



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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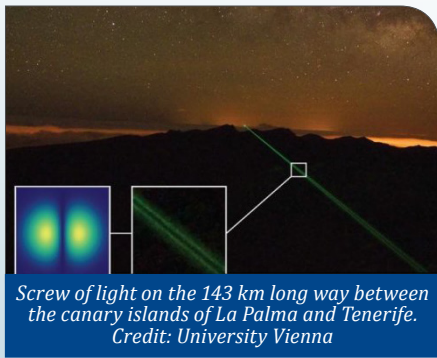
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## FEATURE ARTICLES

### [New records set up with ‘Screws of Light’](#)

[Science Daily, 16NOV2016](#)



*Screw of light on the 143 km long way between the canary islands of La Palma and Tenerife. Credit: University Vienna*

In principle, twisted light can carry a large amount of information per photon. A team of international researchers (Austria, Canada) sent the message ‘Hello World!’ encoded onto a green laser with

an optical hologram from one island and reconstructed it with an artificial neural network on the other island 140 kilometers away. After completion of this initial step, the researchers then twisted one of the photons with the spiral phase mirrors in an unprecedented strong manner. This increased the quantum numbers to huge values demonstrating that quantum physics even holds if 5-digit quantum numbers are entangled. The research paves the way to possible future technologies.

#### [TECHNICAL ARTICLE](#)

*Tags: Communications technology, Photonics, Featured Article*

### [Researchers develop way to ‘fingerprint’ the brain](#)

[Medical Express, 15NOV2016](#)

An international team of researchers (USA - Carnegie Mellon University, UC San Diego, University of Pittsburgh, Taiwan) used a new technique which measures the integrity along each segment of the brain’s biological wires, making it much more sensitive to unique patterns which allows them to identify a person based on this brain “fingerprint” with nearly perfect accuracy. The new method can be applied to the existing data and reveal new information that is already sitting there unexplored. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Neuroscience, S&T Japan, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [Closing tech gaps can fortify advanced manufacturing, save \\$100 billion](#)

[Physorg.com, 17NOV2016](#)

NIST sponsored economic studies of four advanced manufacturing areas - Additive manufacturing, Advanced robotics and automation, Roll-to-roll manufacturing, and Smart manufacturing. Each of the four studies identifies 5 to 10 critical technical barriers to the adoption of its specific manufacturing technology and the impact of eliminating obstacles. Key strategies for overcoming technical barriers and fortifying advanced manufacturing identified by the studies include: keeping standards and performance measures nonproprietary, using public research institutions to develop tools, and working through manufacturing research consortia and technology extension services to ensure that all manufacturers can access them.

*Tags: Advanced manufacturing, S&T Policy*

### ADVANCED MATERIALS

#### [New ultra-thin semiconductor could extend life of Moore’s Law](#)

[Nanowerk, 21NOV2016](#)

Researchers in the UK show that InSe crystals can be made only a few atoms thick, nearly as thin as graphene. InSe was shown to have electronic quality higher than that of silicon. Unlike graphene, but similar to silicon, ultra-thin InSe has a large energy gap allowing transistors to be easily switched on and off, allowing for super-fast next-generation electronic devices. Combining graphene with other new materials has resulted in exciting scientific developments and could produce applications as yet beyond our imagination.

*Tags: Advanced materials, S&T UK*

#### [Patterns that push the limits](#)

[Nanowerk, 18NOV2016](#)

Researchers in Sweden have demonstrated that nano- or microscale patterns, spanning macroscopic surface areas, can be transferred with high conformity onto a

*continued...*

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variety of surfaces, glass, plastics, metals, rough semiconductors and polymers, when such patterns are produced on a thin carbon film, grown on top of a sacrificial layer. The technique has applications in anti-counterfeit technologies, biomolecular and biomedical studies, light-matter interactions at the nanoscale, conformal photovoltaics and flexible electronics. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T Sweden*

### **Ice is no match for CSU-developed coating**

[Physorg.com, 17NOV2016](#)

Researchers at Colorado State University have developed a coating which is a gel-based, soft coating made out of PDMS (polydimethylsiloxane), a silicone polymer gel with already widespread industrial use. The ice adhesion strength, the shear stress necessary to remove ice from a surface, for the coating is about 5 kPa. By contrast, soft coatings available on the market have ice adhesion strength of about 40 kPa. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### **New aeroplane wing changes shape to boost performance**

[Physics World, 16NOV2016](#)

A team of researchers in the US (MIT, Cornell University, UC Santa Cruz, NASA) made the morphing wing from a lattice of lightweight, flexible, centimetre-scale, carbon-fibre-reinforced polymer components. While each component is strong and stiff, the overall flexibility of the structure can be tuned by varying its overall shape and exact composition of its individual components. The wing is completed with an outer skin of overlapping, flexible polyimide pieces that cover the lattice structure. In tests, the new wings can both match the aerodynamic properties of a conventional, fixed wing and deform in such a way that replaces the need for trailing-edge ailerons. The morphing ability could allow for more aerodynamic, manoeuvrable and fuel-efficient aircraft. It could be applied to a variety of other structures from bridges to wind turbines. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

## AUTONOMOUS SYSTEMS & ROBOTICS

### **Tech would use drones and insect biobots to map disaster areas**

[Science Daily, 17NOV2016](#)

The system, developed by researchers at North Carolina State University, works by releasing a swarm of sensor-equipped biobots into a collapsed building or other dangerous, unmapped area. Using remote-control technology, the movement of the biobots would be restricted to an area defined by proximity to a beacon on a UAV, where they can move freely. Once the program receives enough data to map the defined area, the UAV moves forward to hover over an adjacent, unexplored

section. The software program then stitches the new map to the previous one. The system has utility for areas where GPS can't be used. [TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, Imaging technology*

## BIOTECHNOLOGY

### **Tasting light: New type of photoreceptor is 50 times more efficient than the human eye**

[Science Daily, 17NOV2016](#)

Researchers at the University of Michigan suggest that the receptor protein, LITE-1, has unusual characteristics that may have future applications ranging from sunscreen to scientific research tools. Their experiments also raise the possibility that it might be possible to genetically engineer other new types of photoreceptors. [TECHNICAL ARTICLE](#)

*Tags: Biotechnology, Synthetic biology*

### **Researchers create living bio-hybrid system**

[Nanowerk, 14NOV2016](#)

After analyzing the biocompatibility of the substrate and the functionality of the adhering cells using Raman spectroscopy, researchers in Italy used memristor, to connect to the substrate. By combining memristors, it is possible to create pathways within the electrical circuits that work like the natural synapse which develop variable weight in their connections to reproduce the adaptive/learning mechanism. Layers of organic polymers, like polyaniline—a semiconductor polymer, also have memristive properties allowing them to work directly with biological materials into a hybrid bio-electronic system.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Biotechnology, Microelectronics*

## COMMUNICATIONS TECHNOLOGY

### **Silicon nanoantennas control light scattering for optical computing**

[Physorg.com, 17NOV2016](#)

An international team of researchers (Russia, USA - UT Austin) proposed nanoantennas, which are silicon nanoparticles that generate electron plasma under harsh laser radiation. By changing the intensity of the incident light, they have found a way to turn a scattered light beam in the desired direction. They showed that when the nanoantenna is illuminated with a weak laser beam, the light scatters sideways, intense laser impulse leads to the generation of electron plasma within the device and the scattering pattern rotates by 20 degrees. The device will be able to distribute a signal into two optical channels within a very short space of time, which is important for modern telecommunication systems. [TECHNICAL ARTICLE](#)

*Tags: Communications technology, Optical communication*



“Many of the problems the world faces today are the eventual result of short-term measures taken last century.” **JAY FORRESTER**

## COUNTER WMD

### [A secret Russian bioweapon has been decoded, decades after it escaped the lab](#)

Science Alert, 16NOV2016

In April 1979, a mysterious biological weapon escaped from a lab in the Soviet Union, killing at least 66 people and an unknown number of animals. Almost 40 years later an international team of researchers (USA - Northern Arizona University, CDC, industry partner, Argentina, Italy) has finally sequenced the genome of the bacteria by generating a bacillus anthracis population genetic database based upon whole-genome analysis to identify all single-nucleotide polymorphisms across a reference genome. Two autopsy specimens from the Sverdlovsk outbreak were deep sequenced to produce draft B. anthracis genomes. This allowed the phylogenetic placement of the Sverdlovsk strain into a clade with two Asian live vaccine strains, including the Russian Tsiankovskii strain. [TECHNICAL ARTICLE](#)

Tags: Counter WMD, Bioweapons, S&T Russia

## ENERGY

### [Improved microscale energy storage units for wearable and miniaturized electronic devices](#)

Physorg.com, 21NOV2016

Researchers in Saudi Arabia have developed three-dimensional porous architecture integrated microsupercapacitors using two different electrode materials for the cathode (nickel cobalt sulfide) and anode (carbon nanofiber), which nearly doubled the operating voltage. They have an energy density of 200 microwatt-hours per square centimeter and achieve between one and forty microwatt-hours per square centimeter which is comparable to thin film batteries. These high capacities were maintained even after 10,000 operating cycles. [TECHNICAL ARTICLE](#)

Tags: Energy, Battery

### [Thermoelectric paint enables walls to convert heat into electricity](#)

Physorg.com, 21NOV2016

Researchers in South Korea have developed thermoelectric paint that contains bismuth telluride ( $\text{Bi}_2\text{Te}_3$ ) and molecular sintering aids which, upon heating, cause the thermoelectric particles to coalesce, increasing the density of these particles in the paint along with their energy conversion efficiency. In tests, the devices painted with the thermoelectric paint exhibit a high output power density. Unlike rigid thermoelectric materials, the paint can be applied to a variety of curved surfaces. Besides the traditional thermoelectric applications, the paint can be used

in wearable thermoelectric energy harvesters. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Advanced materials

### [New technology aims to make photovoltaic cells 70% more efficient](#)

Science Daily, 15NOV2016

The technology, developed by researchers in Israel, is based on an intermediate process that occurs between sunlight and the photovoltaic cell. Heat is harvested by a low bandgap photoluminescent absorber that emits thermally enhanced photoluminescence towards a higher bandgap photovoltaic cell, resulting in a maximum theoretical efficiency of 70% at a temperature of 1,140 K. They have demonstrated the key feature of sub-bandgap photon thermal upconversion with an efficiency of 1.4% at only 600 K. Experiments on white light excitation of a tailored Cr:Nd:Yb glass absorber suggest that conversion efficiencies as high as 48% at 1,500 K are within reach.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Materials science, Solar energy

## ENVIRONMENTAL SCIENCE

### [Storing carbon dioxide underground by turning it into rock](#)

Science Daily, 18NOV2016

Laboratory studies on basalt have shown that the rock which formed from lava millions of years ago is found throughout the world and it can rapidly convert  $\text{CO}_2$  into stable carbonate minerals. A team of researchers in the US (Pacific Northwest National Laboratory, industry partner) drilled a well in the Columbia River Basalt formation and injected  $\text{CO}_2$  into it in 2013. They extracted core samples from the well two years later and confirmed that the  $\text{CO}_2$  had indeed converted into the carbonate mineral ankerite as predicted. As basalts are widely found in North America and throughout the world, the researchers suggest that the formations could help permanently sequester carbon on a large scale. [TECHNICAL ARTICLE](#)

Tags: Environmental science, Government S&T

## IMAGING TECHNOLOGY

### [Lensless camera technology for adjusting video focus after image capture](#)

Physorg.com, 12NOV2016

Researchers in Japan have developed a camera technology, based on the principle of Moiré fringes, that combines a function for adjusting focus after images are captured in the same manner as a light-field camera. Features of thinness and lightness of a lensless camera reduces the

*continued...*

computational load to 1/300. The camera can be mounted in mobile devices and robots without imposing design restraints. Since it acquires depth information in addition to planar information, it is possible to reproduce an image at an arbitrary point of focus even after the image has been captured. The technology has applications in automated driving, human-behavior analysis, mobile devices, vehicles and robots.

*Tags: Imaging technology, S&T Japan*

## FEATURED RESOURCE

### **Global Biodefense**

Global Biodefense publishes the latest news and insights on health security from pathogens, emerging infectious diseases and CBRN agents bringing together all disciplines invested in responsibly advancing science, technology, preparedness and response capabilities for such threats. [RSS](#)

## INFORMATION TECHNOLOGY

### **World's First Photonic Neural Network Unveiled**

[MIT Technology Review, 18NOV2016](#)

Researchers at Princeton University report first observations of an integrated analog photonic network, in which connections are configured by microring weight banks, as well as the first use of electro-optic modulators as photonic neurons. Exploiting the mathematical isomorphism between the silicon photonic circuit and a continuous neural model, existing neural engineering tools can be adapted to silicon photonic information processing systems. Photonic neural networks leveraging silicon photonic platforms could access new regimes of ultrafast information processing for radio and scientific computing. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Information technology, Artificial intelligence*

### **New AI algorithm taught by humans learns beyond its training**

[Science Daily, 16NOV2016](#)

Researchers in Canada have designed a binary classification using neural networks (NN) that perform training and classification on the same data using the help of a pre-training heuristic classifier. The heuristic classifier is initially used to segment data into three clusters of high-confidence positives, high-confidence negatives, and low-confidence sets. The high-confidence sets are used to train an NN, which is then used to classify the low-confidence set. In tests, it outperformed conventional methods of training neural networks by 160 per cent. But more surprisingly, their algorithm also outperformed its own training by nine per cent. [TECHNICAL ARTICLE](#)

*Tags: Information technology, Artificial intelligence, S&T Canada*

## MATERIALS SCIENCE

### **New understanding of metastability clears path for next-generation materials**

[Physorg.com, 18NOV2016](#)

An international team of researchers (USA - MIT, Lawrence Berkeley National Laboratory, UC Berkeley, UC San Diego, Belgium) calculated properties of more than 67,000 known and predicted materials with the goal of accelerating materials discovery and innovation. They quantified the thermodynamic scale of metastability for almost 30,000 known materials. This paves the way for designing and making promising next-generation materials for use in everything from semiconductors to pharmaceuticals to steels. They proposed a new principle they term "remnant metastability" to explain which metastable materials can be synthesized and which cannot. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science*

### **Semiconducting polymers could make good e-skin**

[Nanotechweb, 17NOV2016](#)

An international team of researchers ( USA - Stanford University, SLAC National Accelerator Laboratory, Japan, South Korea) introduced pyridine dicarboxamide (PDCA) to introduce hydrogen bonds into the flexible backbone of the semiconducting polymer. The technique makes the polymer more stretchy and allows electrical charges to travel faster through the material. When the polymer is strained, the intermolecular hydrogen bonds break, dissipating the strain energy in the material, preventing the polymer network from being disrupted. They have demonstrated that the material retained high mobility when tested on humans.

[TECHNICAL ARTICLE 1, 2](#)

*Tags: Materials science, Flexible electronics*

### **World's fastest quantum simulator operating at the atomic level**

[Science Daily, 16NOV2016](#)

It is difficult to predict the properties of strongly correlated systems theoretically. An international team of researchers (Japan, Austria, France, Germany, China) used a novel approach in which an ultrashort laser pulse is employed to control a high-density ensemble of atoms cooled down to temperatures close to absolute zero. It can simulate the dynamics of a strongly correlated system of more than 40 atoms within one billionths of a second. The simulator is expected to serve as a basic tool to investigate the origin of physical properties of matter including magnetism and, possibly, superconductivity. [TECHNICAL ARTICLE](#)

*Tags: Materials science, Simulation and modeling*



## MEDICAL SCIENCES

### [Beyond the DNA: Comprehensive map of the human epigenome completed](#)

Science Daily, 17NOV2016

The identity of each cell type is largely defined by an instructive layer of molecular annotations on top of the genome -- the epigenome -- which acts as a blueprint unique to each cell type and developmental stage. The epigenome changes as cells develop and in response to changes in the environment. A collection of 41 coordinated papers now published by scientists from across the International Human Epigenome Consortium (IHEC) sheds light on these processes. In their latest study, an international team of researchers (Austria, Germany, UK, the Netherlands) charts the epigenetic landscape of DNA methylation in human blood. It helps us understand how leukemia develops and which cells drive the disease. This is relevant to cancer diagnostics and personalized medicine, and it provides a compass for future efforts aiming to reprogram the epigenome of individual cells.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Medical Sciences, Biology*

## MICROELECTRONICS

### [Liquid silicon: Multi-duty computer chips could bridge the gap between computation and storage](#)

Science Daily, 17NOV2016

Researchers at the University of Wisconsin-Madison are developing chips incorporating memory, computation and communication into the same device using monolithic 3D integration: silicon and semiconductor circuitry on the bottom connected with solid-state memory arrays on the top using dense metal-to-metal links. End users will be able to configure the devices to allocate more or fewer resources to memory or computation, depending on what types of applications a system needs to run. To help people harness the new chip's potential, they are developing software that translates popular programming languages into the chip's machine code.

*Tags: Microelectronics, Advanced materials*

## QUANTUM SCIENCE

### [CMOS-compatible SiC qualifies for quantum technology](#)

Nanotechweb, 21NOV2016

A team of researchers in the US (Virginia Tech, Howard University) has developed explicit schemes for spin-photon entanglement in several SiC defects: the silicon monovacancy, the silicon divacancy, and the NV center in SiC. Distinct approaches are given for (i) single-photon and spin entanglement and (ii) the generation of long strings of entangled photons. The latter are known as

cluster states and comprise a resource for measurement-based quantum information processing. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Switched-on skyrmions](#)

Nanowerk, 18NOV2016

Researchers in Japan found that skyrmion lattices in copper selenium oxide can exist in metastable states at very low temperatures and can be controlled by applying an electric field. They showed that inverting the electric field could switch between the skyrmion lattice and a conical state. In particular, at 55.5 kelvin, the skyrmion lattice remained, once created, which is important since it means that such systems could be used to store data even when they are not being powered. They believe that other external factors such as mechanical pressure could also be used to control skyrmion lattices in similar ways. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Quantum science, S&T Japan*

### [Manipulating quantum order](#)

Physorg.com, 17NOV2016

An international team of researchers (USA - Duke University, University of Chicago, Argonne National Laboratory, Florida State University, Northeastern University, University of Tennessee, Oak Ridge National Laboratory, Los Alamos National Laboratory, Caltech, Canada) subjected manganese phosphide to magnetic fields and large pressures to study different quantum states. They delineated a spiral pattern of the magnetic moments that could be tuned by increasing pressure to induce superconductivity. The geometry of the magnetic pattern held the key to the ultimate state that the material reached. They concluded that the taxonomy of allowable quantum states and the ability to manipulate them unites approaches across quantum physics and technology. [OPEN ACCESS TECHNICAL ARTICLE 1, 2](#)

*Tags: Quantum science, Materials science*

### [Quantum dot LEDs that can produce entangled photons](#)

Physorg.com, 17NOV2016

Researchers in Ireland used nanotechnology to electrify arrays of the pyramid-shaped quantum dots to produce entangled photons. They exploited intrinsic nanoscale properties of the whole "pyramidal" structure, an engineered self-assembled vertical quantum wire, which selectively injects current into the vicinity of a quantum dot. The method allows the direct positioning of quantum dots. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Tracking the flow of quantum information](#)

Science Daily, 17NOV2016

Figuring out where quantum objects go has frustrated scientists for years. An international team of researchers

*continued...*

(USA - Yale University, Princeton University, Germany) used superposition to formulate the probability of quantum objects landing in one spot or the other. The formula also showed there was one situation in which superposition can never be sustained: when a quantum “droplet” in superposition has landed in one “puddle” already, but hasn’t yet arrived at the other “puddle.”

Both aspects of the formula will be helpful in building quantum computers. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Ten Photons in a Tangle](#)

[American Physical Society Synopsis, 15NOV2016](#)

Previous multiphoton entanglement experiments had relatively low collection efficiencies of around 40%. Rather than using a single  $\beta$ -barium borate (BBO) crystal to create pairs, researchers in China utilized two closely spaced crystals separated by a polarization-rotating plate. They used polarizing beam splitters to combine the photon pairs from each BBO crystal together. This “sandwich” configuration generates entangled pairs of photons traveling in the same direction with the same polarization resulting in high count with relatively low input power. To create ten-photon entanglement, they placed five sandwich structures in a row and illuminated them all with a 0.57-W laser. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Photonics, S&T China*

## S&T POLICY

### [Obama Advisers Urge Action Against CRISPR Bioterror Threat](#)

[MIT Technology Review, 17NOV2016](#)

In a letter to the president, the President’s Council of Advisors on Science and Technology urges the creation of a new entity charged with developing a national biodefense strategy within six months. Specifically, the council argues that synthetic DNA, gene therapy, and genome-editing technologies like CRISPR open new possibilities for intentional misuse, such as modifying a virus or bacteria to make it resistant to drugs. [OPEN ACCESS](#)

[Letter](#)

*Tags: S&T policy, Bioweapons, Counter WMD*

## SENSORS

### [World’s fastest gas detector](#)

[Nanowerk, 18NOV2016](#)

EU researchers working on the MIREGAS (‘Mid-IR source for Gas Sensing’) project have developed a sensor which can detect dozens of harmful emissions in milliseconds, making it several thousand times faster than state of the art gas sensors. The device can pick out poisonous gases from a mixture of emissions, including methane, ethane, butane, propane, CO<sub>2</sub>, carbon monoxide, hydrogen sulphide and benzene, all from one compact filter. Combining the principles seen in fibre optic communications, the MIREGAS light source exploits multiplexing-to-demultiplexing filters, modulating and wavelength tuning, with Mid-IR spectroscopic sensing technologies.

*Tags: Sensors, S&T EU ■*

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