



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Scientists make new high-tech liquid materials that can manipulate micro-organisms](#)

[Science Daily, 09FEB2017](#)

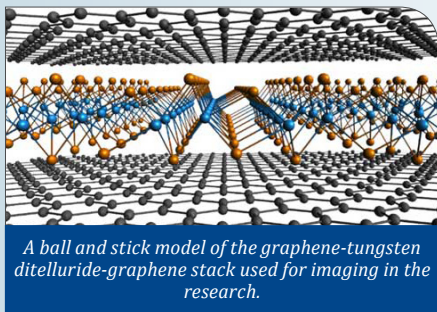
Currents make a liquid behave like materials with regular structures such as crystals. An international team of researchers (Australia, USA - Seattle University) has shown that such structures can be realized at the macroscopic scale on a liquid surface by using rotating waves. By changing waves, they can change the flow patterns which allows them to control the nature of the material remotely. If you use conducting liquids, you can create an interface with designed electrical properties. With biocompatible substances, you can guide micro-organisms or trap them.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Featured Article*

### [Researchers grow a versatile 2-dimensional material](#)

[Nanowerk, 08FEB2017](#)



Unlike other two-dimensional materials, scientists believe tungsten ditelluride has topological electronic states. Researchers at the University of Pennsylvania were able to produce a single,

three-atom-thick layer of two-dimensional tungsten ditelluride and measure its properties. They studied the time dependent degradation under ambient conditions, and identified reaction with oxygen as the degradation mechanism. They found metallic conduction at low temperature along with a weak antilocalization effect that is evidence for strong spin-orbit coupling. The ability of this material to have multiple properties could also have implications in quantum computing. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [Most stretchable elastomer for 3-D printing](#) [Science Daily, 09FEB2017](#)

An international team of researchers (Israel, Singapore) has developed a family of highly stretchable and UV curable (SUV) elastomers that can be stretched by up to 1100%, and are suitable for UV curing based 3-D printing techniques. Using high resolution 3-D printing with the SUV elastomer compositions enables the direct creation of complex 3-D lattices or hollow structures that exhibit extremely large deformation. The SUV elastomers not only sustain large elastic deformation, but also maintain good mechanical repeatability, which makes them good materials for fabricating flexible electronics.

[TECHNICAL ARTICLE](#)

*Tags: Advanced manufacturing, Advanced materials*

### ADVANCED MATERIALS

#### [Optical fibre with Einstein effect](#) [Physorg.com, 14FEB2017](#)

Researchers in Germany have fabricated photonic crystal fibre in a twisted form which causes the hollow channels to wind around the length of the fibre in helical lines. When they transmitted laser light through the fibre, the light was concentrated in the central region, where the core of a conventional optical fibre is located, instead of being distributed evenly as in regular fiber.

Although their work is basic research, in the future the technique may have applications in sensors. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

#### [Metamaterial: Mail armor inspires physicists](#) [Physorg.com, 09FEB2017](#)

Apart from measuring magnetic fields, the Hall effect can also be used to characterize metals and semiconductors and determine charge carrier density of the material. Researchers in Germany show that it is possible to produce meta-materials with a positive coefficient, even though their components have negative coefficients. The charge carriers in the metamaterial remain negatively

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charged electrons, Hall measurements only make them appear positively charged, as the structure forces them to take detours. The next step will be the production of anisotropic structures with a Hall voltage in the direction of the magnetic field. Such unconventional materials might be applied in novel sensors for the direct measurement of magnetic field eddies.

*Tags: Advanced materials, S&T Germany*

### **Nanorods Emit and Detect Light, Could Lead to Displays That Communicate via Li-Fi**

[IEEE Spectrum, 09FEB2017](#)

Dual-functioning displays, which can simultaneously transmit and receive information and energy through visible light would enable enhanced user interfaces and device-to-device interactivity. An international team of researchers (USA - University of Illinois Urbana-Champaign, industry partner, South Korea) demonstrated that double heterojunctions designed into colloidal semiconductor nanorods allow both efficient photocurrent generation through a photovoltaic response and electroluminescence within a single device. They have applications from touchless interactive screens to energy harvesting and scavenging displays and massively parallel display-to-display data communication. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Communications technology*

### **Germanium tin laser could increase processing speed of computer chips**

[Science Daily, 07FEB2017](#)

Germanium tin holds great promise as a semiconducting material for future optical integration of computer chips, because it harnesses efficient emission of light, which silicon cannot do. A team of researchers in the US (University of Arkansas, University of Minnesota, Dartmouth College, Boston College, industry partner) fabricated an optically pumped laser made of the alloy germanium tin grown on silicon substrates. They reduced the laser threshold 80 percent at a lasing operation temperature up to 110 Kelvin which is significant progress compared with the previously reported best result. The augmented material could lead to the development of fully integrated silicon photonics, including both circuits and lasers, and thus faster micro-processing speed at much lower cost. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Microelectronics*

### **'Wet' metallic MoS<sub>2</sub> makes ultrafast supercapacitor**

[Nanotechweb, 06FEB2017](#)

A team of researchers in the US (Northeastern University, University Arkansas) prepared M-MoS<sub>2</sub> with a monolayer of water molecules covering both sides of the material nanosheet using a hydrothermal technique and found that the system reaches a high capacitance of 380 F/g at a scan rate of 5 mV/s. The nanochannels are around 1.18 nm

wide and help increase the amount of space through which ions can diffuse and enlarge the surface area over which ions can be adsorbed. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

## BIOTECHNOLOGY

### **Bacteria fed synthetic iron-containing molecules turn into electrical generators**

[Science Daily, 09FEB2017](#)

In the wild, "electrogenic" bacteria generate current as part of their metabolism. Researchers at UC Santa Barbara built a molecule called DFSO+, which contains an iron atom at its core and added it to the bacteria. Within a few minutes, the synthetic molecule found its way into the bacteria's cell membranes and began conducting current through its iron core. Their concept was to give the bacteria an electrode, so it can produce electricity while cleaning the water. The amount of electricity they produce will never power anything very big, but it can offset the cost of cleaning water. Changing bacteria's capabilities will most likely be cheaper than bacteria genetically engineered to do the same job.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Biotechnology*

### **Removing the Viral Threat: Two Months to Stop Pandemic X from Taking Hold**

[DARPA News, 06FEB2017](#)

Over the past several years, DARPA-funded researchers have pioneered RNA vaccine technology, a medical countermeasure against infectious diseases that uses coded genetic constructs to stimulate production of viral proteins in the body, which in turn can trigger a protective antibody response. DARPA is now launching the [Pandemic Prevention Platform \(P3\)](#) program, aimed at developing that foundational work into an entire system capable of halting the spread of any viral disease outbreak before it can escalate to pandemic status.

*Tags: Biotechnology, DARPA*

## CYBER SECURITY

### **Protecting bulk power systems from hackers**

[Physorg.com, 10FEB2017](#)

In this survey paper, researchers at the Michigan Technological University present a conceptual expansion of real-time monitoring, anomaly detection, impact analyses, and mitigation framework with emphasis on the resulting impacts, both on steady-state and dynamic aspects of power system stability. Their expanded framework includes (1) critical/noncritical combination verification, (2) cascade confirmation, and (3) combination re-evaluation. They discuss open issues for metrics and future design related to the impact quantification of cyber-related contingencies.

[TECHNICAL ARTICLE](#)

*Tags: Cyber security*

“Almost everything that distinguishes the modern world from earlier centuries is attributable to science.” BERTRAND RUSSELL

### [Self-Destructing Gadgets Made Not So Mission Impossible](#)

IEEE Spectrum, 09FEB2017

The self-destruct mechanism proposed by researchers in Saudi Arabia can work swiftly and is compatible with the common semiconductor technology. It relies on an expandable polymer layer that can rapidly expand to around seven times its original volume when heated to temperatures above 80 degrees C. The heat that triggers the polymer expansion comes from heater electrodes that could draw power from the battery of a smartphone or laptop. Roughly 500 to 600 milliwatts supplied to the heater electrodes enables the polymer to expand and crumple the chip within 10 to 15 seconds. Details of the research will be reported in an upcoming issue of the journal *Advanced Materials Technologies*.

Tags: Cyber security

## ENERGY

### [Battery can be recharged with carbon dioxide](#)

Physorg.com, 09FEB2017

Researchers at Pennsylvania State University have developed a rechargeable battery called flow cell, creating pH-gradient between two liquids one with dissolved CO<sub>2</sub> gas and the other ambient air. The two solutions are injected into two channels in a flow cell. The pH gradient in the cell creates a voltage difference between the two electrodes causing electrons to flow along a wire connecting the electrodes. After the flow cell is discharged, it can be recharged again by switching the channels that the solutions flow through. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Battery

### [New, long-lasting flow battery could run for more than a decade with minimum upkeep](#)

Science Daily, 09FEB2017

Molecules of viologen previously used in flow batteries were degrading quickly in neutral solutions. Researchers at Harvard University identified the problem and modified its molecular structure to make it more resilient. By functionalizing ferrocene molecules in the same way as the viologen, the team was able to engineer a battery that loses only one percent of its capacity per 1000 cycles. The neutral pH should be especially helpful in lowering the cost of the ion-selective membrane that separates the two sides of the battery. [TECHNICAL ARTICLE](#)

Tags: Energy, Battery

### [Two-dimensional oxides juice up sodium ion batteries](#)

Nanowerk, 09FEB2017

Sodium ion batteries are a promising alternative to lithium ion batteries, but it exhibits large volume change during the sodiation and lithiation process which makes it unsuitable as a high-performing anode material. Researchers in Saudi Arabia developed a chemical process to control the degree of exfoliation by carefully choosing the reactants, solvents, and reaction conditions. They can precisely control the number of atomic layers in SnO anode sheets. They have demonstrated that, when the number of SnO atomic layers in one SnO nanosheet is less than about five, the sodium ion batteries can last for thousands of cycles. [TECHNICAL ARTICLE](#)

Tags: Energy, Battery

### [Atomtronic battery made from Bose-Einstein condensate](#)

Physics World, 07FEB2017

A team of researchers in the US (NIST, University of Colorado) has created an atomtronic battery based on Bose-Einstein condensate. Unlike conventional batteries, which are driven by an electrical potential, the atomtronic battery is driven by a chemical potential which is related to the abundance of atoms. As the atoms repel each other they cause a current of atoms. Potential applications of the battery include inertial sensing and quantum-information processing. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Battery

### [Water evaporation generates electrical energy](#)

Physics World, 07FEB2017

Researchers in China constructed an electric power supply driven by water evaporating from a carbon nanomaterial. Their device is about 2.5 cm long and can create a voltage of about 1.5 V on par with a standard AA battery. An infrared spectroscopy study of the device suggests that electrical energy is created via a streaming potential. While the power supply only delivers a few hundred nanoamps, the team connected several devices together to run a liquid-crystal display. With further improvements, the researchers say, the device could be used to run sterilization equipment and to purify or desalinate water in warm regions of the world. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, S&T China

## ENVIRONMENTAL SCIENCE

**Current climate change models understate the problem, scientists argue**

Science Daily, 08FEB2017

A team of researchers in the USA (University of Maryland, professional society, Johns Hopkins University, Columbia University, Brown University, Northeastern University, George Mason University) describes how the recent growth in resource use, land-use change, emissions, and pollution has made humanity the dominant driver of change in most of the Earth's natural systems, and how these changes, in turn, have important feedback effects on humans with costly and serious consequences. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Environmental science, Climatology*

## FEATURED RESOURCE

**SciTech Connect**

SciTech Connect is a portal to free, publicly-available DOE-sponsored R&D results including technical reports, bibliographic citations, journal articles, conference papers, books, multimedia, software, and data information. It was developed by the DOE Office of Scientific and Technical Information (OSTI).

## IMAGING TECHNOLOGY

**New record achieved in terahertz pulse generation**

Physorg.com, 13FEB2017

An international team of researchers (Austria, Switzerland) developed a technique to control and fully suppress higher order lateral modes in broadband terahertz quantum cascade lasers by introducing side-absorbers to metal-metal waveguides. They optimized the impact of the side-absorbers on the emission properties and determined the required increase of waveguide losses. The technique enables the generation of a bandwidth up to ~1 THz and an ultra-short pulse length of 2.5 ps suitable for spectroscopic applications and extremely precise frequency measurements. [OPEN ACCESS TECHNICAL ARTICLE 1, 2](#)

Tags: *Imaging technology, Terahertz technology*

**Wave of the future: Terahertz chips a new way of seeing through matter**

Science Daily, 09FEB2017

Researchers at Princeton University exploited the interaction between the front-end antenna and the incident signal to extract spectral information eliminating the need

for extremely wideband longitudinal optical generation and the entire receiver architecture following the antenna. The central premise is that the incident THz signal excites a spectrum-dependent current distribution on the antenna surface and they present a method to measure and then estimate the incident spectrum from the impressed current distribution on an on-chip antenna. They present a synthesizer-free THz spectroscope that consists of an integrated scatterer and a multitude of low-power sensors capable of subwavelength measurement of near-field interactions which are exploited for spectral estimation. The research advances medical imaging, communications and drug development. [TECHNICAL ARTICLE](#)

Tags: *Imaging technology, Terahertz technology*

## INFORMATION TECHNOLOGY

**AI Software Writes, and Rewrites, Its Own Code**

MIT Technology Review, 14FEB2017

Training deep-learning algorithms requires large amounts of data. It would be lot more efficient if an algorithm could develop an idea about what it is looking for with less data. A company in the US has developed a system that uses probabilistic programming, rather than specific variables, to build a predictive model that explains a particular data set. As further examples are provided, the code behind the model is rewritten, and the probabilities tweaked.

Tags: *Information technology, Artificial intelligence*

**New study of ferroelectrics offers roadmap to multivalued logic for neuromorphic computing**

Physorg.com, 10FEB2017

An international team of researchers (France, USA - Argonne National Laboratory) lays out a recipe by which we could tap the properties of very thin films of perovskites. According to the calculations, perovskite films could hold two, three, or even four polarization positions that are energetically stable. The team calculated these stable configurations and how to manipulate the polarization to move it between stable positions using electric fields. They are working with experimentalists to apply the principles to create a working system. When realized in a device, it offers a significant step towards neuromorphic computing. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Information technology*

**Secure wireless chargers**

MIT News, 09FEB2017

Counterfeit chargers for portable electronics are a major problem. Researchers at MIT have built a chip that blocks attempts to wirelessly charge a device's battery unless the charger first provides cryptographic authentication. The chip uses elliptic curve cryptography for authentication, which is a "public-key". The chip doesn't need to store a secret key of its own. They found a way to simplify the encryption circuit so that it takes up less space on the chip

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and consumes less power. They presented their work at the recent International Solid-State Circuits Conference.

*Tags: Information technology*

### **Human intuition added to planning algorithms**

[Science Daily, 07FEB2017](#)

Researchers at MIT are trying to encode the strategies of high-performing human planners in a machine-readable form to improve the performance of planning algorithms by 10 to 15 percent on a challenging set of problems. They discovered that linear temporal logic could be used to add constraints to the problem specifications. They are using natural-language-processing techniques to make the system fully automatic, so that it will convert users' free-form descriptions of their high-level strategies into linear temporal logic without human intervention. Researchers will report their research at an upcoming conference.

*Tags: Information technology, Artificial intelligence*

## **MATERIALS SCIENCE**

### **Theoretical physicists deliberately misled intelligent machines**

[Science Daily, 13FEB2017](#)

Researches in Switzerland propose a neural-network approach to finding phase transitions, based on the performance of a neural network after it is trained with data that are deliberately labelled incorrectly. They demonstrated the success of this method on the many-body-localization transition in a disordered quantum spin chain. Their method does not depend on order parameters, knowledge of the topological content of the phases, or any other specifics of the transition at hand. It paves the way to the development of a generic tool for identifying unexplored phase transitions. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

### **Novel quantum state in strange insulating materials**

[Science Daily, 09FEB2017](#)

Despite the promise of Mott insulators, scientists still don't fully understand how they work. A team of researchers in the US (Brown University, National High Magnetic Field Laboratory, Stanford University, SLAC National Accelerator Laboratory) focused on a strange type of magnetism that arises with Mott insulators with strong spin-orbit coupling. They showed that as the material is cooled below a critical temperature, changes in the distribution of electron charges cause distortion in the material's atomic orbitals and lattice. As the temperature cools further, that distortion drives the magnetism by causing an alignment of electron spins within individual layers of the atomic lattice. The work is

an important step toward understanding and manipulating the properties of Mott insulators for real-world applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science, Advanced materials*

## **QUANTUM SCIENCE**

### **Taming complexity**

[Science Daily, 10FEB2017](#)

An international team of researchers (Switzerland, USA - Microsoft Research) has found a way to overcome the mathematical complexity of many particles quantum systems by using an artificial neural network. They used reinforcement learning to train it to recognize which parameters are most important in the chaotic system of equations and which could be ignored, so that even larger systems can be calculated with simplified equations. Their approach enables the description of quantum systems with more than 100 particles, with a reasonable computational effort. In the next phase, the researchers hope to examine the limits of this approach more closely. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### **Large groups of photons on demand: An equivalent of photonic 'integrated circuit'**

[Science Daily, 08FEB2017](#)

Researchers in Poland have demonstrated an angularly multiplexed holographic memory capable of intrinsic generation, storage, and retrieval of multiple photons, based on an off-resonant Raman interaction in warm rubidium-87 vapors. All the photons are created immediately within the quantum memory and external sources of single photons are no longer needed. The new source generated a group of up to 60 photons. Calculations show that in realistic conditions the use of higher power lasers would help to increase this number even up to several thousand. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

## **S&T POLICY**

### **China on track to expand its navy to 500 warships**

[Next Big Future, 09FEB2017](#)

The UK Royal United Services Institute expects China to reach a 500 ship navy. The 500 warships will include aircraft carriers, nuclear submarines, amphibious ships and a burgeoning frigate and destroyer force. Just in the past three weeks a new destroyer and new corvette have been launched and discussion over new carrier-based aircraft has been increasing. China's official defense spending is expected to be \$233 billion in 2020, up from \$123 billion in 2010, according to a new report by IHS Jane's.

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

## SCIENCE WITHOUT BORDERS

### Experts investigate how order emerges from chaos

Physorg.com, 13FEB2017

Researchers in Russia have developed an analytical scheme explaining the results of numerical and laboratory experiments where coherent vortices (stable vortex formations) are observed by relating vortex characteristics to the statistical properties of chaotic fluctuations. Uncovering this link could be useful in identifying the causes of the particular characteristics of such atmospheric phenomena as cyclones and anticyclones. The results of the analysis are valuable for their predictive power. [TECHNICAL ARTICLE](#)

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

### University incubators may lead to lower-quality innovation, new study shows

Science Daily, 10FEB2017

In their study, an international team of researchers (UK, USA - Baylor College) found some empirical support to the hypothesis that universities often create incubators under the pressures of reduced public funding for academia and increased pressure for public accountability. The incubators are competing against other academic innovation activities for integral resources— personnel, money, lab space, etc. The net result of that competition may be a dilution of innovation. They focused less on other things that universities can do that are related to innovation and entrepreneurship. [TECHNICAL ARTICLE](#)

Tags: *Science without borders*

## SENSORS

### The Curious Case of Cockroach Magnetization

MIT Technology Review, 09FEB2017

American cockroaches become magnetized when placed in a magnetic field. An international team of researchers (Singapore, China, Australia, Poland) found that the magnetic properties of living cockroaches are strikingly different from those of dead cockroaches. They assume that magnetization is the result of magnetic particles inside the cockroaches aligning themselves with the external magnetic field. A better understanding of biomagnetic sensing could help engineers design better sensors for other applications, such as microrobot navigation. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Sensors, Biomimetics* ■

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