2017

Researchers in Germany used a compound that contains carbon-carbon double bond to develop a new method to synthesize a molecular motor to reduce the speed of its light-driven rotation. Reduced speed allowed them to follow its light-driven rotational motion in complete detail. The goal is to develop the chemical components necessary for the construction of nanomachines whose motions and structural states can be controlled by external stimuli. The greater the degree of control achieved, the wider the range of potential applications available. [TECHNICAL ARTICLE](#)

Tags: *Biotechnology, Foreign S&T, S&T Germany*

Sorting Molecules with DNA Robots

Caltech, 14SEP2017

Researchers at Caltech constructed three basic building blocks that could be used to assemble a DNA robot: a “leg” with two “feet”, an “arm” and “hand” and a segment that can recognize a specific drop-off point and signal to the hand to release its cargo. Each of these components is made of just a few nucleotides within a single strand of DNA. They built a robot and demonstrated that it could explore a molecular surface, pick up two different molecules and then distribute them to two distinct regions on the surface. According to the researchers, the system design can be generalized to work with dozens of types of cargos at any arbitrary initial location on the surface. The technique may have applications in synthesizing therapeutic chemicals in an artificial molecular factory, delivering a drug only when a specific signal is given in bloodstreams or cells, or sorting molecular components in trash for recycling. [TECHNICAL ARTICLE](#)

Tags: *Biotechnology*

COUNTER WMD

100 Years after the Lethal 1918 Flu Pandemic, We Are Still Vulnerable

Scientific American, 15SEP2017

According to a team of researchers at the National Institute of Allergy and Infectious Diseases at NIH, even though we now have vaccines, they likely would not be effective against a 1918-like virus. One hundred years later, we must reexamine our approach to influenza vaccines so we can avert a repeat of that worldwide catastrophe. We must address the issue of “pre-pandemic” influenza viruses. Recently, NIAID convened a scientific agenda-setting workshop with leading experts in the influenza field to address the need for better influenza vaccines. Among many hurdles to developing a universal vaccine, the most formidable is our incomplete understanding of the immune responses that protect people against influenza, including the role of immunity at mucosal surfaces.

Tags: *Counter WMD, Science without borders*

ENERGY

Advanced lithium-ion and metal-air batteries

Science Daily, 19SEP2017

A team of researchers in the US (University of Central Florida, Rice University) has developed a battery cathode created from a thin-film alloy of nickel sulfide and iron sulfide which is etched to create a porous surface of microscopic nanostructures. The nanopores greatly expand the surface area available for chemical reaction. They developed a new process for creating a catalyst with a substrate of graphene. In tests, the battery with the nickel sulfide-iron sulfide cathode could be depleted and recharged more than 5,000 times before degrading.

[TECHNICAL ARTICLE](#)

Tags: *Energy, Advanced materials*

Graphene-wrapped nanocrystals make inroads toward next-gen fuel cells

Nanowerk, 14SEP2017

Graphene-wrapped magnesium nanoparticles exhibit high hydrogen storage density, yet its practical usage is hindered by necessarily high temperatures and slow kinetics for hydrogenation–dehydrogenation cycling. A new study by an international team of researchers (USA - Lawrence Livermore National Laboratory, South Korea, Taiwan) explains how it is possible to improve hydrogen absorption by coating the graphene-wrapped magnesium nanoparticles with an ultrathin layer of oxide. [TECHNICAL ARTICLE](#)

Tags: *Energy, Materials science*

continued...

[How solar power can protect the US military from threats to the electric grid](#)

[Physorg.com](#), 14SEP2017

A team of researchers in the US reviews the technical and economic viability of utilizing defense contracting for the beginning of a national transition to distributed generation in the U.S. The technical scale of electrical demand and the solar PV system necessary are analyzed in detail to meet the first level of strategic importance. To rectify this situation, the technical skills of the top 20 U.S. defense contractors is reviewed and analyzed.

[TECHNICAL ARTICLE](#)

Tags: Energy, Solar energy

FEATURED RESOURCE

[Armed with Science](#)

Armed with Science is a daily blog site for the Department of Defense that incorporates print, video, and social media assets over 50 scientific organizations across the Federal government. [RSS](#)

FORECASTING

[Get Ready for EmTech MIT 2017: November 6-9](#)

[MIT Technology Review](#), 16SEP2017

Em Tech 2017 will take place at the MIT Media Lab, where attendees will share a unique architectural space with technology leaders and innovators from across industries and around the world. We'll hear about both the latest breakthroughs and the biggest challenges facing thought leaders in various technology fields and disciplines.

Tags: Forecasting, Disruptive technology, Emerging technology, Science without borders

FOREIGN S&T

[Israel advances military technology with project for an invisible to radar tank](#)

[Next Big Future](#), 14SEP2017

Israel has plans for a tank that is to be equipped with technology – currently under development – that would make it a tank version of the F-35 stealth bomber, which is invisible on radar. Plans call for the tank to have just two crew members and be “transparent,” which would allow the crew to see the area around the tank without getting outside of it. The tank is to be outfitted with an active protection system similar to the current Windbreaker (also known as Trophy), but it will also provide protection to other vehicles in the area from anti-tank fire.

Tags: Foreign S&T, Military technology, Sensors

IMAGING TECHNOLOGY

[Drones can almost see in the dark](#)

[Physorg.com](#), 20SEP2017

To fly safely, drones need to know their precise position and orientation in space at all times. Professional drones use sensors that are elaborate, expensive, and bulky, such as laser scanners. Researchers in Switzerland have developed an eye-inspired camera that only reports changes in brightness for each pixel, ensuring perfectly sharp vision even during fast motion or in low-light environments. This enables drones to fly in a wide range of conditions. They have also designed new software to efficiently process the output from such cameras, harnessing this to enable autonomous flight at higher speeds and in lower light than currently possible with commercial drones. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Imaging technology, Autonomous systems & robotics, S&T Switzerland

INFORMATION TECHNOLOGY

[Researchers find new way to manipulate magnetism](#)

[Physorg.com](#), 15SEP2017

In cobalt, the spins of neighboring electrons interact, causing them to all point in the same direction. If some of the spins are forced away from that direction, it causes the spins to undergo a gradual twist. A team of researchers in the US (NIST, University of Maryland, Los Alamos National Laboratory) found a way to control the Dzyaloshinskii-Moriya interaction (DMI), which imposes a preferred twist direction on spins. Controlling the DMI can boost magnetic memory which uses the orientation of spin to store information. By regulating the DMI, researchers can create skyrmions, which would require less power to operate than other types of magnetic memory, and should be able to guide their motion through a magnetic material. [TECHNICAL ARTICLE](#)

Tags: Information technology, Materials science

MATERIALS SCIENCE

[One-way track for microwaves based on mechanical interference](#)

[Science Daily](#), 19SEP2017

An international team of researchers (Switzerland, UK) has demonstrated reconfigurable nonreciprocal transmission between two microwave modes using purely optomechanical interactions in a superconducting electromechanical circuit. The scheme relies on the interference in two mechanical modes that mediate coupling between the microwave cavities and requires no magnetic field. The system can be tuned in such a way that positive interference occurs in one direction, while destructive interference occurs in the other and the parameters can be modified on the fly, allowing dynamically reconfigurable use of the isolator, instantly changing its direction. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science

continued...

[Digging sensors out of an efficiency hole](#)

Nanowerk, 15SEP2017

Tungsten diselenide is promising for ultra-sensitive, ultra-thin light sensors, solar cells and light-emitting diodes, because of its ability to absorb light and re-emit at a different frequency. To increase its optical absorption or emission, an international team of researchers (Singapore, UK, Taiwan, Saudi Arabia) mounted it on a gold surface patterned with narrow trenches. The light energy in the form of surface plasmons was trapped in the trenches through the Purcell effect achieving a 20,000-fold increase in the photoluminescence. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science, Energy, Solar energy

[A Solid-State Fridge in Your Pocket](#)

IEEE Spectrum, 14SEP2017

Based on the electrocaloric effect, a team of researchers in the US (UCLA, SRI international) has developed a 5-millimeter-thick solid-state cooler device. The flexible electrocaloric polymer component is a dual-layer stack of flexible electrocaloric film, separated by carbon nanotubes; voltage is applied (or relaxed) across the layers to change the stack's temperature. That polymer stack is itself situated between a pair of electrodes that form the heat sink and the heat source of the device. Its refrigeration cycle is silent, rapid, and efficient. In tests, the prototype delivered 150 times as much cooling per gram of material than estimates published for prior electrocaloric devices. It endured 30,000 cycles without evidence of degradation. The device opens a path to using the technology for a variety of practical applications.

[TECHNICAL ARTICLE](#)

Tags: Materials science

[How to measure a molecule's energy using a quantum computer](#)

Physorg.com, 14SEP2017

Researchers at IBM in New York implemented a new quantum algorithm capable of efficiently computing the lowest energy state of small molecules. By mapping the electronic structure of molecular orbitals onto a subset of the purpose-built seven qubit quantum processor, they studied lithium hydride and beryllium hydride. They demonstrated the flexibility of their approach by applying it to a problem of quantum magnetism and showing agreement between their experiments and numerical simulations using a model of the device with noise. Their research helps scaling the method to larger systems and for bridging the gap between key problems in high-performance computing and their implementation on quantum hardware.

[TECHNICAL ARTICLE](#)

Tags: Materials science, Quantum science

[Self-healing gold particles](#)

Science Daily, 14SEP2017

An international team of researchers (Israel, Germany) found that annealing air temperatures far below the melting temperature of gold caused gold atoms to move along surface steps back into the dents, refilling them almost completely. Such surface steps occur in many deformed metals. The findings may allow robust components for structures smaller than one thousandth of a millimeter to be designed. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Quantum sensors decipher magnetic ordering in a new semiconducting material](#)

Nanowerk, 13SEP2017

Multiferroics are materials that simultaneously react to electric and magnetic fields. An international team of researchers (France, Switzerland) has developed quantum sensors based on diamonds with nitrogen vacancy centers to study the magnetic ordering of thin bismuth ferrite film. They have shown that bismuth ferrite exhibits spiral magnetic ordering, with two superimposed electron spins adopting opposing orientations and rotating in space, whereas it was previously assumed that this rotation took place within a plane. According to the researchers, the slight tilt in these opposing spins leads to spatial rotation with a slight twist. Knowing how the electron spins behave and how the magnetic field is ordered is of crucial importance for the future application of multiferroic materials as data storage. [TECHNICAL ARTICLE](#)

Tags: Materials science, Information technology

MICROELECTRONICS

[The Future of Computing and Microchips](#)

Inside Big Data, 17SEP2017

The looming demise of Moore's Law has spurred computer scientists and researchers to look for new ways of maintaining processing speed growth. Promising solutions include cloud computing, deep learning, quantum computing, extreme ultraviolet lithography, and chips that mimic brain functioning. Researchers at the New Jersey Institute of Technology have created the infographic that highlights the future of computing and microchips. Although Moore's law is nearing its end, there are many avenues available to computer scientists continued discoveries and innovations. These new challenges will likely result in more creative solutions with increased benefits.

Tags: Microelectronics

[Nanotechnology experts create first terahertz-speed polarization optical switch](#)

Nanowerk, 14SEP2017

A team of researchers in the US (Sandia National Laboratory, North Carolina State University) used two laser

beams, one carrying the information and the second switching the device on and off. The optical switch is turned on and off by creating a plasmonic cavity using doped cadmium oxide, which confines light within a few tens of nanometers, and significantly boosts light-matter interaction. Heating up electrons in the doped cadmium oxide drastically modifies the opto-electrical properties of the plasmonics cavity, modulating the intensity of the reflected light. A very rapid and compact switching platform opens a new way to investigate fundamental physics problems. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, Terahertz technology

S&T POLICY

[Dual Use Research of Concern in the Life Sciences: Current Issues and Controversies \(2017\)](#)

[National Academy of Sciences, 15SEP2017](#)

The potential misuse of advances in life sciences research is raising concerns about national security threats. This publication examines the U.S. strategy for reducing biosecurity risks in life sciences research and considers mechanisms that would allow researchers to manage the dissemination of the results of research while mitigating the potential for harm to national security. [FULL REPORT](#)

Tags: S&T policy, Synthetic biology

[DARPA Rolls Out Electronics Resurgence Initiative](#)

[DARPA News, 13SEP2017](#)

DARPA has launched the Electronics Resurgence Initiative (ERI) to open new innovation pathways to address impending engineering and economics challenges. ERI's three research pillars are [materials and integration](#), [circuit design](#), and [systems architecture](#). Another major ERI component is the extensive university-based program—the Joint University Microelectronics Program (JUMP) to build up a fundamental research base in fields underlying microelectronic technologies. The six programs represent new annual investments of \$75 million in ERI's three pillars.

Tags: S&T policy, DARPA, Microelectronics

SENSORS

[Sensing with a twist: A new kind of optical nanosensor uses torque for signal processing](#)

[Nanowerk, 16SEP2017](#)

Using a nanofabrication method, an international team of researchers in Singapore designed a resonator to allow light to couple directly via an etched grating to a waveguide configuration, called a racetrack cavity, in which the nanoresonator sits. As light is coupled into the racetrack cavity, mechanical torsional motion in the cavity alters the propagation of light and changes the power of the output light. By detecting the small variation of output light, the torsional motions can be measured. The resonators can also affect the resulting optical properties of the incident signal. The demonstration has implications for potential applications in on-chip physical sensors and RF signal modulation, such as super-heterodyne receivers using optical mechanical resonators. [OPEN ACCESS](#) [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