



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Electronic devices that can degrade and physically disappear on demand](#)

[Texlore, 04SEP2017](#)

An international team of researchers (USA - University of Houston, China) has demonstrated electronic devices that can degrade and disappear on demand using nothing but moisture in the air. They integrated the polymer polyanhydride, which degrades in humid environments, with electronic components by applying it in thin films. The films allow the components to operate normally until humidity is applied. The time frame for degradation can be varied, allowing manufacturers to pre-program self-destructing components on demand—from days to weeks, or indefinitely in some applications. They demonstrated the technology in several types of devices such as resistors, capacitors, transistors and even optoelectronics and diodes. The technology could be used for security applications and reduce the number of electronic components that pollute the environment.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Information technology, Integrated circuits, Microelectronics, Featured Article*

### [Safety assistance system warns of dirty bombs](#)

[Fraunhofer Institute \(Germany\), 01SEP2017](#)



*Lab testing at Fraunhofer FKIE to see how robust the security assistance system is: it must be able to clearly identify the carrier of a dirty bomb without sounding a false alarm.*

Researchers in Germany have developed a new system that will be able to detect possible carriers of radioactive substances, even in large crowds of people. The system consists of a sensor network, commercially available cameras, and data fusion software. The sensor network detects and classifies gamma radiation, and whether

it is being carried on someone's person or is present inside their body; the cameras pinpoint the location and provide images and information about distances. When the devices are connected to each other, the data is fused using mathematical evaluation algorithms and filter out the desired information, including the potential attacker, from the huge amounts of data.

*Tags: Sensors, S&T Germany, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [Perovskite-based flexible image sensor array \(w/video\)](#)

[Nanowerk, 05SEP2017](#)

Researchers in South Korea have developed a high-resolution spin-on-patterning (SoP) process for the fabrication of optoelectronic devices arrays such as image sensors. The SoP process is compatible with almost every spin-coated perovskite material and deposition technique as well as microfabrication processes used in the industry for mass production of multiplexed image sensor arrays. As such, it can be applied to high-performance, ultrathin, and deformable optoelectronic device arrays. However, as the uniformity of the spin-coating process decreases with increasing number of pixels in the array, uniform patterns are not achieved. They expect to address the problem in their future work. [TECHNICAL ARTICLE](#)

*Tags: Advanced manufacturing, Advanced materials*

#### [Machinery that repairs itself](#)

[Physorg.com, 01SEP2017](#)

Researchers in Germany working on SelSus, a project sponsored by the EU, are developing a maintenance technology capable of forecasting machine downtimes in production before they occur. The aim is for the system to detect potential weak points or signs of wear and tear early enough, predict potential malfunctions, develop diagnostic models, directly provide suggestions or recommendations on how to rectify the problem and correct some defects automatically. The SelSus software based

*continued...*

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on Bayesian networks relies not only on sensors, but also takes the technical characteristics of the machine and its performance parameters into account.

*Tags: Advanced manufacturing, S&T EU*

## ADVANCED MATERIALS

### From iPad to iPaper

[Nanowerk, 01SEP2017](#)

Significant progress has been made in the past decade to manipulate the smallest plant fibers, called “nanocellulose”, for use in electronics. Researchers in Singapore have made “nanopaper” out of nanocellulose and silver nanowires. It conducted electricity after being folded in half 500 times. Some nanopapers have reached 90% transparency, while others are in the 80% range, similar to plastic. The hydrophilic properties of cellulose make the items easy to degrade. Researchers are working to make it more stable during its operational life. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### Center for Biorenewable Chemicals introduces idea for new molecules, innovation, value

[EurekaAlert, 31AUG2017](#)

Researchers at Iowa State University are proposing a new model for identifying “bioprivileged molecules” that offer unique properties that could lead to new products. Because of their origin from biological-derived molecules and concomitant plethora of functionalities, the bioprivileged molecules have the potential to greatly expand the bioproduct horizon. Biomass-derived feedstocks hold promise for dramatically increasing the pool of possible intermediates because they provide a rich array of chemical complexity, including next-generation pharmaceuticals, nutraceuticals, antimicrobials, insecticides, herbicides, consumer goods and specialty chemicals. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### Insect eyes inspire new solar cell design

[Nanowerk, 30AUG2017](#)

Researchers at Stanford University used the compound honeycomb shaped eye of the fly consisting of hundreds of tiny segmented eyes with built-in redundancy as the model for creating solar cell from perovskite. The design protects unstable and mechanically fragile perovskite from deteriorating when exposed to heat, moisture or mechanical stress. The honeycombs are encapsulated in a hexagon-shaped scaffold just 500 microns wide. The scaffold is made of an inexpensive epoxy resin. In tests, the scaffolding had little effect on the perovskite’s ability to convert light into electricity and the power-conversion efficiencies of the perovskite cell was the same as the planar solar cell. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Biomimetics, Energy, Solar energy*

### Photosensitive perovskites change shape when exposed to light

[Physorg.com, 28AUG2017](#)

An international team of researchers (Saudi Arabia, Taiwan) has shown that the perovskite MAPbBr<sub>3</sub> (Methylammonium Lead Bromide) has a photostriction coefficient of 1.25% and the photostriction was partly due to the photovoltaic effect. They demonstrated that in situ Raman spectroscopy with confocal microscopy, which they used for measuring intrinsic photoinduced lattice deformation of MAPbBr<sub>3</sub>, could be applied to measure photostriction in other materials. MAPbBr<sub>4</sub> has applications in next-generation optical micro-electromechanical devices. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

## AUTONOMOUS SYSTEMS & ROBOTICS

### Robot learns to follow orders like Alexa

[MIT News, 30AUG2017](#)

Researchers at MIT have developed a system called “ComText” that allows robots to understand a wide range of commands that require contextual knowledge about objects and their environments. ComText can observe a range of visuals and natural language to glean “episodic memory” about an object’s size, shape, position, type and even if it belongs to somebody. From this knowledge base, it can reason, infer meaning and respond to commands. When tested on Baxter, a two-armed humanoid robot, ComText was successful in executing the right command about 90 percent of the time. In the future, the team hopes to enable robots to understand more complicated information, such as multi-step commands, the intent of actions, and using properties about objects. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, Artificial intelligence*

### Here Is the Safety Trick That Will Help SpaceX Fly You to the Moon

[MIT Technology Review, 23AUG2017](#)

Rocket launches traditionally require extensive ground communications infrastructure, and humans monitoring data from the ground must send a command to the rocket to destroy it if necessary. A team of researchers in the US (US Air Force, industry partner) has developed a new technology called the autonomous flight safety system (AFSS) that relies on GPS on-board the rocket to determine whether it has deviated from a programmed safe flight path, and if the rocket must be detonated and the system will do so on its own. It can also track a rocket further down range than the conventional system and destroy an errant vehicle several seconds sooner than a human can. The new system requires fewer workers on the ground, needs much less time to prepare for it, helps increase launch capacity and meets the rising demand for commercial space launches. The AFSS has flown on eight successful operations.

*Tags: Autonomous systems & robotics, Space technology*

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“The science of today is the technology of tomorrow.”

EDWARD TELLER

### **A Brief Survey of Deep Reinforcement Learning**

[ArXiv, 19AUG2017](#)

In this survey, researchers in the UK begin with an introduction to the general field of reinforcement learning, then progress to the main streams of value-based and policy-based methods. The survey will cover central algorithms in deep reinforcement learning, including the deep Q-network, trust region policy optimisation, and asynchronous advantage actor-critic. They highlight the unique advantages of deep neural networks, focusing on visual understanding via reinforcement learning and conclude with a description of the current areas of research within the field. [OPEN ACCESS](#)

**TECHNICAL ARTICLE**

*Tags: Autonomous systems & robotics, Artificial intelligence, S&T UK*

## BIOTECHNOLOGY

### **Self-driving vehicles at the microscale**

[Physorg.com, 28AUG2017](#)

An international team of researchers (USA - UC San Diego, China) has developed a 5- $\mu$ m spherical microvehicle for precise autonomous navigation in complicated and dynamically changing environments through optimal path planning. The process consists of three main steps—a CCD camera that takes pictures, a feature extraction processor which analyses the pictures and constructs a map of the environment and an AI planner which determines the shortest collision-free path. The AI planner sends travel directions to a magnetic field generator, which orients a magnetic field to steer the microvehicle along the collision-free pathway. In demonstrations, the microvehicle distinguished between cancer cells, red blood cells, and mixed cells. The research has biomedical applications. **TECHNICAL ARTICLE**

*Tags: Biotechnology*

## COMMUNICATIONS TECHNOLOGY

### **Researchers demonstrate high-bandwidth communications capability for ships**

[Physorg.com, 28AUG2017](#)

Researchers at Johns Hopkins University have demonstrated up to 10 gigabits per second, the free-space optical (FSO) communications system between two moving ships, proving operational utility of FSO technology in near-shore environments. The FSO system provides secure high data rates outside the conventional RF spectrum. The team achieved more than 14 hours of link-up time, including during 4- to 6-foot high seas; 1–2 gigabits of error-free data transport at ranges greater than 25 kilometers; voice communications at greater than 35 kilometers; chat messaging out to

45 kilometers, the maximum available line of sight; and repeatable, semiautomatic reacquisitions over the entire line-of-sight range.

*Tags: Communications technology*

## COUNTER WMD

### **New biosecurity initiative launched**

[Stanford University, 29AUG2017](#)

A new biosecurity initiative at the Freeman Spogli Institute for International Studies (FSI) aims to identify and mitigate biological risks, both natural and man-made, and safeguard the future of the life sciences and associated technologies. The initiative will seek to advance the beneficial applications of the life sciences while reducing the risks of misuse by promoting research, education and policy outreach in biological security. It will bring together interest and expertise across the centers and programs of FSI in partnership with Schools and Departments across the university.

*Tags: Counter WMD, S&T Policy*

## CYBER SECURITY

### **Artificial intelligence cyber attacks are coming - but what does that mean?**

[Physorg.com, 28AUG2017](#)

At a recent cyber security conference, industry professionals said the first AI-enhanced cyberattack could come in the next 12 months. The capabilities AI could bring to cyberattacks—and cyberdefense—are not likely to immediately involve computers choosing targets and attacking them on their own. People will still have to create attack AI systems, and launch them at particular targets. Very rudimentary AI-like capabilities have for decades given virus programs the ability to self-replicate, spreading from computer to computer without specific human instructions. AI, however, could help human cybercriminals customize attacks. As we continue to fill our homes, factories, offices and roads with internet-connected robotic systems, the potential effects of an attack by artificial intelligence only grows.

*Tags: Cyber security, Artificial intelligence*

## ENERGY

### **Solid crystals that self-assemble to form channels for an electric current could make safer batteries**

[Physorg.com, 05SEP2017](#)

Electrolytes in batteries are toxic and flammable. While looking for non-toxic alternatives, researchers in Japan *continued...*

added an organic compound to lithium salt that self-assembled to form channels through which lithium ions moved, creating an electric current. The crystal structure of these materials could be changed by making alterations to their molecules and changing the crystals' structures affecting their ion-conducting functions. The findings could open the door to the design of new solid electrolytes and thus the development of new molecular devices.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Energy, Advanced materials, Battery, S&T Japan*

## FEATURED RESOURCE

### [Nature RSS feeds](#)

Feeds provide headlines, summaries and links for all the new content published on their respective sites. [RSS](#)

### [Wireless underwater charging tech will bring a new level of autonomy for UUVs](#)

[Defense Systems, 01SEP2017](#)

Wireless underwater charging developed by scientists at the Space and Naval Warfare Systems Center Pacific is based on resonant wireless power transfer. It uses amplification technology to convert DC power current into radio frequency waves, which use resonance to project power, that can be transferred to a charging object with a resonance receiver tuned to the same frequency. To move this process beneath the ocean's surface adds some complicating factors such as difference in conductivity between air and seawater, decrease in conductivity at 20kHz and developing chargers that are standardized across multiple UUVs.

*Tags: Energy, Government S&T, Military technology*

### [Silicon solves problems for next-generation battery technology](#)

[Nanowerk, 30AUG2017](#)

Researchers in Finland have introduced new technology to Li-ion batteries by replacing graphite used in anodes by silicon. They combined the nano-level functionality with micro-level processibility, and all this without compromising performance. As the silicon they used is expensive, they are considering the possibility of manufacturing a similar material from agricultural waste, for example from barley husk ash, so that the new technology is feasible for commercial use. [OPEN ACCESS TECHNICAL ARTICLE](#)

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

### [Making better batteries via real-time TEM observation](#)

[Science Daily, 24AUG2017](#)

Dissolution of lithium polysulfides into an electrolyte limits the practical application of lithium sulfur batteries, eventually resulting in poor cycle performance and other drawbacks, such as rapid capacity fading. An international team of researchers (Singapore, South Korea, China, USA - Oak Ridge National Laboratory) has demonstrated that the high flexibility and strong van der Waals force in MoS<sub>2</sub> nanoflakes allows effective encapsulation of the sulfur particles. They demonstrated that composite electrodes made from the MoS<sub>2</sub>-encapsulated sulfur spheres show outstanding electrochemical performance and long cycle life of more than 1000 cycles. [TECHNICAL ARTICLE](#)

*Tags: Energy, Battery, Materials science*

## INFORMATION TECHNOLOGY

### [Bit data goes anti-skyrmions](#)

[Physorg.com, 01SEP2017](#)

An international team of researchers (Germany, France) has discovered a new kind of magnetic nano-object in a novel material that could serve as a magnetic bit with cloaking properties to make a magnetic disk drive without moving parts - a Racetrack Memory - a reality in the near future. They present the experimental manifestation of the magnetic antiskyrmion. A spiral magnetic ground-state, which propagates in the tetragonal basal plane is transformed into an antiskyrmion lattice state under magnetic fields applied along the tetragonal axis over a wide range of temperatures. These results enlarge the family of magnetic skyrmions and pave the way to the engineering of complex skyrmionic structures. [TECHNICAL ARTICLE](#)

*Tags: Information technology, Advanced materials*

## MATERIALS SCIENCE

### [Bendable crystals tie current thinking in knots](#)

[Queensland University of Technology, 29AUG2017](#)

Researchers in Australia grew bendable crystals about the width of a fishing line and up to five centimetres long from a common metal compound—copper (II) acetylacetonate. They mapped changes in the atomic scale structure when the crystals were bent using X-ray measurements. They showed that the crystals can be repeatedly bent and they return quickly to their original shape with no signs of breaking or cracking when the force bending them is removed. Under strain, the molecules in the crystal reversibly rotate and reorganize to allow the compression and expansion required for elasticity and still maintain the integrity of the crystal structure. Flexible crystals could lead to new hybrid materials for numerous applications, from components of planes and spacecraft to parts of motion or pressure sensors and electronic devices. [TECHNICAL ARTICLE](#)

*Tags: Materials science, S&T Australia*

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## [Physicists resolve long-standing mystery of structure-less transition](#)

Nanowerk, 22AUG2017

Metallic, semiconducting and even superconducting properties can be achieved in certain organic molecular crystals. Researchers in Japan have precisely characterized the subtle structural changes and the accompanying phase transition in TMTTF (tetramethyltetrafulvalene) at each stage. They reported that the structure-less transition involves the formation of a two-dimensional Wigner crystal, based on a change in the distribution pattern of electrons in the structure. A better understanding of the complex behavior of organic molecular crystals could pave the way to a range of new functional electronic materials.

[TECHNICAL ARTICLE](#)

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

## PHOTONICS

### [New mini tool has massive implications](#)

EurekAlert, 28AUG2017

Ion trap mass spectrometers have metal electrodes creating an electric field. When radio frequency signal is applied, ions from ionized samples are trapped and ejected based on their masses which identifies the chemical composition of the sample. A team of researchers in the US (Brigham Young University, industry) used microlithography to decrease the space between ceramic and glass plates to less than a millimeter. The resulting ion trap is a hundred times lighter and smaller than a conventional ion trap. The miniaturized spectrometer can be used for detecting chemical weapons, explosives and other chemicals.

[TECHNICAL ARTICLE](#)

*Tags: Photonics, Imaging technology*

## QUANTUM SCIENCE

### [Equation reveals the characteristics of quantum chaos](#)

Physorg.com, 04SEP2017

An international team of researchers (Israel, Sweden) analysed statistical properties at different energy levels in a quantum chaos state formulating a mathematical result that provides an exact answer to the question of how chaos behaves. Chaos theory and the associated concept of random matrices are used in different contexts where there is an attempt to describe and analyse chaotic states. These contexts include financial instruments, brain surgery and even the string theory for the universe. As small differences in initial values can produce large deviations in the final result of the calculation, the results of the new study makes it possible to use an exact mathematical equation to predict the characteristics of chaos without extensive number-crunching.

[TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Long-range interactions leave a quantum reminder](#)

Physorg.com, 04SEP2017

Although statistical mechanics describes thermal equilibrium states, these states may or may not emerge dynamically for a subsystem of an isolated quantum many-body system. A team of researchers in the US (University of Maryland, Indiana University) reported finding a new kind of effect on the road to thermalization—one in which a chain of up to 22 trapped ions, all initially with their quantum spins aligned, can retain a memory of a flipped spin long after it begins to roam through the chain. The memory in this experiment comes from the long-range communication of the ions and confirms a theoretical prediction by two of the paper's authors.

[TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [New quantum memory device small enough to fit on a chip](#)

Physorg.com, 01SEP2017

An international team of researchers (USA - Caltech, NIST, JPL, Italy) has developed an approximately 10 by 0.7 micrometer size quantum memory device mirrors on either end. It is made of yttrium orthovanadate with small amounts of neodymium, which form a cavity. The cavities hold a crystal that traps single photons encoding data information (zero, one or both). It is small enough to fit on a chip and able to retrieve data on demand. They confirmed that the device was storing data and that it is truly a quantum memory device.

[TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Integrated quantum optical circuits soon a reality](#)

Science Daily, 30AUG2017

An international team of researchers (Sweden, the Netherlands, Canada) used a novel nanomanipulation technique to transfer selected and pre-characterized single photon emitters in nanowires, to a silicon chip. They built an integrated optical circuit to filter single photons and multiplex them. Every component of the circuit was carefully designed and optimized to perform a specific task. They have created a hybrid approach that combines two semiconductor technologies, III-V technology in the form of nanowire-based quantum emitters, and silicon technology in the form of the integrated optical circuit.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Quantum science, Information technology*

## SCIENCE WITHOUT BORDERS

**35 Innovators Under 35 - 2017**

MIT Technology Review, 02SEP2017

MIT technology Review's annual look at 35 outstanding innovators under 35 is a reminder that behind all those innovations are people with dreams, fears, and ambitions. Sometimes they hack away at a problem for years before figuring out a way forward. Sometimes they stumble on a solution they didn't know they were searching for. These portraits offer a sense of the variety of work being done in technology, and a sense of what's coming next.

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

## SENSORS

**Tracking debris in the Earth's orbit with centimeter precision using efficient laser technology**

Physorg.com, 01SEP2017

Researchers in Germany have developed a fiber laser that reliably determines the position and direction of the space debris' movement to mitigate the risks posed by them. Very short laser pulses, which last only a few billionths of a second, are shot at different positions in space to determine the speed, direction of motion and the rotational motion of the objects. If an object is actually at one of the positions examined, part of the radiation is reflected back to a special scanner, which is directly integrated into the system. Time of flight is converted into a distance and a real 3-D coordinate. The system's sensors, which collect the reflected light reflexes, can detect even billionths of the reflected light.

*Tags: Sensors, S&T Germany, Space technology*

**A microfluidic tactile sensor based on a diaphragm pressure sensor design**

Nanowerk, 28AUG2017

An international team of researchers (USA - UC Berkeley, Lawrence Berkeley National Laboratory, UK) utilized an embedded equivalent Wheatstone bridge circuit making the most of tangential and radial strain fields, allowing the researchers to achieve a combination of high sensitivity, linearity, low limit of detection, high resolution, and temperature self-compensation. The Wheatstone bridge design also provides built-in temperature compensation allowing for operation between 20 and 50°C without external offsets. The extremely low detection limit and resolution combined with an ultrafast response time of 90 ms allows for the sensor to be used in a wide range of applications in soft robotics, wearable electronics, and artificial electronic skins. **TECHNICAL ARTICLE**

*Tags: Sensors*

**Navy seeks lightweight, jam resistant antennae**

Defense Systems, 22AUG2017

The Naval Research Laboratory is working with the Tactical Reachback Extended Communications to develop an ultra-wideband phased array antenna with extended line-of-sight (LOS) communications which can support wide bandwidth frequency transmissions that are often capable of avoiding any jamming or interference attempts. The prototype includes an arrayed surface about the size of a human hand. According to the NRL, the small size and weight of the antenna is a key goal of the project because it lessens costs and the electronic signature of the weapons system it is integrated with. When the new antenna becomes operable, it will provide stability for low-altitude tracking.

*Tags: Sensors, Military technology*

## STEM

**Technology Moves to the Head of the 21st Century Classroom**

MIT Technology Review, 01SEP2017

According to a World Economic report, 35 percent of core workplace skills will change between 2015 and 2020, with complex problem solving, critical thinking, creativity, and collaboration in high demand. Emerging technologies like artificial intelligence, machine learning, and big data analytics will raise the bar even higher, allowing educators to personalize content to meet an individual student's needs while serving up metrics to ensure specific goals are met. In the US, 48 states and the District of Columbia are also supplementing traditional classroom-style instruction with virtual and online learning.

*Tags: STEM, Science without borders ■*

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