



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLES

[A novel semiconductor nanocomposite material that moves in response to light](#)

[Nanowerk, 17OCT2016](#)

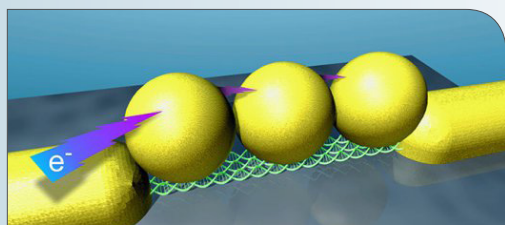
An international team of researchers (USA - Worcester Polytechnic Institute, University of Louisville, Poland) created thin films made up of just one to three layers of molybdenum disulfide encased in layers of a rubber-like polymer. They found that when the nanocomposites are exposed to various wavelengths of light, the heat generated as a result of the exciton resonance caused the polymer to expand and contract, depending on the wavelength of the light used. They stretched the material and discovered that mechanical stresses increased its ability to absorb light. Its increased optical absorption under strain makes it a good candidate for more efficient solar cells, photodetectors, and detectors for thermal and infrared cameras. [OPEN ACCESS TECHNICAL ARTICLE](#)

[ARTICLE](#)

Tags: Advanced materials, Featured Article

[DNA-based single-electron electronic devices created](#)

[Science Daily, 13OCT2016](#)



Gold nanoparticles are attached directly within the aqueous solution onto a DNA structure. The whole process is based on DNA self-assembly, and yields countless of structures within a single patch. Credit: Image courtesy of Academy of Finland

An international team of researchers (Finland, Germany) has demonstrated a method to fabricate electronic devices by using DNA.

The DNA itself has no part in the electrical function, but acts as a scaffold for forming a linear, pearl-necklace-like nanostructure consisting of three gold nanoparticles.

[TECHNICAL ARTICLE](#)

Tags: Microelectronics, Featured Article

[There's a way to turn almost any object into a computer - and it could cause shockwaves in AI](#)

[The Conversation, 11OCT2016](#)

The trend for smaller, increasingly powerful computers could be coming to an end. An alternative idea known as “reservoir computing” came from attempts to develop computer networks modelled on the brain. It involves the idea that we can tap into the behaviour of physical systems—anything from a bucket of water to blobs of plastic laced with carbon nanotubes—in order to harness their natural computing power. Research indicates that reservoir computers could be extremely robust and computationally powerful and, in theory, could effectively carry out an infinite number of functions. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Autonomous systems & robotics, Artificial intelligence, Featured Article

S&T NEWS ARTICLES

AUTONOMOUS SYSTEMS & ROBOTICS

[Context, Language, and Reasoning in AI: Three Key Challenges](#)

[MIT Technology Review, 14OCT2016](#)

Because of AI's revolutionary potential, its applications in non-vision problems have attracted tremendous interest. There have also been attempts to replicate what worked with spatial data and apply it to text (and numbers). There is a rush of computational, statistically based approaches to process natural language. Such approaches attempt to turn text into data and then look for deep patterns in that data. According to the author, AI technologies must overcome three challenges to be successful in the non-vision world and perhaps even in the vision world: language, context, and reasoning.

Tags: Autonomous systems & robotics, Artificial intelligence

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Scientists simplify model for human behavior in automation

PhysOrg.com, 14OCT2016

Human unpredictability is a problem in the automated human-machine systems people use every day. An international team of researchers (China, USA - UC Merced) propose a unified model which provides a formalized description for the human operator behavior based on fractional order calculus in which multiple outcomes can be considered within the same equation. They modeled the human operator as a part of the system rather than an addition to the system. Compared to traditional mathematical models, the proposed method was a better fit for how the human operator actually behaved. [OPEN ACCESS](#)

TECHNICAL ARTICLE

Tags: Autonomous systems & robotics

There is a blind spot in AI research

Nature News, 13OCT2016

The recently released Preparing for the Future of Artificial Intelligence surveys the current state of AI, its existing and potential applications, and the questions that progress in AI raise for society and public policy. The authors argue that fears about the future impacts of artificial intelligence are distracting researchers from the real risks of deployed systems. They recommend researchers—across a range of disciplines, government departments and industry—to start investigating how differences in communities' access to information, wealth and basic services shape the data that AI systems train on.

Tags: Autonomous systems & robotics, Artificial intelligence

BIOTECHNOLOGY

New smart textile is the muscle behind next generation devices

Science Daily, 11OCT2016

An international team of researchers (Australia, USA - UT Dallas) developed a smart textile by continuously wrapping CNT aerogel sheets around SPX filaments. By adjusting the SPX/CNT feed ratio, the fabric's electrical conductivity could be tailored. The knitted textile provides strain sensing and the ability to control dimensions required for smart clothing that simultaneously monitors the wearer's movements and adjusts the garment fit or exerts forces or pressures on the wearer, according to needs. The processing method is scalable for the fabrication of industrial quantities of the smart textiles.

TECHNICAL ARTICLE

Tags: Biotechnology, Flexible electronics, Sensors

COMMUNICATIONS TECHNOLOGY

China's quantum satellite could make data breaches a thing of the past

PhysOrg.com, 12OCT2016

China recently launched a satellite into orbit with a unique feature: it has the ability to send information securely,

not with mathematical encryption, but by using the fundamental laws of physics. A special crystal divides a laser into two beams that are then directed to independent receiving stations on Earth. The link is used to send random data from one receiving station to the other. The data can be collected and used, essentially as a complex password, to encrypt data sent over a public channel such as the internet.

Tags: Communications technology, Quantum science, S&T China

ENERGY

Nano-spike catalysts convert carbon dioxide directly into ethanol

Nanowerk, 13OCT2016

Researchers at Oak Ridge National Laboratory used a catalyst made of carbon, copper and nitrogen and applied voltage to trigger a complicated chemical reaction that essentially reverses the combustion process. With the help of the nanotechnology-based catalyst, which contains multiple reaction sites, the solution of carbon dioxide dissolved in water turned into ethanol with a yield of 63 percent. The catalyst's novelty lies in its nanoscale structure, consisting of copper nanoparticles embedded in carbon spikes. This nano-texturing approach avoids the use of expensive or rare metals such as platinum that limit the economic viability of many catalysts. [OPEN ACCESS](#)

TECHNICAL ARTICLE

Tags: Energy, Materials science

Next-generation thermoelectrics

EurekAlert, 12OCT2016

Thermoelectric generators rely on temperature differences to generate heat directly into electricity. In their investigation, researchers at UC Santa Barbara show how ions, which are the charge carriers in batteries, can contribute to the thermoelectric effect alongside electrical charge carriers in polymers. The results of this study could open the door to less expensive and more versatile thermoelectric materials that would come in handy not only for consumers but also in less common and more urgent circumstances such as search-and-rescue, medical, disaster recovery and military operations.

Tags: Energy, Materials science

Researchers develop an efficient dual-ion battery design

PhysOrg.com, 12OCT2016

Researchers in China designed a 3D porous aluminum foil coated with a uniform carbon layer both as the anode and the current collector for the dual ion battery (DIB). The 3D porous structure of aluminum alleviates the mechanical stress caused by the volume change of aluminum during electrochemical cycling, and shortens the ion diffusion length as well. The carbon layer buffers the aluminum volume change and alleviates undesirable surface reactions through solid electrolyte interface film formation. The DIB

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“But the real glory of science is that we can find a way of thinking such that the law is evident.” RICHARD FEYNMAN

exhibits an excellent long-term cycling stability of over 1000 cycles with 89.4 percent retention of capacity at 2C current rate.

Tags: Energy, Battery, S&T China

New 3-D design for mobile microbatteries

[PhysOrg.com](#), 11OCT2016

An international team of researchers (France, USA - Argonne National Laboratory) stacked four functional layers composing the 3D lithium ion microbattery on simple and double microtube 3D templates. Using Atomic Layer Deposition, anatase TiO₂ negative electrode is coated on 3D tubes with Li₃PO₄ lithium phosphate as electrolyte. The surface capacity is significantly increased by the proposed topology. [TECHNICAL ARTICLE](#)

Tags: Energy, Advanced materials, Battery

INFORMATION TECHNOLOGY

Google adds fact-checking to news articles

[PhysOrg.com](#), 14OCT2016

Google News determines whether an article might contain fact checks using an algorithm that evaluates claims and by seeking websites that follow the commonly accepted criteria for fact checks. It aims to stem the spread of “fake” news that may spread through social media.

Tags: Information technology

MATERIALS SCIENCE

It's official: Phonon and magnon are a couple (w/video)

[Nanowerk](#), 19OCT2016

An international team of researchers (South Korea, UK, USA - Brookhaven National Laboratory, Rutgers University, UC Irvine, Japan, Canada) has observed, quantified and created a new theoretical model of the coupling of magnons and phonons in crystals of the antiferromagnet manganite, a mineral made of manganese oxide and rare-earth elements called yttrium and lutetium. The finding deepens our knowledge of multiferroics. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science

Superconductivity Model Misses Its Target

[American Physical Society Synopsis](#), 13OCT2016

High-temperature superconductivity may arise from a disordered spin state. To test this theory, researchers at Johns Hopkins University doped herbertsmithite and measured changes in its electronic properties. The doped samples showed no hints of superconductivity. Resistance measurements showed that the material remained insulating, even with the electrons donated by lithium. This

contradicts theory, which predicted that doped spin liquids would exhibit multiple phases. Theorists now have their work cut out explaining why the predictions were off. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science

Ultra-thin ferroelectric material for next-generation electronics

[PhysOrg.com](#), 12OCT2016

Researchers in Japan have determined the ferroelectric properties of hafnium oxide whose crystal structure allows it to be deposited in ultra-thin films. Their discovery of a particular epitaxial thin-film crystal of HfO₂ that exhibits ferroelectricity below 450 °C will be of great significance in the field. This is the first ferroelectric material compatible with silicon-based semiconductors. The material will have applications in novel random-access memory and transistors, as well as quantum computing. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science, S&T Japan

MICROELECTRONICS

3D-printed decal electronics for the Internet-of-Everything

[Nanowerk](#), 17OCT2016

Researchers in Saudi Arabia developed a comprehensive integration strategy which made use of mature CMOS-based technology—photolithography, deposition, and patterning on a low-cost silicon (100) substrate—to flex thin-film based electronics on silicon, and then to package them using 3D printing and finally print such packaged decal electronics on soft substrates enabling high volume manufacturing. The roll-to-roll printing capability gives decal electronics the advantage of allowing high throughput in highly complex flexible electronics systems. The demonstrated circuits show no performance degradation due to flexing or packaging processes. [TECHNICAL ARTICLE](#)

Tags: Microelectronics

Transistor ‘imperfection’ leads towards perfection

[Nanotechweb](#), 17OCT2016

The functionality of a MOS transistor as a logic switch, which distinguishes between the states, is becoming a challenge in the nanoscale regime. Researchers in India have come up with an innovative design that transforms an unfavourable feature into a unique asset to achieve a steep switching junctionless MOSFET and can potentially lead to energy efficient operation. [TECHNICAL ARTICLE](#)

Tags: Microelectronics

continued...

[Electron-phonon interactions affect heat dissipation in computer chips](#)

Nanowerk, 13OCT2016

In their experiment, researchers at MIT used precisely timed laser pulses to measure the interactions between electrons and phonons in a very thin silicon wafer. As the concentration of electrons in the silicon increased, the more these electrons scattered phonons and prevented them from carrying heat away. This same effect may benefit thermoelectric generators, which convert heat directly into electrical energy. In such devices, scattering phonons, and thereby reducing heat leakage, would significantly improve their performance. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Microelectronics*

[Memristor could make embedded memory for low-power chips](#)

Nanotechweb, 11OCT2016

One of the drawbacks of memristors is the electrical power that is wasted during the data writing process. To solve this problem, an international team of researchers (USA - UMass Amherst, industry partner, South Korea) has developed a memristor with a large intrinsic current-rectifying characteristic that acts as an internal or integral selector. They describe how to use this self-selecting memristor to reduce power consumption to just 8% of that in conventional crossbar circuits. The new memristor could be used to make embedded memories for low-power chips, such as ASICS, used to store data in or near sensors at the edge of IoT devices and eventually, it might find use as a stand-alone non-volatile memory for low-power systems.

Tags: *Microelectronics*

FEATURED RESOURCE

[AI Topics](#)

AI Topics is the Internet's largest collection of information about the research, the people, and the applications of Artificial Intelligence. A wide variety of curated and organized resources are gathered from across the web. [RSS](#)

PHOTONICS

[Scientists create most efficient quantum cascade laser ever](#)

PhysOrg.com, 17OCT2016

Compared to traditional lasers, Quantum cascade lasers (QCL) offer higher power output and can be tuned to a wide range of infrared wavelengths. They can also be used at room temperature without the need for bulky cooling systems. Researchers at the University of Central Florida improved upon the previous method by using only two

materials instead of five and the technology is easier to transition to production. The researchers expect greater use of QCL in spectroscopy, such as using the infrared lasers as remote sensors to detect gases and toxins in the atmosphere. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Photonics*

QUANTUM SCIENCE

[How quantum effects could improve artificial intelligence](#)

PhysOrg.com, 17OCT2016

An international team of researchers (Austria, USA - NIST, University of Maryland) proposes an approach for the systematic treatment of machine learning, from the perspective of quantum information. Their approach is general and covers all three main branches of machine learning: supervised, unsupervised, and reinforcement learning. They tackle the problem of quantum enhancements in reinforcement learning as well, and propose a systematic scheme for providing improvements. They show that quadratic improvements in learning efficiency and exponential improvements in performance over limited time periods can be obtained for a broad class of learning problems. [TECHNICAL ARTICLE](#)

Tags: *Quantum science, Artificial intelligence*

[Silicon makes good qubit material](#)

Nanotechweb, 17OCT2016

An international team of researchers (the Netherlands, USA - University of Wisconsin at Madison, Iowa State University, industry partner) found that electrically controlled silicon-based qubits are 100 times more robust and can also be manipulated with 10 times greater precision than qubits based on GaAs. They studied the qubit performance of an electron spin in a Si/SiGe quantum dot and looked into the dominant error mechanisms in it. They could electrically control the Si/SiGe-based qubit with sufficient accuracy so that the remaining errors could, in principle, be corrected using known protocols. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science*

[Diamonds aren't forever: Team creates first quantum computer bridge](#)

Science Daily, 14OCT2016

An international team of researchers (USA - Harvard University, Sandia National Laboratory, Russia, Germany) used implantation to replace one carbon atom of a diamond with a larger silicon atom. Once the silicon atoms are settled in the diamond substrate, laser-generated photons bump silicon electrons into their next higher atomic energy state; when the electrons return to the lower energy state they spit out quantized photons that carry information through their frequency, intensity and the polarization of their wave. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

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Exceptionally robust quantum states found in industrially important semiconductor

PhysOrg.com, 14OCT2016

Defects in silicon carbide have recently attracted attention as potential candidates for solid-state qubits but it has short coherence times because of the high concentration of magnetic nuclei in the crystals. A team of researchers in the US (University of Chicago, Argonne National Laboratory, industry partner) found that the binary nature of silicon carbide plays a central role in suppressing the magnetic noise produced by the nuclear spin fluctuation. The results suggest that developing defect spin qubits in complex polyatomic crystals would be a promising route to realize novel, multifunctional, quantum systems. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science, Materials science

Physicists pass spin information through a superconductor

PhysOrg.com, 14OCT2016

According to a fundamental property of superconductivity, superconductors can't transmit spin. Any electron pairs that pass through a superconductor will have the combined spin of zero. An international team of researchers (USA - Harvard University, Germany) built a superconducting sandwich, with superconductors on the outside and mercury telluride in the middle. As a result of the Cooper Pairs (paired electrons) interaction with the material, they were able to measure the spin at various points as the electron waves moved through the material. By using an external magnet, the total spin of the pairs can be tuned. [TECHNICAL ARTICLE](#)

Tags: Quantum science, Materials science

Teleporting toward a quantum Internet

PhysOrg.com, 14OCT2016

Longer distances teleportation recorded in the past were conducted in lab settings. An international team of researchers (Canada, USA - NIST Boulder, JPL Caltech) teleported the quantum state of a photon more than 3.7 miles in "dark" cables under the city of Calgary. The experiment showed how they overcame the challenges posed by the environment outside the laboratory. The next step is building repeaters that can further teleport the state of a photon from one location to the next. They are planning to use more advanced versions of these detectors for demonstrations of optical communication from deep space and quantum teleportation from the International Space Station. [TECHNICAL ARTICLE](#)

Tags: Quantum science, Communications technology

Strongest coupling between light and matter ever achieved

Science Daily, 12OCT2016

An international team of researchers (Canada, Spain, USA - Harvard University) recorded interaction between

light and matter 10 times larger than previously seen. The research is enabling the investigation of light-matter interactions in a new domain in quantum optics and it could potentially act as a quantum simulator to study other interesting quantum systems in nature. It may lead to the exploration of new physics related to biological processes, exotic materials such as high-temperature superconductors, and even relativistic physics. [TECHNICAL ARTICLE](#)

Tags: Quantum science

S&T POLICY

Chinese J20s Show New Camouflage

Next Big Future, 18OCT2016

Two J-20 stealth fighters seen in Chengdo, China show a new camouflage paint that is likely to be used with the Low Rate Initial Production (LRIP) batch currently being delivered from the assembly plant in Chengdu. Photos aired on Chinese websites and twitter.

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

SENSORS

Lego-like wall produces acoustic holograms

PhysOrg.com, 14OCT2016

A team of researchers in the US (Duke University, North Carolina State University) made blocks of metamaterials that resemble a wall of Legos. Each individual block is made of plastic by a 3-D printer and contains a spiral within. The tighter the coil, the slower sound waves travel through it. While the individual blocks can't influence the sound wave's direction, the entire device effectively can. By calculating how 12 different types of acoustic metamaterial building blocks will affect the sound wave, the researchers can arrange them in a wall to form any wave pattern on the other side of the wall. With enough care, the sound waves can produce a specific hologram at a specific distance away. The technique could revolutionize applications ranging from home stereo systems to medical ultrasound devices.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors

Engineers reveal fabrication process for revolutionary transparent sensors

Nanowerk, 13OCT2016

In 2014, University of Wisconsin-Madison engineers announced that they had developed transparent sensors for use in imaging the brain. As there was unprecedented interest in transparent sensors, an international team of researchers (USA - University of Wisconsin at Milwaukee, University of Wisconsin at Madison, University of Washington, industry partner, Thailand) has described in great detail how to fabricate and use transparent graphene neural electrode arrays in applications in electrophysiology, fluorescent microscopy, optical coherence tomography, and optogenetics. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors, Microelectronics

continued...

No GPS, no problem: Next-generation navigation

Science Daily, 13OCT2016

Instead of adding more internal sensors, researchers at UC Riverside have been developing autonomous vehicles that could tap into the hundreds of signals around us like cellular, radio, television, Wi-Fi, and other satellite signals, called “signals of opportunity (SOP).” The system can be used by itself, or, more likely, to supplement INS data in the event GPS fails. The team’s end-to-end research approach includes theoretical analysis of SOPs in the environment, building specialized software-defined radios that will extract relevant timing and positioning information from SOPs, developing practical navigation algorithms, and finally testing the system on ground vehicles and unmanned drones.

Tags: Sensors, Communications technology ■

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