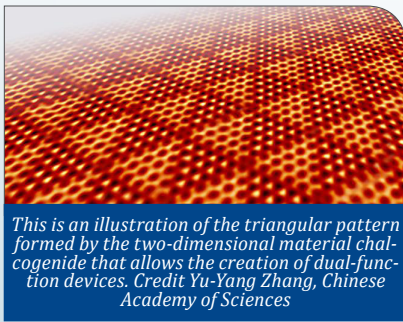


[Advanced materials \(4\)](#)[Autonomous systems & robotics \(3\)](#)[Big data \(1\)](#)[Biotechnology \(2\)](#)[Communications technology \(2\)](#)[Cyber security \(2\)](#)[Energy \(5\)](#)[Imaging technology \(2\)](#)[Information technology \(1\)](#)[Materials science \(3\)](#)[Quantum science \(3\)](#)[S&T policy \(3\)](#)[Sensors \(1\)](#)

## FEATURE ARTICLES

### [Multitasking monolayers](#)

[EurekAlert, 24JUL2017](#)

This is an illustration of the triangular pattern formed by the two-dimensional material chalcogenide that allows the creation of dual-function devices. Credit Yu-Yang Zhang, Chinese Academy of Sciences

An international team of researchers (China, USA - Vanderbilt University, Oak Ridge National Laboratory) has shown that monolayers formed by two chalcogenides (platinum-selenium and copper-selenium)

naturally combine with nanoscale precision into alternating triangles with metallic and semiconductor phases. Because each phase has different electrical and chemical properties, two different types of molecules can bond to its surface, allowing it to perform two functions simultaneously. Patterned materials open the possibility of having two functionalities in a single material, such as catalyzing a chemical reaction while simultaneously serving as a sensor for a second set of molecules. They offer a whole range of new options for device designers. [TECHNICAL ARTICLE](#)

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

### [Supramolecular materials with a time switch](#)

[Physorg.com, 19JUL2017](#)

Most man-made substances are chemically very stable: to decompose them back into their components requires a lot of energy. Researchers in Germany have developed a new material based on the natural model: the molecular building blocks are initially freely mobile, but if energy is added in the form of high-energy molecules, supramolecular structures form which disintegrate once the energy is exhausted. Thus, the lifetime can be predefined by the amount of "fuel" added. Following a cycle, the degraded material can be reused by simply adding another batch of high-energy molecules. They designed different anhydrides which assemble into colloids, supramolecular

hydrogels or inks, and building blocks that assemble into long fibrous structures that transform fluids into gels which may have applications in medical fields.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T Germany, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [Graphene for batteries, supercapacitors and other energy storage](#)

[Nanowerk, 20JUL2017](#)

In this review article, an international team of researchers (USA - UCLA, Egypt, China) discusses the current status of graphene in energy storage and highlights ongoing research activities. With specific emphasis placed on the processing of graphene into electrodes, they calculated the maximum energy density of graphene supercapacitors and outline ways for future improvements. They discuss the synthesis and assembly of graphene into macrostructures that allow the design of batteries and supercapacitors with many new features. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

#### [A breakthrough in 'dead layer' of antiferromagnet](#)

[Nanowerk, 18JUL2017](#)

Engineering antiferromagnetism in oxide heterostructures is tricky because the necessary ferromagnetism of the constituent layers may not survive thinning to nanometer thicknesses. An international team of researchers (China, Germany) engineered an antiferromagnetic interlayer exchange coupling (AF-IEC) between ultrathin but ferromagnetic  $\text{La}_{2/3}\text{Ca}_{1/3}\text{MnO}_3$  layers across an insulating  $\text{CaRu}_{1/2}\text{Ti}_{1/2}\text{O}_3$  spacer. The magnetization configurations can be switched at moderate fields of hundreds of oersted. The findings will add functionalities to devices with correlated-oxide interfaces. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

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## AUTONOMOUS SYSTEMS & ROBOTICS

### [New type of soft, growing robot created](#)

[Science Daily, 20JUL2017](#)

A team of researchers (UC Santa Barbara, Stanford University) has built a prototype of a soft pneumatic robot that can grow substantially in length from the tip while actively controlling direction using onboard sensing of environmental stimuli. Pressurization of an inverted thin-walled vessel allows rapid and substantial lengthening of the tip of the robot body, and controlled asymmetric lengthening of the tip allows directional control. They demonstrated the abilities to lengthen through constrained environments by exploiting passive deformations and form three-dimensional structures by lengthening the body of the robot along a path. The research helps lay the foundation for engineered systems that grow to navigate the environment. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics*

### [Folding robots: No battery, no wire, no problem](#)

[Science Daily, 19JUL2017](#)

An international team of researchers (Harvard University, South Korea) demonstrates a battery-free wireless folding method for dynamic multijoint structures, achieving addressable folding motions using only basic passive electronic components on the device. The method is based on electromagnetic power transmission and resonance selectivity for actuation of resistive shape memory alloy actuators without the need for physical connection or line of sight. The invention has applications in medicine, robotics and battery-free communication between multiple smart objects. [TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, Biotechnology*

### [New algorithm, metrics improve autonomous underwater vehicles' energy efficiency](#)

[Science Daily, 19JUL2017](#)

Researchers at Oregon State University developed an iterative optimization algorithm for path planning which presents many different trajectory comparison metrics that allow a vehicle to intelligently choose when to switch to newly planned paths based on new information gathered about uncertain environmental disturbances. Tests showed that a path planning algorithm was able to plan more energy-efficient paths, the revised plans were more energy-efficient in the presence of uncertainty than plans based only on the ocean current forecast, and the algorithm is robust enough to deal with environments where limited amounts of data are available. [TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics*

## BIG DATA

### [Getting Results from Big Data is Like Finding Needles in Haystacks](#)

[Inside Big Data, 18JUL2017](#)

An increasing number of companies apply big data technologies in the form of AI and machine learning, but don't see the results they want. Companies too often manage their critical commercial information using a combination of tribal knowledge, ad hoc CRM data, and spreadsheets containing data pulled from disparate systems. According to the experts, mobilizing huge volumes of data is great, but it's not enough. Quantity must be accompanied by quality, data should be clean and accurate.

*Tags: Big data*

## BIOTECHNOLOGY

### [New harmless radiopaque glue to seal bleeding and guide surgery](#)

[Science Daily, 19JUL2017](#)

Researchers in South Korea demonstrated that biocompatible tantalum oxide/silica core/shell nanoparticles (TSNs) exhibit not only high contrast effects for real-time imaging but also strong adhesive properties. They cause much less cellular toxicity and less inflammation than a clinically used tissue adhesive. Because of their multi-functional imaging and adhesive property, the TSNs are successfully applied as a hemostatic adhesive for minimally invasive procedures and as an immobilized marker for image-guided procedures. It was successfully tested in animals and showed less toxicity than the FDA-approved glue CA-Lp. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Biotechnology, Advanced materials*

### [Robotic exosuit enhances human performance](#)

[Next Big Future, 19JUL2017](#)

A team of researchers in the US (Harvard University, University of Nebraska at Omaha) has designed a tethered soft textile-based exosuit and demonstrated that it can reduce the metabolic cost of running on a treadmill by 5.4 percent. They incorporated flexible wires connecting apparel anchored to the back of the thigh and waist belt to an external actuation unit. As subjects ran on a treadmill wearing the exosuit, the unit pulled on the wires, which acted as a second pair of hip extensor muscles applying force to the legs with each stride. According to the researchers, technology is moving toward making an untethered assistive exosuit possible in the near future. [TECHNICAL ARTICLE](#)

*Tags: Biotechnology*



“No amount of experimentation can ever prove me right; a single experiment can prove me wrong.” ALBERT EINSTEIN

## COMMUNICATIONS TECHNOLOGY

### [Quantum Cryptography System Breaks Daylight Distance Record](#)

IEEE Spectrum, 24JUL2017

An international team of researchers (China, USA - Stanford University) switched from the roughly 700-to-900-nanometer wavelengths of light to roughly 1,550 nm to overcome interference from sunlight. 1,550-nanometer light used in telecommunications, can pass through Earth's atmosphere with virtually no interference making it more compatible with existing networks. They could establish the links despite roughly 48 decibels of loss in communications channel. The experiments were performed in good weather. Quantum communication is currently not possible in bad weather. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Communications technology, Quantum science*

### [For First Time, On-Chip Nanoantennas Enable High-Bit-Rate Transmission](#)

IEEE Spectrum, 19JUL2017

An international team of researchers (Australia, Germany) has demonstrated that nanoantennas can separate optical signals with different polarizations by coupling the different polarizations of light vertically to different waveguide modes propagating into opposite directions. They showed the suitability of this concept for the control of optical signals without significant bit error rate impairments. The research shows that waveguide-integrated nanoantennas have the potential to be used as ultra-compact polarization-demultiplexing on-chip devices for high-bit rate telecommunication applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Communications technology*

## CYBER SECURITY

### [Enhancing the resilience of the American electricity system](#)

Science Daily, 20JUL2017

In a report to the Congress, the National Academies of Sciences, Engineering, and Medicine recommended ways to make the grid more resilient through the development and demonstration of technologies and organizational strategies that minimize the likelihood that outages will happen, reduce the impacts and speed up recovery, all the while developing mechanisms for continual improvements based on changing threats.

Tags: *Cyber security*

### [Sonic cyber attack shows security holes in ubiquitous sensors](#)

University of Michigan, 14MAR2017

A team of researchers in the US (University of Michigan, University of South Carolina) reports that sound waves could be used to hack into critical sensors in a broad array of technologies including smartphones, automobiles, medical devices and the Internet of Things. They modeled physics of malicious acoustic interference and discovered the circuit-level security flaws that cause the vulnerabilities by measuring acoustic injection attacks on MEMS accelerometers, as well as systems that employ on these sensors. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Cyber security*

## ENERGY

### [Ultrathin device harvests electricity from human motion](#)

Science Daily, 21JUL2017

Researchers at Vanderbilt University demonstrated a device based on sodiated black phosphorus nanosheets, or phosphorene that can harvest energy. The devices can be made as thin or as thick as needed for specific applications. Bending the device produces as much as 40 microwatts per square foot and can sustain current generation over the full duration of movements as slow as 0.01 Hertz, one cycle every 100 seconds. The work broadly demonstrates how 2D materials can be effectively leveraged as building blocks in strategies for efficient electrochemical strain energy harvesting. The challenges they face is the low voltage produced by the device. [TECHNICAL ARTICLE](#)

Tags: *Energy, Flexible electronics*

### [Molecular 'pulleys' improve battery performance](#)

Science Daily, 20JUL2017

A challenge in using silicon particles for lithium batteries is that large volume changes during charge-discharge cycling cause the particles to fracture, which builds up an insulating interface layer. Researchers in South Korea report that adding a small amount of polyrotaxane to conventional polyacrylic acid binder imparts extraordinary elasticity to the polymer network originating from the ring sliding motion of polyrotaxane. This enables a stable cycle life for silicon microparticle anodes at commercial-level capacities. [TECHNICAL ARTICLE](#)

Tags: *Energy, Materials science*

**Scientists design promising new cathode for sodium-based batteries**

Physorg.com, 20JUL2017

When exposed to air, the metals in a sodium battery's cathode can be oxidized, decreasing the performance of the battery or even rendering it completely inactive. An international team of researchers (China, Brookhaven National Laboratory) has demonstrated that substituting different types of metals in the cathode and increasing the space between the metals suppressed oxidation. The findings open a new avenue for high-performance O<sub>3</sub>-type cathodes and pushes the large-scale industrialization of Na-ion batteries a step forward. [TECHNICAL ARTICLE](#)

Tags: Energy, Battery, Government S&T

**Nanomaterial helps store solar energy: Efficiently and inexpensively**

Science Daily, 17JUL2017

An international team of researchers (Switzerland, USA - industry) developed a technique to produce nanopowder of barium, strontium, cobalt, iron and oxygen as a catalyst material for electrolyzers. In tests, the device worked more reliably with the new perovskite than with a conventional iridium-oxide catalyst. The research provides a fundamental understanding of the Oxygen Evolution Reaction mechanism for highly active perovskite catalysts. [TECHNICAL ARTICLE](#)

Tags: Energy, Materials science

**FEATURED RESOURCE****R&D Magazine**

News stories and technical articles, reports on state-of-the-art scientific and technical advances and important trends in research management, funding, and policy.

**Researchers develop fast, cheap method to make supercapacitor electrodes for electric cars, high-powered lasers**

Nanowerk, 17JUL2017

A team of researchers in the US (University of Washington, Pacific Northwest National Laboratory) made electrodes by treating molybdenum disulfide or tungsten disulfide with high-frequency sound waves to break them into thin sheets and incorporating them into the carbon-rich gel matrix. The electrode's capacitance was 127 percent greater than the carbon-rich aerogel alone. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Advanced materials

**IMAGING TECHNOLOGY****Computers using linguistic clues to deduce photo content**

Physorg.com, 21JUL2017

A team of researchers in the US (UC Davis, industry partner) has demonstrated that it is not just the words, but the sentence structure of a caption that can help a computer determine where an action is depicted in an image or an object. By parsing the sentence and applying deep learning techniques, their system produced more accurate localizations than baseline systems that do not consider the structure of natural language. A neural network based on this approach could potentially automate the process of annotating images that can be used to train visual recognition programs. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Imaging technology, Big data, Pattern recognition

**Flickering Lights Yield a Trove of Information**  
Optics and Photonics, 18JUL2017

An international team of researchers (Israel, Canada) developed a camera prototype, called ACam, that is tuned to capture the faster-than-the-eye flickering patterns of different lighting. ACam has an electronic shutter that remains open for hundreds of AC cycles and a digital micro-mirror device that optically blocks the sensor most of the time, unmasking each pixel, timed at twice the AC rate. It captures the data at the same points during each AC-driven flicker cycle, distinguishing information on the different components of AC flicker. They developed a database for different light sources. They believe the technique has applications in monitoring of the electrical grid and digital imaging. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Imaging technology

**INFORMATION TECHNOLOGY****Google Algorithm speeds up internet by up to 14%**

Next Big Future, 21JUL2017

Google Cloud Platform (GCP) now features a cutting-edge new congestion control algorithm, TCP BBR, which achieves higher bandwidths and lower latencies for internet traffic. According to Google's tests, BBR's throughput can reach as much as 2,700x higher than today's best loss-based congestion control; queueing delays can be 25x lower.

Tags: Information technology

**MATERIALS SCIENCE****All-dielectric nanophotonics: The quest for better materials and fabrication techniques**

Nanowerk, 21JUL2017

An international team of researchers (Sweden, Russia, USA - UT Austin, Germany) provides an overview of available high-index materials and existing fabrication techniques for the realization of all-dielectric nanostructures. They

*continued...*



compare performance of the chosen materials in the visible and IR spectral ranges in terms of scattering efficiencies and  $Q$  factors of the magnetic Mie resonance. They detail methods for all-dielectric nanostructure fabrication and discuss their advantages and disadvantages. They present a method for finding better materials with higher refractive indices and novel fabrication methods that will enable low-cost manufacturing of optically resonant high-index nanoparticles. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science*

### [Dielectric nanomaterial changes refractive index when heated](#)

[Nanotechweb](#), 20JUL2017

Dielectric metasurfaces are difficult to tune. An international team of researchers (Australia, China) designed a metasurface based on a 2D array of silicon disks, resonating at a particular frequency, and demonstrated that its refractive index can be changed by applying heat to it. Thermal tuning can cause drastic but reciprocal changes in the directional scattering and result in a 50-fold enhancement of the radiation directionality. Reversible tuning can play a significant role in novel flat optical devices including the metalenses and metaholograms.

[TECHNICAL ARTICLE](#)

*Tags: Materials science, Photonics*

### [Physicist points way to controlling elasticity with magnetism](#)

[Physorg.com](#), 19JUL2017

Researchers at the University of Nebraska-Lincoln found that, under certain conditions, the magnetic properties of a material can predict the relationship between its elasticity and temperature. It may point the way toward controlling the elasticity of certain materials by designing their magnetic properties or applying a magnetic field to them. Given the ease with which magnetic fields can be manipulated, it will be easy to tailor elasticity. [OPEN ACCESS TECHNICAL ARTICLE](#)

[TECHNICAL ARTICLE](#)

*Tags: Materials science*

## QUANTUM SCIENCE

### [Pulses of electrons manipulate nanomagnets and store information](#)

[Science Daily](#), 20JUL2017

An international team of researchers (Germany, USA - SLAC National Accelerator Laboratory) has demonstrated that read/write ability using bursts of electrons showing magnetization of nanoscale magnets can be steered by intense ultrashort electron pulses. The tailored electron pulses can swiftly write, erase or switch topologically protected magnetic textures such as skyrmions. Their results demonstrate potential for achieving similar topological charge transcription by way of laser pulses, whose lower and mass-free energy offer many practical

benefits. The research has potential applications in data storage. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Manipulating electron spins without loss of information](#)

[Science Daily](#), 19JUL2017

An international team of researchers (Switzerland, Brazil, UC Santa Barbara, University of Chicago, Naval Research Laboratory, China) has developed a chip on which an electron rotates uniformly in its orbit through the material without decay of the spin. The spin's orientation follows a spiral pattern. If the voltages applied by two gate electrodes change, it affects the wavelength of the helix and the orientation of the spin can be influenced. They adjusted the spin's orientation over distances greater than 20 micrometers which corresponds to many spin rotations. Thus spin can be transmitted between different quantum bits. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Communications technology*

### [New breakthrough discovery—every quantum particle travels backwards](#)

[Physorg.com](#), 18JUL2017

An international team of researchers (UK, Germany) has identified a unique property of quantum mechanical particles – they can move in the opposite way to the direction in which they are being pushed. Using a combination of analytical and numerical methods, researchers also obtained precise estimates about the strength of this phenomenon. The backflow effect is the result of wave-particle duality and the probabilistic nature of quantum mechanics. The discovery could be applied to future experiments in quantum technology fields such as computer encryption. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

## S&T POLICY

### [A New Vision for Center-Based Engineering Research](#)

[National Academy of Sciences](#), 25JUL2017

NSF Engineering Research Centers (ERC) are interdisciplinary, multi-institutional centers that join academia, industry and government in partnership to produce transformational engineered systems and engineering graduates who are adept at innovation and primed for leadership in the global economy. To ensure that the ERCs continue to be a source of innovation [A New Vision for Center-Based Engineering Research](#) explores the future of center-based engineering research, the skills needed for effective center leadership, and opportunities to enhance engineering education through the centers.

*Tags: S&T policy*

## **China Plans to Use Artificial Intelligence to Gain Global Economic Dominance by 2030**

MIT Technology Review, 21JUL2017

The State Council of the People's Republic of China has announced a bold scheme meant to build an AI industry worth \$150 billion, and to make China the global leader in the field by 2030. While U.S. researchers grab headlines for developing cutting-edge algorithms and techniques, Chinese companies have become adept at commercializing AI technologies and have shown a growing willingness to "invest in fundamental research and development."

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

## **Additive Manufacturing could be used to rapidly make Prototype or custom weapons**

Next Big Future, 18JUL2017

A 2015 prototype produced by the Royal Navy while at sea provides an example of additive manufacturing. As additive manufacturing technology advances, it will become possible for military forces to produce and iterate on many kinds of prototypes on their own in forward locations. To this end, the naval services are examining the use of commercial technology, such as Blockchain, to create a network of tactical manufacturing hubs, connected by a digital thread.

*Tags: S&T policy, Advanced manufacturing*

## SENSORS

### **New phase change mechanism could lead to new class of chemical vapor sensors**

Physorg.com, 25JUL2017

Researchers at the Naval Research Laboratory exposed monolayer MoS<sub>2</sub> and MoSe<sub>2</sub> films to strong electron donor chemical vapor analytes and found that the conductance response of their devices ceased after moderate exposure and the overall magnitude of the conductance abruptly increased significantly that moment, which signaled a phase change. The optical response also corroborated a phase change. Annealing in vacuum at 400 °C restores full device relaxation back to a semiconducting state.

The discovery opens possibilities for low-power, flexible, versatile chemical vapor sensor devices. [OPEN ACCESS](#)

**TECHNICAL ARTICLE**

*Tags: Sensors, Government S&T* ■

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