



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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

[Advanced materials \(4\)](#)

[Autonomous systems & robotics \(1\)](#)

[Communications technology \(2\)](#)

[Cyber security \(3\)](#)

[Energy \(3\)](#)

[Environmental science \(2\)](#)

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

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

[Materials science \(3\)](#)

[Microelectronics \(3\)](#)

[Neuroscience \(1\)](#)

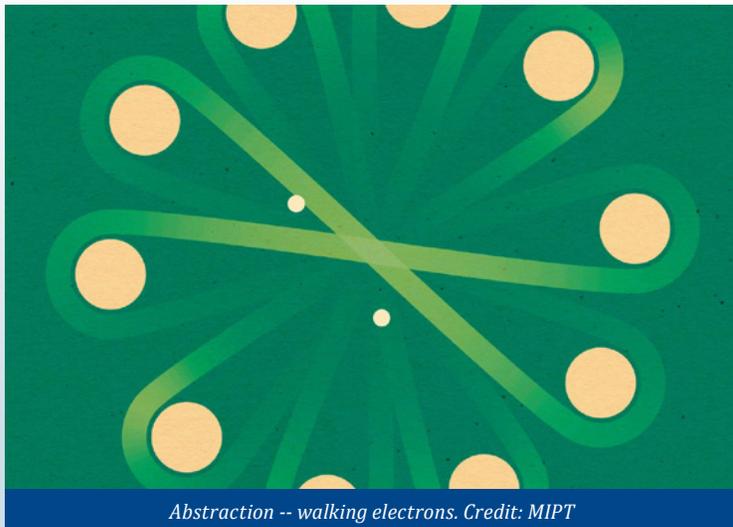
[Photonics \(2\)](#)

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

[Science without borders \(1\)](#)

[Sensors \(2\)](#)

FEATURE ARTICLES



Abstraction -- walking electrons. Credit: MIPT

[Scientists create a quantum computer memory cell of a higher dimension than a qubit](#)

[Physorg.com](#), 13DEC2016

An international team of researchers (Austria, Russia) let two electrons loose in a system of quantum dots to create a quantum computer memory cell of a higher dimension than a qubit. The entanglement of the two electrons is caused by the mutual electrostatic repulsion experienced by like charges. It is possible to create a system of even more qubits in the same volume of semiconductor material. They demonstrated that their proposed system is characterized by a relatively high degree of stability. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: [Quantum science](#), [Featured Article](#)

[Mitigating the risk of geoengineering](#)

[Harvard Gazette](#), 12DEC2016

The planet is warming at an unprecedented rate. Reducing emissions of greenhouse gases alone is not enough to remove the risk. Supplemental efforts can further reduce risks. One drastic idea is solar geoengineering. Anytime you introduce even initially unreactive surfaces into the stratosphere, you get reactions that ultimately result in ozone

destruction, as they are coated with sulfuric acid. Instead of trying to minimize the reactivity of the aerosol, through extensive modeling of stratospheric chemistry, researchers at Harvard University found that calcite, a constituent of limestone, could counter ozone loss by neutralizing emissions-borne acids in the atmosphere, while also reflecting light and cooling the planet. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: [Environmental science](#), [Featured Article](#)

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

[Modified metals for space engineering produced in microsecond](#)

[Science Daily](#), 06DEC2016

Researchers in Russia have developed a new material based on an alloy of aluminum and silicon. They used a pulsed electron beam to fuse coatings of polytechnicians titanium, titanium nitride and silumin containing 25% of silicon. Experimental studies have shown that it resulted in almost six-fold improvement in the hardness of the metal and three times improvement in wear resistance. The modified metals can be used for manufacturing parts in spacecraft. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: [Advanced manufacturing](#), [S&T Russia](#)

ADVANCED MATERIALS

[New diamond harder than ring bling](#)

[Science Daily](#), 12DEC2016

An international team of researchers (Australia, USA - Oak Ridge National Laboratory, Carnegie Institute of Washington) has synthesized nano-sized Lonsdaleite, a hexagonal diamond, in a diamond anvil at 400 degrees Celsius, halving the temperature at which it can be formed in a laboratory. The hexagonal structure of this diamond's atoms makes it much harder than regular diamonds which have a cubic

continued...

[BACK TO TOP](#)

structure. In nature, Lonsdaleite is found at the site of meteorite impacts such as Canyon Diablo in the US.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials

[Super-flexible liquid crystal device for bendable and rollable displays](#)

[Science Daily, 09DEC2016](#)

Researchers in Japan developed a super-flexible LC device by bonding two ultra-thin transparent polyimide substrates using robust polymer wall spacers. The substrate, which is made using the coating and debonding processes of a polyimide solution, is heat resistant and forms fine pixel structures, including transparent electrodes and colour filters. The refractive index anisotropy is extremely small, making wide viewing angles and high contrast ratio possible. The technology is applicable to mobile information terminals, wearable devices, in-vehicle displays and large digital signage.

Tags: Advanced materials, S&T Japan

[Stamping technique creates nanoscale circuits with electronic ink](#)

[Nanowerk, 07DEC2016](#)

Researchers at MIT fabricated a stamp made from forests of carbon nanotubes that can print electronic inks onto rigid and flexible surfaces. The stamp was infused with a small volume of electronic ink containing nanoparticles such as silver, zinc oxide, or semiconductor quantum dots. After stamping ink patterns of various designs, the team tested the printed patterns' electrical conductivity and found it to be very high. The process should be able to print transistors small enough to control individual pixels in high-resolution displays and touchscreens. The new printing technique may also offer a relatively cheap, fast way to manufacture electronic surfaces for as-yet-unknown applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, Flexible electronics

[New aspect of atom mimicry for nanotechnology applications](#)

[Nanowerk, 06DEC2016](#)

Researchers in Japan use dendrimers that mimic the electron valency of atoms and link them into arrays using molecules. They analysed the coordination of dendritic polyphenylazomethine with a stronger binding Lewis acid bound to the rod-like molecule phenylene ethynylene. The phenylene ethynylene backbone is rigid enough that a polymer chain of dendrimers forms. Using a different starting dendrimer led to the formation of two dimensional polymerisation of the dendrimers, producing a 2D array of nanocontainers. The technology is applicable to plasmonics and nanoelectrode grids. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, S&T Japan

AUTONOMOUS SYSTEMS & ROBOTICS

[Meet the World's First Completely Soft Robot](#)

[MIT Technology Review, 08DEC2016](#)

The "octobot," developed by researchers at Harvard University, is completely self-contained. It has no hard electronic components—no batteries or computer chips—and moves without being tethered to a computer. It is a pneumatic tube powered by a gas produced by hydrogen peroxide and platinum. Still missing are sensing and programming abilities that would afford more control over the robot's movement. But the octobot is purposefully minimalist, meant just to show that such a soft robot can be made at all.

Tags: Autonomous systems & robotics

COMMUNICATIONS TECHNOLOGY

[How to avoid congestion of mobile network](#)

[Science Daily, 12DEC2016](#)

Researchers in Russia have derived a general formula for the queuing theory: it is enough to substitute for the variables specific parameters, such as the number of servers, towers, communication channels, and others and you can find out under what conditions the system will run smoothly. It is possible to predict the functioning of such systems to make effective management decisions. Scientists say this method is so universal that it is suitable for calculating the efficiency of different service systems, such as retail, insurance companies, banks, ports and others.

Tags: Communications technology, S&T Russia

[Researchers show viability of 5G communication with record-setting data rates](#)

[Physorg.com, 08DEC2016](#)

A team of researchers in the US (UC San Diego, industry partner) has built a 300 m long, 32-element array phased-array link in the 60 GHz band which achieved a data rate of 4 Gbps at 100 m and 500 Mbps at 800 m over most scan angles. The entire phased array consumed 3 to 4 W of DC power in either its transmit or receive modes. This is due to the high-performance system-on-a-chip designs.

Tags: Communications technology

CYBER SECURITY

[Researchers create hidden images with commercial inkjet printers](#)

[Physorg.com, 08DEC2016](#)

Researchers at the University of Utah used silver and carbon ink to print an image consisting of small rods that are about a millimeter long and a couple of hundred microns wide. They found that changing the fraction of silver and carbon in each rod changes the conductivity in each rod just slightly, but visually, you can't see this

“One thing I have learned in a long life: that all our science, measured against reality, is primitive and childlike and yet it is the most precious thing we have.” **ALBERT EINSTEIN**

modification. Passing terahertz radiation at the correct frequency and polarization through the array allows extraction of information encoded into the conductivity. They demonstrated their new method to hide image information in an array of printed rods that all look nearly identical. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Cyber security, Advanced materials

Foiling cyber attackers with rerandomization MIT Lincoln Laboratory, 07DEC2016

Researchers at MIT Lincoln Laboratory have developed Timely Address Space Randomization (TASR), a unique randomization technique, to counter information leakage attacks that may thwart Address Space Layout Randomization protections. TASR ensures that the memory layout is rerandomized before the attacker has an opportunity to act on stolen information, and hence denies them the opportunity to use it to bypass operating system defenses. Because TASR's rerandomization is based upon application activity and not upon a set timing, an attacker cannot anticipate the interval during which the leaked information might be used to send an exploit to the application before randomization recurs.

Tags: Cyber security

Safer, less vulnerable software is the goal of new computer publication

Science Daily, 06DEC2016

According to researchers at NIST it is possible to create software with 100 times fewer vulnerabilities than we have today. They recommend coders adopt the approaches they have compiled in an [OPEN ACCESS](#) publication. The document recommends five sets of approaches: using math-based tools to verify the code will work properly; breaking up a computer's programs into modular parts so that if one part fails, the whole program doesn't crash; connecting analysis tools for code that currently operate in isolation; using appropriate programming languages for the task that the code attempts to carry out; and developing evolving and changing tactics for protecting code that is the target of cyberattacks.

Tags: Cyber security

ENERGY

Russia planning to build up to 38 small 300 MW cogenerating nuclear reactors to reduce fossil fuel usage

Next Big Future, 12DEC2016

A study concluded that 38 cogeneration reactors could potentially be deployed at 14 sites for this purpose. VK-300

is a boiling water model with 750 MW thermal capacity and 150–250 MW electric depending on the required mix of heat and power. It uses proven components, including similar fuel elements to the large established VVER pressurized water design. It features fully passive cooling and safety features and has no need for operator action in an emergency or for offsite electricity or water supply. VK-300 has two containments and the consequences of any accident should not extend beyond the site boundary.

Tags: Energy, Nuclear energy, S&T Russia

Pioneering nanotechnology captures energy from people (w/video)

Nanowerk, 08DEC2016

Researchers at Michigan State University created an energy harvesting device they called FENG (ferroelectret nanogenerator) using silicone wafer fabricated with several layers of substances including silver, polyimide and polypropylene ferroelectret. Ions are added so that each layer in the device contains charged particles. Electrical energy is created when the device is compressed by human motion, or mechanical energy. Each time you fold it you are increasing exponentially the amount of voltage you are creating. FENG is lightweight, flexible, biocompatible, scalable, low-cost and robust. [TECHNICAL ARTICLE](#)

Tags: Energy, Flexible electronics

Researchers peer into atom-sized tunnels in hunt for better battery

Nanowerk, 08DEC2016

In a battery, “tunneled” structures make it easier for charge-carrying ions to move in and out of the electrode. An international team of researchers (USA - Michigan Technological University, Argonne National Laboratory, University of Illinois at Chicago, UK, China) studied potassium-doped nanowires of manganese dioxide down to the single-atom level. They found that when you add a tunnel stabilizer, the tunnels expand, their electronic structures also change, and such changes allow the lithium ions to move in and out, around the stabilizer. The presence of potassium ions in the tunnels allows lithium ions to diffuse quickly in and out of the nanowires and the battery can hold on to its capacity for a longer time. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Battery

ENVIRONMENTAL SCIENCE

Japan launching 'space junk' collector (Update)

Physorg.com, 09DEC2016

Researches in Japan are experimenting with a 700 metre long electrodynamic tether made from thin wires of stainless steel and aluminium to pull junk out of orbit around Earth, clearing up tonnes of space clutter including cast-off equipment from old satellites and pieces of rocket. The electricity generated by the tether as it swings through the Earth's magnetic field is expected to have a slowing effect on the space junk, which should, scientists say, pull it into a lower and lower orbit. Eventually the detritus will enter the Earth's atmosphere, burning up harmlessly long before it has a chance to crash to the planet's surface.

Tags: Environmental science, S&T Japan, Satellite technology, Space technology

FEATURED RESOURCE

Nature Podcast

Every show features highlighted content from the week's edition of Nature including interviews with the people behind the science, and in-depth commentary and analysis from journalists covering science around the world. [RSS](#)

FOREIGN S&T

China builds world's largest diesel submarine but almost three times smaller than nuclear US Ohio and seven times smaller than nuclear Russian Typhoon

Next Big Future, 06DEC2016

China's Qing class submarine displaces 6,628 tons submerged and measuring one hundred yards long, it is by most accounts the largest diesel submarine ever built. The Type 032 can fire not only long-range cruise missiles, but submarine-launched ballistic missiles with the capacity to send a nuclear warhead across the ocean. They claim that the Type 032 can carry an additional one hundred "scientists and technicians." The sub has also reportedly been used to test submarine-launched surface-to-air missiles and a new underwater escape pods. Some suggest the Type 032 may be applied to deploying undersea drones.

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

INFORMATION TECHNOLOGY

In-memory de-duplication technology to accelerate response for large-scale storage

Physorg.com, 05DEC2016

Fujitsu Laboratories has developed a new method that can accelerate response speeds by executing deduplication after writing data. As data may be written to memory twice in some cases, the system automatically switches between the new method and the previous method, as operational conditions require. This means that response speeds can be increased by up to two times, improving the response of virtual desktop services and reducing database processing times.

Tags: Information technology, S&T Japan

MATERIALS SCIENCE

Sand absorbs high-speed ballistic impact better than steel

Physorg.com, 09DEC2016

Researchers in Singapore found that sand can absorb more than 85 per cent of the energy exerted against it, and its ability to resist the impact increases with the speed of the projectile, even at high velocities. The impact results in an extreme frictional force due to the pressure and friction offered by the sand grains as they dilate and resist continual penetration of the incoming projectile. This could potentially break the projectile into pieces. In contrast, due to the hydrodynamic effect, energy absorption capacity of an equivalent steel plate reduces dramatically as the velocity of the projectile increases. Potentially, sand can be used as a cheaper, lighter and more environmentally friendly alternative to enhance protection of critical infrastructure as well as armor systems.

Tags: Materials science

Electron highway inside crystal

Nanowerk, 08DEC2016

An international team of researchers (Germany, Poland, Switzerland) report that when topological crystalline insulators are split, small atomically flat terraces emerge at the split off surfaces which are separated from each other by step edges. Inside these structures, conductive channels for electrical currents form which are robust against external disturbance. Electrons travel on these conductive channels with different spin in opposite directions. This effect makes the materials interesting for technological applications in future electronic components such as ultra-fast and energy-efficient computers. [TECHNICAL ARTICLE](#)

Tags: Materials science

Scientists develop ‘programmable’ cement particles to attain enhanced properties

Physorg.com, 07DEC2016

A team of researchers in the US (Rice University, University of Houston, industry partner) created well-shaped cubes and rectangles using positive or negative ionic surfactants, calcium silicate and calcium-silicate hydrate. Decreasing the calcium silicate yielded more spherical particles and smaller cubes, while increasing it formed clumped spheres and interlocking cubes. The process turns particles from disordered clumps into regimented cubes, spheres and other forms that combine to make the material less porous and more durable. [TECHNICAL ARTICLE](#)

Tags: *Materials science*

MICROELECTRONICS

New material could lead to erasable and rewriteable optical chips

Science Daily, 07DEC2016

Researchers at UT Austin have integrated Rabi splitting into the hybrid plasmon-waveguide modes (HPWMs) based on hybrid systems of Al nanodisk arrays covered by Polymethyl methacrylate thin films that are doped with photochromic molecules. The demonstration of Rabi splitting in the HPWMs will further advance scientific research and device applications of hybrid plasmon-molecule systems. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics*

World’s first vertically stacked gate-all-around Si nanowire CMOS transistors

Nanowerk, 07DEC2016

Researchers in Belgium report on the CMOS integration of vertically stacked GAA Si nanowire MOSFETs, with matched threshold voltages for n- and p-type devices. Key in the integration scheme is the implementation of dual-work-function metal gates to set the threshold voltages of the n- and p-FETs independently. The proposed integration scheme for Si GAA CMOS technology and the results on ESD protection are important achievements towards realizing these 7 nm and beyond technology nodes.

Tags: *Microelectronics*

Researchers are able to study individual defects in transistors

Science Daily, 06DEC2016

Researchers in the Netherlands created chips with a group of ten electrodes 35 nanometres wide and, located perpendicularly above them, a single electrode 80 nanometres long. At a temperature of -270 degrees Celsius, they can open or close the other ‘taps’. This enables them to identify the electrodes beneath which defects are located. In a subsequent step, the researchers could neutralize more

than eighty percent of the defects by heating the chips to 300 degrees Celsius. Having reduced the density of defects in the material, the researchers were able to study individual defects. This knowledge will be highly relevant to the further development of the semiconductor industry.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Microelectronics*

NEUROSCIENCE

Memristive devices can mimic brain’s capability to change synaptic connectivity

Nanowerk, 06DEC2016

Neural systems in the human brain exhibit various types and time periods of plasticity. Researchers in France proposed an architecture that implements both short- and long-term plasticity (STP and LTP) using RRAM devices. They showed the benefits of utilizing both kinds of plasticity with visual pattern extraction and decoding of neural signals. LTP allows the artificial neural networks to learn patterns, and STP makes the learning process very robust against environmental noise. Embedding neuro-morphic learning into low-power devices could enable design of autonomous systems, such as a brain-machine interface that makes decisions based on real-time, on-line processing of in-vivo recorded biological signals.

Tags: *Neuroscience, S&T France*

PHOTONICS

Mix and match lasers

Science Daily, 09DEC2016

Researchers in Singapore started with a silicon substrate, and deposited a thin layer of silicon oxide on it. The optically active InGaAsP film was fabricated separately and then bonded on top of the silicon oxide. They etched through some of the material to create cylinders either two or three micrometers in diameter. The whispering gallery mode extends over both the silicon and the InGaAsP regions. The InGaAsP provides light amplification while the silicon passively guides the light. The architecture renders an alternative laser structure for heterogeneous laser-on-chip, with no dedicated vertical coupling mechanism needed between the two materials’ layers.

[TECHNICAL ARTICLE](#)

Tags: *Photonics*

A nano-roundabout for light

Nanowerk, 08DEC2016

Optical circulators are mostly based on the so-called Faraday effect which cannot be realized on the small scales of nanotechnology. Researchers in Austria coupled glass fibers at their intersection point to an optical resonator in which the light circulates and behaves as in a roundabout.

The direction of circulation is defined by a single atom coupled to the resonator. The atom also ensures that the light always leaves the roundabout at the next exit. According to the researchers, such a circulator can, in principle, be prepared in a coherent superposition of its operational states and may become a key element for quantum information processing in scalable integrated optical circuits. [TECHNICAL ARTICLE](#)

Tags: Photonics, Quantum science

S&T POLICY

[Report proposes standards for sharing data and code used in computational studies](#)

[Science Daily](#), 08DEC2016

Computational methods have radically changed the ability of researchers from all areas of scholarship to process and analyze data and to simulate complex systems. Current reporting methods are often uneven, incomplete, and still evolving. A team of researchers in the US (University of Illinois at Urbana-Champaign, NAS, UC Davis, UCSD, AGU, Sandia National Laboratory, Stanford University, University of Delaware) presents a novel set of Reproducibility Enhancement Principles targeting disclosure challenges involving computation. These recommendations, which build upon more general proposals from the Transparency and Openness Promotion guidelines and recommendations for field data, emerged from workshop discussions among funding agencies, publishers and journal editors, industry participants, and researchers representing a broad range of domains. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

Tags: S&T policy, Science without borders

SCIENCE WITHOUT BORDERS

[Controversial impact factor gets a heavyweight rival](#)

[Nature News](#), 08DEC2016

Elsevier's CiteScore ranks journals with a formula that largely mimics the influential Journal Impact Factor (JIF). It covers twice as many journals—22,000 to the JIF's 11,000—and its formula includes tweaks that produce some notably different results, including lower scores for some high-JIF journals. Some even wonder whether Elsevier, which publishes more than 2,500 journals, should be producing CiteScore at all. The JIF has always been owned by non-publishers.

Tags: Science without borders, Bibliometrics

SENSORS

[Researchers use graphene to make state of the art sensors from silly putty](#)

[Nanowerk](#), 08DEC2016

An international team of researchers (Ireland, UK) added graphene to a lightly cross-linked polysilicone, often encountered as Silly Putty, changing its electromechanical properties substantially. The resulting nanocomposites displayed unusual electromechanical behavior, such as postdeformation temporal relaxation of electrical resistance and nonmonotonic changes in resistivity with strain. The new material is extremely sensitive to the slightest deformation or impact. Researchers believe this material will find applications in a range of medical devices.

[TECHNICAL ARTICLE](#)

Tags: Sensors, Advanced materials, Materials science

[Learning words from pictures](#)

[MIT News](#), 06DEC2016

Researchers at MIT built a system based on a neural network that analyzes correspondences between images and spoken descriptions of those images rather than being trained on transcription. Processing nodes in neural networks are capable of only very simple computations but are connected to each other in dense networks. Data is fed to a network's input nodes, which modify it and feed it to other nodes, they modify it and feed it to still other nodes, and so on. When a neural network is being trained, it constantly modifies the operations executed by its nodes to improve its performance on a specified task. The system's ability to learn from unlabeled data is significant for big data analysis. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

Tags: Sensors, Artificial intelligence

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Ryan Zelnio, Ph.D., Associate Director - Tech Watch / Horizon Scans, Office of Net Technical Assessments, OSD AT&L/OASD(R&E)

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