



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

[Advanced materials \(2\)](#)

[Counter WMD \(1\)](#)

[Microelectronics \(2\)](#)

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

[Autonomous systems
& robotics \(3\)](#)

[Energy \(1\)](#)

[Neuroscience \(1\)](#)

[S&T policy \(3\)](#)

[Communications technology \(3\)](#)

[Materials science \(7\)](#)

[Photonics \(5\)](#)

[Science without borders \(3\)](#)

FEATURE ARTICLES

[Gravitation under human control?](#)

Science Daily, 08JAN2016



Artist's concept (stock illustration).
Credit: © Sergey Nivens / Fotolia

Researchers in Belgium proposed, with supporting mathematical proof, a device with which to create detectable gravitational fields. The device is based on superconducting electromagnets and therefore

relies on technologies routinely used. If successful, it would certainly be a major step forward in physics: the ability to produce, detect and, ultimately, control gravitational fields. People could then produce gravitational interaction in the same way as the other three fundamental interactions (e.g. electromagnetic and strong and weak nuclear forces). That would usher gravitation into a new experimental and industrial era. [TECHNICAL ARTICLE](#)

Tags: [Science without borders](#), [Featured Article](#)

[New material can fold itself into hundreds of shapes](#)

Science Magazine, 08JAN2016

To make a material that is both plastic and elastic, researchers in China crosslinked polycaprolactone. To give the material plasticity, they added a chemical called 1,5,7-triazabicyclo[4.4.0]dec-5-ene. They combined the two in such a way that the elastic and plastic temperatures were far enough away from each other so that the material could switch cleanly between its different shapes. It can be bent in many different shapes, but it would still always be able to retract. A reconfigurable antenna is a possible application for this material.

[TECHNICAL ARTICLE](#)

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

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Legos for the fabrication of atomically precise electronic circuits](#)

Nanowerk, 08JAN2016

An international team of researchers (USA - UC Berkeley, Lawrence Berkeley National Laboratory, Spain) designed molecular building blocks to fuse together to controllably modulate the width of a single nanoribbon in a series of connected segments, each having a different width specified at the atomic level. They confirmed that the modulated width altered the nanoribbon's electronic properties, specifically the bandgap. Modifying the bandgap enables the creation of atomically engineered junctions within graphene nanoribbons which could be used to produce high performance circuits for use in future electronics and solar cells. [TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#), [Microelectronics](#)

[A Nanoscale Look at Why a New Alloy is Amazingly Tough](#)

Berkeley Lab, 06JAN2016

An international team of researchers (China, USA - University of Pittsburgh, Lawrence Berkeley National Laboratory, UC Berkeley, Germany) report that an alloy made of chromium, manganese, iron, cobalt and nickel (CrMnFeCoNi) is exceptionally tough and strong at room temperature, which translates into excellent ductility, tensile strength, and resistance to fracture. And unlike most materials, the alloy becomes tougher and stronger the colder it gets, making it suitable for cryogenic applications. The formation of nano-sized bridges across a growing crack, which inhibit the crack's growth, are one of several mechanisms identified by the scientists that give the alloy incredible toughness and strength. [TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#), [Materials science](#)

[continued...](#)

[BACK TO TOP](#)

AUTONOMOUS SYSTEMS & ROBOTICS

Could AI Solve the World's Biggest Problems?

MIT Technology Review, 12JAN2016

A steady stream of advances—mostly enabled by the latest machine-learning techniques—are indeed empowering computers to do even more things, from recognizing the contents of images to holding short text or voice conversations. These advances seem destined to change the way computers are used in many industries, but it's far from clear how the industry will go from captioning images to tackling poverty and climate change.

Tags: Autonomous systems & robotics, Artificial intelligence

Will computers ever truly understand what we're saying?

UC Berkeley, 11JAN2016

According to researchers at UC Berkeley, machines don't develop a shared understanding of the people, place and situation – often including a long social history – that is key to human communication. Without such common ground, a computer cannot help but be confused. People tend to think of communication as an exchange of linguistic signs or gestures, forgetting that much of communication is about the social context, about who you are communicating with.

Tags: Autonomous systems & robotics, Artificial intelligence

How Drones May Avoid Collisions by Sharing Knowledge

MIT Technology Review, 04JAN2016

Instead of programming drones to know what to do in every single scenario, researchers at Stanford University are giving them the intelligence to understand their surroundings. They have developed a quick decision process the traffic-management system can use to reroute drones and avoid a collision. They ran more than a million simulations for conflict situations for anywhere between two and 10 drones. Drones were given varying levels of information about the other drones in the system and then were tested on their response time and how often they ran into conflict. **TECHNICAL ARTICLE**

Tags: Autonomous systems & robotics

COMMUNICATIONS TECHNOLOGY

New Chips Ease Operations In Electromagnetic Environments

DARPA News, 11JAN2016

DARPA's Arrays at Commercial Timescales (ACT) program supports the development of an ADC with a processing speed nearly ten times that of commercially available, state-of-the-art alternatives. By leveraging this increased speed, the resulting ADC can analyze data from across a much wider spectrum range, allowing DoD systems to better operate in congested spectrum bands and to more rapidly react to spectrum-based threats. Enhanced situational awareness could come from new chips that can

sample and digitize battlefield radiofrequency signals at blazingly fast rates.

Tags: Communications technology, DARPA, Government S&T

Intercity quantum key distribution method outperforms quantum repeaters

PhysOrg.com, 08JAN2016

Currently, QKD links are limited to about 400 km due to optical fiber losses. Researchers in Japan propose an alternate method of expanding QKD networks that is entirely based on light and doesn't require quantum repeaters for connecting places within an 800 km radius in a cost-effective and high-speed manner. In contrast to quantum repeaters, their protocol uses just a single intermediate node equipped only with optical devices.

TECHNICAL ARTICLE

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

Highly efficient, high speed technology for satellite communications

University of Tokyo, 06JAN2016

Researchers in Japan developed the most efficient 64APSK data transmission system yet for an Earth observation satellite. The system was installed in the Hodoyoshi 4 satellite, which has a mass of just 64 kg. Using this system, the research group transmitted data at a rate of 505 Mbps. The technology may have applications in future generations of earth observation micro satellites under 100 kg.

Tags: Communications technology, S&T Japan

COUNTER WMD

Wake-up call for obscure but deadly infection

Science Magazine, 11JAN2016

Melioidosis is caused by the bacterium *Burkholderia pseudomallei*, which typically lives in the soil. The microbe can lead to acute disease immediately or lie dormant before exploding into full-blown melioidosis decades later. Researchers in the UK developed a model to study melioidosis which suggests that the disease is common throughout the tropics, including 34 countries where it has never been reported. *B. pseudomallei* can be aerosolized and had been investigated as a bioweapon.

Tags: Counter WMD, Medical sciences

ENERGY

UAE desert sand can store solar energy up to 1000 °C

Science Daily, 04JAN2016

Researchers in United Arab Emirates have demonstrated that it is possible to use desert sand as a thermal energy storage material up to 800-1000 °C. They measured sand's radiant energy reflectiveness before and after a thermal cycle and showed that the sand can be used as a direct solar absorber under concentrated solar flux.

Tags: Energy, Solar energy

continued...

“Science is the highest personification of the nation because that nation will remain the first which carries the furthest the works of thought and intelligence.” LOUIS PASTEUR

MATERIALS SCIENCE

[Creating an electrical conduit using two insulators](#)

Nanowerk, 11JAN2016

A team of researchers in the US (University of Minnesota, Pacific Northwest National Laboratory) deposited alternating, ultra-thin layers of NdTiO₃ and SrTiO₃ on a crystalline surface. By investigating their properties experimentally and theoretically, the researchers demonstrated that a very high density of mobile electrons can be generated and confined within the SrTiO₃ layers. The mobile electrons jump from the NdTiO₃ layers, where they cannot easily move, into the SrTiO₃ layers, where they are free to move. The discovery paves the way for a new class of electronic devices. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Programmable Material Algorithm Solves Universal Coating Problem](#)

MIT Technology Review, 11JAN2016

To design a sensor that can measure the temperature at any point on an object, a team of international researchers (USA - Arizona State University, Germany) developed a series of algorithms that provide the mathematical framework for a programmable material that entirely coats an object in a thin layer. The coating contains tiny particulate sensors that gather information about the surface, such as temperature, and communicate it to their nearest neighbors. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Self-adaptive material heals itself, stays tough](#)

Science Daily, 11JAN2016

In the self adaptive material made by researchers at Rice University, the tiny spheres of polyvinylidene fluoride encapsulate much of the liquid. The viscous polydimethylsiloxane further coats the entire surface. The spheres are extremely resilient as their thin shells deform easily. Their liquid contents enhance their viscoelasticity, a measure of their ability to absorb the strain and return to their original state, while the coatings keep the spheres together. The spheres also have the freedom to slide past each other when compressed, but remain attached. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Damaged material, heal thyself](#)

Nanowerk, 08JAN2016

Inspired by healing wounds in skin, researchers at Harvard University have developed a new approach that protects and heals surfaces using a fluid secretion process. In response to damage, dispersed liquid-storage droplets are controllably secreted. The stored liquid replenishes the surface and completes the repair of the polymer in seconds to hours. This approach has also been demonstrated in fibers and microbeads. It could be extended to create highly desired adaptive, resilient materials with possible uses in heat transfer, humidity control, slippery surfaces, and fluid delivery. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Electrical fields can alter properties of nanomaterials](#)

Nanowerk, 08JAN2016

A team of researchers in the US (University of Wyoming, University of Arkansas, University of Tennessee, Argonne National Laboratory) reports that the intrinsic electric field in the Schottky barrier was created at the interfaces. This then polarized the materials near the interfaces by changing the atomic positions in the crystal. The changed atomic positions altered the inter-atomic bond length inside the materials to change the mechanical properties near the interfaces. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Researchers conduct the first atomic resolution study of perovskites used in next generation solar cells](#)

PhysOrg.com, 08JAN2016

An international team of researchers (Japan, South Korea) used a single crystal of methylammonium lead bromide to create topographic images of its surface. They discovered that the molecules can rotate and that they favour specific orientations that lead to two types of surface structures with distinctly different properties. They also affect positions of neighbouring bromine ions, further altering the atomic structure. Since the structure dictates the electronic properties of the material, the geometric positions of atoms are essential for understanding of solar cells. [TECHNICAL ARTICLE](#)

Tags: Materials science, Solar energy

MICROELECTRONICS

Autonomous Maxwell's demon displays chilling power[Physics World, 11JAN2016](#)

An international team of researchers (Finland, Russia, USA - Brown University) has created "Maxwell's demon" that operates without external control. The device separates electrons in terms of their energies and prevents the higher-energy electrons from reaching a transistor – thereby cooling the transistor. The process occurs without the direct exchange of heat between the demon and the transistor and uses information about the energies of the electrons. It highlights the role that information plays in thermodynamics and could have practical uses in cooling electronic circuits. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics***MoS₂ monolayers make GHz transistor**[Nanotechweb, 07JAN2016](#)

Researchers at UT Austin report that they have fabricated flexible radio-frequency transistors from molybdenum disulphide with the highest ever intrinsic cut-off frequency of 5.6 GHz and power gain of 3.3 GHz. The devices, which are grown by chemical vapour deposition on large sheets of silica, could find use in a wide range of wireless communication applications, especially in wearable technologies, "smart" patches and the internet of things. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, Flexible electronics

FEATURED RESOURCE

STRN for STEM

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NEUROSCIENCE

New wave in tech: hacking the brain (Update)[PhysOrg.com, 08JAN2016](#)

A new breed of neuro-hacker is finding ways to capture and manipulate brainwaves to improve health, with potential to help the severely handicapped. A number of the innovations were on display at the Consumer Electronics Show in Las Vegas, where computer scientists and biomedical experts showcased ways to tap into and use brain signals.

Tags: Neuroscience, Artificial intelligence

PHOTONICS

Recycling light[Science Daily, 11JAN2016](#)

A team of researchers in the US (MIT, Purdue University) designed nanofilters to recycle the infrared light, while allowing the visible light to go through. The key advance was to design a photonic structure that transmits visible light and reflects infrared light for a very wide range of angles. Conventional photonic filters usually operate for a single incidence angle. They extended the desired optical properties across all directions using special numerical optimization techniques. While as a proof-of-concept the research group built a more energy-efficient incandescent light bulb, the same approach could also be used to improve the performance of other hot thermal emitters, including thermo-photovoltaic devices. [TECHNICAL ARTICLE](#)

*Tags: Photonics***Light discussion on nanophotonics**[Nanotechweb, 08JAN2016](#)

At a webinar sponsored by the Institute of Physics, a panel of experts in nanophotonics discussed their own latest results, as well as posing their verdicts on the most pressing topics in terahertz plasmonics, metamaterials, graphene and scanning probe research. [Webinar, TECHNICAL ARTICLES](#)

*Tags: Photonics, Nanotechnology***Novel metasurface revolutionizes ubiquitous scientific tool**[Nanowerk, 08JAN2016](#)

An international team of researchers (USA - Harvard University, Iceland) built a two-dimensional metasurface that is covered with a thin array of metallic antennas, smaller than a wavelength of light, embedded in a polymer film. As light propagates down an optical fiber and illuminates the array, a small amount scatters in four directions. Four detectors measure the intensity of the scattered light and combine to give the state of polarization in real time. From medical diagnostics to high-tech manufacturing to the food industry, measuring polarization reveals critical data. [TECHNICAL ARTICLE](#)

*Tags: Photonics***Single-chip laser delivers powerful result**[PhysOrg.com, 07JAN2016](#)

Researchers at Northwestern University have integrated a mid-infrared tunable laser with an on-chip amplifier. This breakthrough allows adjustable wavelength output, modulators, and amplifiers to be held inside a single package. With this architecture, the laser has demonstrated an order-of-magnitude more output power than its predecessors, and the tuning range has been enhanced by more than a factor of two. [TECHNICAL ARTICLE](#)

Tags: Photonics, Sensors

Using a microscopic ring to produce pulsed light[PhysOrg.com](#), 07JAN2016

To generate solitons, an international team of researchers (Switzerland, Russia) used microresonators made from very fine silicon nitride. The microresonators are capable of storing, for a few nanoseconds, the light of the laser to which they are coupled. This period of time is sufficient for the light to circumnavigate the ring thousands of times and to accumulate there, which strongly increases the intensity of the light. The interaction between the microresonator and the light becomes non-linear. The laser, which is normally continuous by nature, is converted into solitons.

TECHNICAL ARTICLE

Tags: Photonics

QUANTUM SCIENCE

Measurement noise 100 times lower than the quantum-projection limit using entangled atoms[Nature](#), 11JAN2016

When measuring a signal, such as the phase shift of a light beam or an atomic state, a prominent limitation to achievable precision arises from the noise associated with the counting of uncorrelated probe particles. Researchers at Stanford University demonstrate an approach that achieves unprecedented levels of metrological improvement using half a million ⁸⁷Rb atoms in their 'clock' states. Applications include atomic clocks, inertial sensors, and fundamental physics experiments such as tests of general relativity or searches for electron electric dipole moment.

*Tags: Quantum science***Beating the heat - Ultrafast sensing and quantum control**[Nanowerk](#), 07JAN2016

Harnessing quantum systems for information processing will require controlling large numbers of qubits that must be isolated, and in most cases cooled such that, among other things, errors in qubit operations do not overwhelm the system rendering it useless. A team of researchers in the US (University of Maryland, NIST) demonstrated important steps towards implementing a proposed type of gate, which does not rely on supercooling their ion qubits. They implemented ultrafast sensing and control of an ion's motion, which is required to realize these hot gates. Notably, this experiment demonstrates thermometry over an unprecedented range of temperatures—from zero-point to room temperature. TECHNICAL ARTICLE

*Tags: Quantum science***Advances in quantum machine learning**[arXiv](#), 09DEC2015

Researchers in the UK review the field as it is currently, and suggest directions for further research. They include both algorithms and experimental implementations in the discussion. The field's outlook is generally positive, showing significant promise. However, they believe there are appreciable hurdles to overcome before one can claim that it is a primary application of quantum computation.

TECHNICAL ARTICLE

Tags: Quantum science

S&T POLICY

China plans more than 20 space launches in 2016[PhysOrg.com](#), 12JAN2016

China conducted 19 successful space flights in 2015, intends to launch its Tiangong 2 space laboratory and a manned spacecraft Shenzhou 11, among other military and commercial orbital missions. With the launches of Shenzhou and Tiangong, this year could be the stepping stone for China towards establishing its own space station. The station could become fully operational around 2022.

*Tags: S&T policy, S&T China, Space technology***Strategic Priority Program on Space Science**
Chinese Academy of Science, 08JAN2016

During [China's] Twelfth Five-Year Plan period, the Strategic Priority Program on Space Science implements the following missions and studies: Hard X-ray Modulation Telescope, Quantum Experiments at Space Scale, Dark Matter Particle Explorer, Shijian-10, Kuafu Mission, Intensive Study of Future Space Science Missions and Advanced Research of Space Science Missions and Payloads.

*Tags: S&T policy, S&T China, Space technology***NSF commits \$30 million to expand the frontiers of computing**[NSF News](#), 07JAN2016

NSF announced \$30 million in funding to three Expeditions in Computing projects. Each grant will provide \$10 million over five years to interdisciplinary, multi-investigator research teams. The three projects are led by researchers at Princeton University, Boston University and Cornell University, and include scholars at 14 colleges, universities and labs across a wide range of disciplines. The projects aim to explore the frontiers of theoretical computer science, synthetic biology and computational sustainability.

Tags: S&T policy, Information technology

SCIENCE WITHOUT BORDERS

What does it mean to think and could a machine ever do it?

[The Conversation](#), 06JAN2016

Generally speaking, what computers are good at, like raw data manipulation, humans are quite bad at; and what computers are bad at, such as language, poetry, voice recognition, interpreting complex behaviour and making holistic judgements, humans are quite good at. If the analogy between human and computer “thinking” is so bad, why expect computers to eventually think like us? When it comes to questions of value it is interesting to consider two things. The first is if a thinking computer could be capable of attributing value to anything at all. The second is that if it could attribute value to anything, what would it choose?

Tags: Science without borders, Artificial intelligence

30 Under 30 2016: Today's Brightest Young Stars And The Future Leaders Of Everything

[Forbes](#), 04JAN2016

From an initial screening list of more than 15,000 of the best of the best, the 600 women and men featured in the Forbes fifth annual 30 Under 30 are America's most important young entrepreneurs, creative leaders and brightest stars.

Tags: Science without borders ■

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