



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLES

[New combined system blocks jamming in GPS-denied environment](#)

[Defense Systems, 28JUL2017](#)

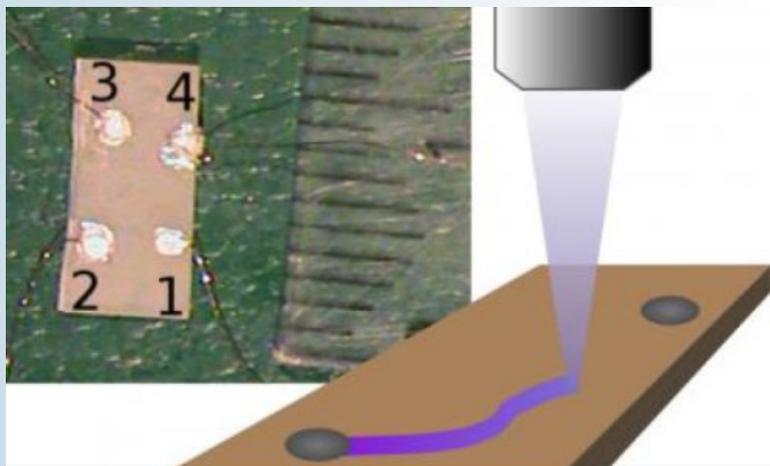
An international team of researchers (USA - industry, Israel) is combining two technologies they developed to ensure the survival of GPS navigation in the age of electronic warfare. When combined, the system will remain compatible with the currently employed military GPS frequency and the next-generation m-code frequency. Platforms installed with the new integrated system can navigate in GPS-denied environments and then reinforce the navigational information, and at the same time block the jamming signals.

Tags: Sensors, Military technology, Featured Article

[Physicists turn a crystal into an electrical circuit](#)

[Science Daily, 27JUL2017](#)

Materials with persistent photoconductivity experience an increase in conductivity upon exposure to light that persists after the light is turned off. Researchers at



Washington State University researchers used light to write a highly conducting electric path in a crystal. This opens up the possibility of transparent, three-dimensional electronics that, like an Etch-A-Sketch, can be erased and reconfigured. On the left, a photograph of a sample with four metal contacts. On the right, an illustration of a laser drawing a conductive path between two contacts.

Credit: Washington State University

Washington State University performed two-point resistance measurements on annealed strontium titanate single crystals at room temperature. After illumination with sub-gap light, the resistance decreased by three orders of magnitude. The enhanced conductivity persisted for several days in the dark. Analysis suggest that contact resistance plays an important role. The laser was then used as an “optical pen” to write a low-resistance path between two contacts, demonstrating the feasibility of optically defined, transparent electronics. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, Advanced materials, Featured Article

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

[New 3-D technique uses water and robotics to reconstruct complex objects](#)

[Science Daily, 26JUL2017](#)

An international team of researchers (Israel, China, Canada) has developed a three-dimensional shape acquisition and reconstruction method based on Archimedes principle. By repeatedly dipping a shape in liquid in different orientations and measuring its volume displacement, they generated the dip transform: a novel volumetric shape representation that characterizes the object's surface. Unlike optical sensors, the liquid has no line-of-sight requirements, it penetrates cavities and hidden parts of the object, as well as transparent and glossy materials, thus bypassing all visibility and optical limitations of conventional scanning devices.

[TECHNICAL ARTICLE](#)

Tags: Advanced manufacturing

[Army seeks shape-changing biomimetic aircraft](#)

[Defense Systems, 25JUL2017](#)

The Army research solicitation called Adaptive Biomimetic Aircraft Structures (ABAS) aims to exploit biomimetics

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to create manned or unmanned aircraft that can reshape itself in mid-air enhancing an aircraft's adaptability in achieving its mission. The Army wants weight-efficient concepts capable of optimizing aircraft structural and aerodynamic configuration, not how many missions the aircraft can fly.

Tags: Advanced manufacturing, Biomimetics, Military technology

ADVANCED MATERIALS

Metal instability achieves energy-efficient nanotechnology

[Science Daily, 31AUG2017](#)

An international team of researchers (Japan, Italy, the Netherlands) fabricated freestanding vanadium dioxide (VO₂) nanowires by growing them on magnesium oxide (MgO) and then etching the MgO layer away. Because of the electro-mechanical properties of VO₂ crystals, the nanowires could generate mechanical oscillations at MHz frequencies using nothing more than a simple DC power source. This efficient conversion of electrical energy to mechanical work reduces the need for dedicated electronic devices, thus enabling the creation of even smaller NEMS than currently used. [TECHNICAL ARTICLE 1, 2](#)

Tags: Advanced materials

Scientists discover new magnet with nearly massless charge carriers

[Nanowerk, 28JUL2017](#)

A team of researchers in the US (Tulane University, Louisiana State University, Oak Ridge National Laboratory, National High Magnetic Field Laboratory, University of New Orleans, Los Alamos National Laboratory) reported the first observation of topological behavior in a magnet, Sr_{1-y}Mn_{1-z}Sb₂ (y, z < 0.1). The new magnet displays electronic charge carriers that have almost no mass. The magnetism brings with it time reversal symmetry where the ability to run time backward would no longer return the system back to its starting conditions. The new material is thought to be an excellent one to investigate for evidence of the Weyl phase and to uncover its consequences. The nearly massless behavior of the charge carriers offers possibilities for novel device concepts taking advantage of the extremely low power dissipation. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

Graphene bubbles measure shear forces

[Nanotechweb, 27JUL2017](#)

An international team of researchers (China, USA - UT Austin) has measured the interlayer shear stress of bilayer graphene based on pressurized microscale bubble loading devices. A much higher interfacial shear stress of 1.64 MPa was determined for monolayer graphene on a silicon oxide substrate. The results establish an experimental method for characterizing the fundamental interlayer shear

properties of the emerging 2D materials for potential applications in multilayer systems. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

Reality check for 'wonder material'

[Science Daily, 27JUL2017](#)

In topological insulators, the surface transport channels can be accompanied by a finite conducting bulk, as well as additional topologically trivial surface states. An international team of researchers (the Netherlands, USA - Rutgers University) investigated the parallel conduction transport channels in Shubnikov-de Haas oscillations in Bi₂Se₃ thin films in high magnetic fields up to 30 T. Their analyses indicate the presence of a two-dimensional state and signatures of additional states the origin of which cannot be conclusively determined. Their findings underpin the necessity of theoretical studies on the origin of and the interplay between these parallel conduction channels for a careful analysis of the material's performance. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

Sticky when wet: Strong adhesive for wound healing

[Science Daily, 27JUL2017](#)

An international team of researchers (USA - Harvard University, Boston Children's Hospital, Canada, UK, Ireland) has developed a bio-inspired adhesive consisting of two layers: an adhesive surface and a dissipative matrix. The former adheres to the substrate by electrostatic interactions, covalent bonds, and physical interpenetration. The latter amplifies energy dissipation through hysteresis. The two layers synergistically lead to higher adhesion energies on wet surfaces as compared with those of existing adhesives. Adhesion occurs within minutes, independent of blood exposure and compatible with in vivo dynamic movements. This family of adhesives may be useful in many areas including tissue adhesives, wound dressings, and tissue repair. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Biomimetics, Biotechnology

Getting closer to porous, light-responsive materials

[Science Daily, 26JUL2017](#)

Researchers in Japan have developed photoresponsive crystalline materials showing quantitative reversible photochemical reactions upon ultraviolet and visible light irradiation by introducing structural flexibility into crystalline porous frameworks with a twofold interpenetration composed of a diarylethene-based ligand. It enables highly efficient photochemical electrocyclization in a single-crystal-to-single-crystal manner. CO₂ sorption on the porous crystal at 195 K was reversibly modulated by light irradiation. Preliminary tests indicated that the porous crystal could also adsorb other gases, such as nitrogen, at various temperatures. The research has

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“No doubt those who really founded modern science were usually those whose love of truth exceeded their love of power.” —C.S LEWIS

applications in photochemical conversions and the photo-modulation of porous properties. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, S&T Japan

[Triple-layer catalyst does double duty](#)

Nanowerk, 26JUL2017

A team of researchers in the US (Rice University, University of Houston) produced electrolytic film which is a three-layer structure of nickel, graphene and a compound of iron, manganese and phosphorus. The foamy nickel gives the film a large surface, the conductive graphene protects nickel from degrading and metal phosphide carries out the reaction. It is stable in acidic or basic solution. Graphene is key to protecting the underlying nickel. The new catalyst also requires less energy. The material is scalable and should find use in industries that produce hydrogen and oxygen and solar and wind-powered facilities that can use electrocatalysis to store off-peak energy. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

[Potential for synthetic materials systems that can 'count' and sense their size](#)

Science Daily, 25JUL2017

Many organisms can sense their local population density and modify their behavior in crowded environments using quorum sensing. Quorum sensing is a highly desirable attribute for synthetic systems because it permits novel self-recognition and self-regulating functionality. Using theory and simulation, researchers at the University of Pittsburgh have designed chemical-producing microcapsules that display quorum sensing. When the chemical production is regulated by a biomimetic feedback loop, the capsules exhibit tunable transitions between steady (“off”) and oscillatory (“on”) states as a function of the number and number density of microcapsules in a colony. Such a system can behave as a mechanoresponsive material, modulating chemical activity when applied stresses alter the spatial configuration of the capsules. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS

[Empowering robots for ethical behavior](#)

Science Daily, 18JUL2017

The three laws proposed by Isaac Asimov state that a robot should not harm a human, or allow a human to be harmed. The concept of “harm” is complex, context-specific and is difficult to explain clearly to a robot. Researchers in the UK mathematically coded the Empowerment concept so that the robot seeks to maintain a human’s Empowerment and

see the world through the eyes of the human with which it interacts. Keeping the human safe consists of the robot acting to increase the human’s own Empowerment.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Autonomous systems & robotics

BIOTECHNOLOGY

[A new twist on electrosprays](#)

Nanowerk, 27JUL2017

A team of researchers in the US (Brown University, Northwestern University) used drops of silicone oil submerged in more electrically conductive castor oil. When an electric field was applied, the drop first flattened into a lens-like shape, encircled by concentric rings, which broke up to form an array of micro-droplets around the equator. Eventually it transformed into millions of microscopic, uniform-sized beads. The technology has applications in developing pharmaceuticals. [TECHNICAL ARTICLE](#)

Tags: Biotechnology, Materials science

COMMUNICATIONS TECHNOLOGY

[Breakthrough lofts the smallest satellites ever](#)

Physorg.com, 27JUL2017

A non-profit organization established Breakthrough Starshot, a program to create a lightsail-driven “wafercraft” that would make the journey to the nearest star system—Alpha Centauri—within our lifetime. They conducted a successful test flight of its first spacecraft. Known as “Sprites”, these are the smallest spacecraft ever launched. They measure 3.5 by 3.5 cm (1.378 x 1.378 inches) and weigh only four grams (0.14 ounces), but still manage to pack solar panels, computers, sensors and radios into their tiny frames and they operate at 437.24 MHz, corresponding to a wavelength of roughly 69 cm.

Tags: Communications technology, Satellite technology, Space technology

ENERGY

[Energy-harvesting bracelet could power wearable electronics](#)

Physorg.com, 25JUL2017

Researchers in China have designed an energy harvesting bracelet (EHB) based on two mutually exclusive circular motion permanent magnetic movers. It can capture energy through the natural motions of the wearer’s wrist. The EHB can transform the translational motion in any orientation except the axial into the rotational motion of the movers, which passes through four coil transducers and induces significantly large electro-motive forces across the coils. A prototype EHB is shown to produce power that can

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charge a capacitor with 470 μF 25 V up to more than 0.81 V during at most 132 ms from any single excitations. It could potentially be used to help power activity trackers, smart-watches, and even some health-monitoring applications.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Energy, Flexible electronics, S&T China*

FEATURED RESOURCE

[Kurzweil Network](#)

Kurzweil Network explores the radical growth of pervasive technologies—both biological and machine — that are radically changing our world; examine the trends, people and projects deeply impacting marketplace, arts + entertainment, government, defense, medicine, communication, education, lifestyle, and society's future. [RSS feeds](#)

ENVIRONMENTAL SCIENCE

[Climate change means more rain, more nitrogen runoff, more problems](#)

[Science Daily, 27JUL2017](#)

A team of researchers in the US (Stanford University, Princeton University) analyzed anticipated changes in precipitation according to 21 different climate models, each of which was run for three climate scenarios (varying from aggressive efforts to mitigate climate change to a “business-as-usual” scenario), and two time periods (near future, 2031–2060; and far-future, 2071–2100). Across the continental United States as a whole, models consistently estimate that nitrogen loading will increase under all three scenarios, for both time periods. Offsetting this increase would require a $33 \pm 24\%$ reduction in nitrogen inputs. Globally, changes in precipitation are especially likely to exacerbate excessive nutrient enrichment in India, China, and Southeast Asia. [TECHNICAL ARTICLE](#)

Tags: *Environmental science, Climatology*

[Could spraying particles into marine clouds help cool the planet?](#)

[University of Washington, 25JUL2017](#)

Researchers at the University of Washington are investigating marine cloud brightening as a promising strategy to offset global warming. Aerosol particle perturbations can be introduced into patches of marine low clouds in a systematic manner. Such cloud perturbation experiments constitute a fresh approach to climate science and would provide unprecedented data to untangle the effects of aerosol particles on cloud microphysics and the resulting reflection of solar radiation by clouds. The control experiments would provide a critical test of high-resolution models that are used to develop an improved

representation aerosol–cloud interactions needed to better constrain aerosol forcing in global climate models. Their analysis shows that some climate response tests, such as those attempting to detect changes in regional climate impacts, may not be deployable in time periods relevant to realistic geoengineering scenarios. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Environmental science, Climatology*

[Human-made aerosols identified as driver in shifting global rainfall patterns](#)

[Science Daily, 18JUL2017](#)

Using multiple climate model projections, researchers at the University of Miami measured the effects human-made aerosols had on rainfall changes in the 20th and 21st centuries to discover that human-made aerosols are the primary driver of the observed southward shift in rainfall patterns throughout the latter half of the 20th century. The majority of the precipitation shift does not result from aerosols directly through their absorption and scattering of radiation, but rather indirectly through their modification of cloud radiative properties. The models found that the largest shift in rainfall patterns will occur over the tropics rather than in the mid-latitude northern hemisphere.

[TECHNICAL ARTICLE](#)

Tags: *Environmental science, Climatology*

FOREIGN S&T

[Russia developing 200 kilowatt lasers and mounting them on combat icebreakers](#)

[Next Big Future, 26JUL2017](#)

The two ships will displace about 8,500 tons, about the size of modern destroyers, but much of that weight is due to the reinforced hull needed by icebreakers to plow through thick sea ice. Dimensionally, the Papanin class will be only about the size of a frigate. The ships will carry one AK-176MA 3-inch multipurpose deck gun (76.2-millimeter), a Kamov Ka-27 search and rescue helicopter, and eight Kalibr anti-ship missiles or longer-range cruise missile variants. The ships will be powered by diesel electric engines mounted in azipods generating a combined horsepower of 9,160 horsepower, and will carry bow thrusters for precise maneuvering. Later this year Russian engineers will test a 30-kilowatt laser on the icebreaker Dikson, with an eye toward eventually fielding a 200-kilowatt seagoing laser.

Tags: *Foreign S&T, Military technology, S&T Russia*

MATERIALS SCIENCE

[Fundamental breakthrough in the future of designing materials](#)

[Science Daily, 27JUL2017](#)

An international team of researchers (Ireland, USA - University of Pennsylvania, industry partner, UK) showed that the surfaces of nanocrystalline copper films are not

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flat but rather have ridges and valleys created by the grains rotating out of plane, which introduce grain boundary defects. Such defects might be avoided if films of different orientations could be grown. This behavior applies to many materials beyond copper and will have important implications for how materials are used and designed in the future. The blueprint and the strategies they are developing to control the level of grain rotation will lead to manipulating material properties at an unprecedented level. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Physicists design ultrafocused pulses](#)

[Science Daily, 27JUL2017](#)

An international team of researchers (Austria, Germany) has theoretically found that by placing a coil inside a cylinder that reflects the waves perfectly, arbitrarily focused pulses and quasi-equidistant pulses could be generated. The more waveguide modes are excited, the more focused the electromagnetic fields become. Because of the specific properties of the system, the current pulse needs to be adjusted only slightly to change the number of modes. The findings could facilitate the development of more precise devices. [TECHNICAL ARTICLE](#)

Tags: Materials science

MICROELECTRONICS

[Amplification on a chip: Research raises hope for erbium-based integrated photonics device](#)

[Nanowerk, 29JUL2017](#)

An international team of researchers (China, USA - State University of Arizona) reports the results of the signal enhancement and transmission experiments on a single-crystal erbium chloride silicate nanowire. They have shown that a net material gain over 100 dB cm^{-1} at wavelengths around 1,530 nm is possible due to the nanowire's single-crystalline material quality and its high erbium concentration. The results establish that such rare-earth-compound nanowires are a potentially important class of nanomaterials for a variety of applications including subwavelength-scale optical amplifiers and lasers for integrated nanophotonics, and quantum information. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, Materials science

[Spintronic neuron recognizes speech](#)

[Physics World, 28JUL2017](#)

An international team of researchers (France, Japan, USA - NIST, Cornell University) has experimentally shown that a nanoscale spintronic oscillator (a magnetic tunnel junction) can be used to achieve spoken-digit recognition with an accuracy like that of state-of-the-art neural networks. They determined the regime of magnetization dynamics that leads to the greatest performance. Being sub-micron in

size could allow one hundred million oscillators to fit on a thumb-sized chip which offer low noise operation, high stability and low energy consumption. The oscillators can be made using the same fabrication methods as conventional computer chips. [OPEN ACCESS TECHNICAL ARTICLE](#)
Tags: Microelectronics, Artificial intelligence, Communications technology

[New method promises easier nanoscale manufacturing](#)

[Science Daily, 27JUL2017](#)

A team of researchers in the US (University of Chicago, Argonne National Laboratory) used light-responsive ligands to change the solubility of nanocrystals in specific solvents to develop simple redispersion of nanocrystals in dark regions. The process can fully utilize the advantages of conventional semiconductor processing, but without the need for photoresists, because the nanocrystals are only deposited where they are exposed to light. The technique can be used with a wide range of materials, including semiconductors, metals, oxides or magnetic materials. [TECHNICAL ARTICLE](#)

Tags: Microelectronics

PHOTONICS

[Single molecular layer and thin silicon beam enable nanolaser operation at room temperature](#)

[Nanowerk, 29JUL2017](#)

An international team of researchers (China, USA - Arizona State University) used a monolayer of molybdenum ditelluride integrated with a silicon nanobeam cavity to fabricate a device which did not require cooking for lasing. Excitons in molybdenum telluride emit in a wavelength that is transparent to silicon, making silicon a waveguide material. Excitons in such monolayer materials are 100 times stronger than those in conventional semiconductors, allowing efficient light emission at room temperature. The device could potentially be used to send information between different points on a single computer chip. The lasers may be useful for other sensing applications in a compact, integrated format. [TECHNICAL ARTICLE](#)

Tags: Photonics

[Broadband light sources with liquid core](#)

[Nanowerk, 28JUL2017](#)

Researchers in Germany pumped a hybrid waveguide with an ultrafast, intense laser pulse and produced a very broad light spectrum in the near and mid-infrared range. Due to the unique characteristics of the liquid fiber core, the light pulse is broken up into solitons. The findings lead to the emerging field of hybrid solitons, revealing their impact on the bandwidth, onset energy and noise characteristics of the supercontinua. According to the researchers, liquid-core

fibres is a promising platform for fundamental optics and applications towards novel coherent and reconfigurable light sources. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Photonics, S&T Germany

[Optical lens can transfer digital information without loss](#)

[Physorg.com](#), 28JUL2017

Researchers in China have established a feasible experiment platform to design and demonstrate an optical lens that exhibits two seemingly opposing – self-focusing effect and the Talbot effect – that creates repeating patterns of light. They showed that the combination of these two properties can be used to transfer an encoded digital signal without information loss, which has potential applications for realizing highly efficient optical communication systems. [TECHNICAL ARTICLE](#)

Tags: Photonics, S&T China

QUANTUM SCIENCE

[Experimental method measures quantum coherence, the ability of being in two states at once](#)

[EurekAlert](#), 27JUL2017

An international team of researchers (India, Spain) proposes a new way of measuring the robustness of the quantum coherence of a superimposed state. The method is based on the measurement of the visibility of interference fringes produced when two coherent states coincide. They show that each visibility parameter of the interference pattern, such as the difference between maximums and minimums in intensity, gives rise to a measure of coherence. The study thus connects the theory of coherence to concrete and physically relevant observations. [TECHNICAL ARTICLE](#)

Tags: Quantum science

[Ultracold molecules hold promise for quantum computing](#)

[MIT News](#), 27JUL2017

An international team of researchers (USA - MIT, Columbia University, Singapore, South Korea) reports the observation of stable coherence, on the scale of 1 second, between nuclear spin states of ultracold fermionic sodium-potassium molecules in the singlet rovibrational ground state. This enables high-resolution spectroscopy of the molecular gas. Collisional shifts are shown to be absent down to the 100-millihertz level. The work opens the door to the use of molecules as a versatile quantum memory and for precision measurements on dipolar quantum matter. [TECHNICAL ARTICLE](#)

Tags: Quantum science

[‘Tiny dancer’ atoms could prove a hit with quantum computer scientists](#)

[Physorg.com](#), 25JUL2017

An international team of researchers (UK, the Netherlands, Switzerland) trapped single phosphorous atoms inside crystals of silicon. They demonstrated THz laser pulse control of Si:P orbitals using multiple orbital state admixtures, observing beat patterns produced by Zeeman splitting. The beats are an observable signature of the ability to control the path of the electron, which implies that the strength and duration of the interaction of the atom with different neighbors can be controlled. The team believes that positioning these atoms in a fixed grid structure could pave the way for reliable quantum computers. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science

S&T POLICY

[China’s quest to become a space science superpower](#)

[Nature News](#), 26JUL2017

China’s latest space lab, launched in September 2016, carries more than a dozen scientific payloads. Four additional missions dedicated to astrophysics and other fields have been sent into orbit in the past two years, including a spacecraft that is conducting pioneering experiments in quantum communication. But despite the momentum, many researchers in China worry about the nation’s future in space science. For China’s space scientists, however, the main challenge is to convince their own government of the need for long-term investment.

Tags: S&T policy, Foreign S&T, Space technology

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