



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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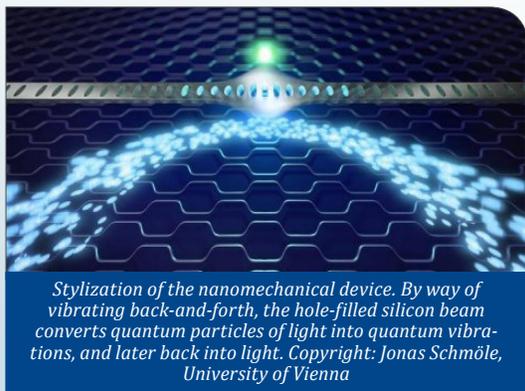
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## FEATURE ARTICLES

### [Mechanical quanta see the light](#)

[Science Daily, 19JAN2016](#)



Stylization of the nanomechanical device. By way of vibrating back-and-forth, the hole-filled silicon beam converts quantum particles of light into quantum vibrations, and later back into light. Copyright: Jonas Schmöle, University of Vienna

One of the open challenges for practical applications is how to make different quantum technologies talk to each other. One solution

proposed by scientists is to build and engineer nanomechanical devices such that their vibrations are the mediators between otherwise different quantum systems. An international team of researchers (Austria, the Netherlands, industry partner) has built such a nanomechanical device. It converts photons to phonons, and then back again. Such quantum mechanical vibrations could eventually be used as a 'memory' to temporarily store quantum information inside quantum networks or computers. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [Graphene composite may keep wings ice-free](#)

[Science Daily, 25JAN2016](#)

A thin coating of graphene nanoribbons in epoxy, developed by researchers at Rice University, has proven effective at melting ice. In laboratory tests they melted centimeter-thick ice from a static helicopter rotor blade in a minus-4-degree Fahrenheit environment. When a small voltage was applied, the coating delivered electrothermal heat to the surface, which melted the ice. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

#### [Self-stacking nanogrids](#)

[MIT News, 22JAN2016](#)

Block copolymers, molecules that spontaneously self-assemble into useful shapes, are one promising alternative to photolithography. Researchers at MIT describe the first technique for stacking layers of block-copolymer wires such that the wires in one layer naturally orient themselves perpendicularly to those in the layer below. The ability to easily produce such "mesh structures" could make self-assembly a much more practical way to manufacture memory, optical chips, and even future generations of computer processors. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Microelectronics*

#### [Simple artificial material can influence the properties of visible light](#)

[Science Daily, 21JAN2016](#)

The metasurface used by researchers in Singapore comprised a square array of silicon disks. Light striking the surface of the structure passed through to the other side, but was deflected by approximately ten degrees. The phase change imparted to the transmitted light by the metasurface was dependent on the radius of the silicon disks. The team showed that varying the radii between 120 and 155 nanometers could produce any desired phase shift. By creating certain phase shift distributions it is possible to focus light or even create on-demand holographic images. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

#### [Glass-based ultraviolet absorbers act as 'biological shields'](#)

[EurekAlert, 20JAN2016](#)

Based on the self-limited nanocrystallization of glass, researchers in China used cerium oxide to craft the composite glass-based UV absorber. Optical transparency and the ability to suppress the separation of photo-generated electrons and holes are key features of the material. The team demonstrated that the new glass effectively protects living cells and organic dyes, and

*continued...*

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believe it could also be developed as a transparent shield to protect electronics in space. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T China*

### [Switchable material could enable new memory chips](#)

[PhysOrg.com](#), 20JAN2016

Researchers at MIT have developed a thin-film material whose phase and electrical properties can be switched between metallic and semiconducting simply by applying a small voltage. The discovery could pave the way for a new kind of “nonvolatile” computer memory chip that retains information when the power is switched off, and for energy conversion and catalytic applications.

[TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Microelectronics*

### [Have scientists really found something tougher than nature’s invincible material?](#)

[PhysOrg.com](#), 19JAN2016

Researchers at North Carolina State University created a new form of carbon called “Q-carbon” by heating non-crystalline carbon with a high-powered fast laser pulse to 3,700 °C and quenching it. It has the unusual properties of being magnetic and glowing when exposed to light. They found Q-carbon to be 60% harder than diamond-like carbon. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## AUTONOMOUS SYSTEMS & ROBOTICS

### [The Neural Network That Remembers](#)

[IEEE Spectrum](#), 26JAN2016

Modern AI research has largely split into two camps. On one side, theorists work on the fundamental mathematical and statistical problems related to algorithms that learn. On the other side, more practically oriented researchers apply machine learning to various real-world tasks, guided more by experimentation than by mathematical theory. Breakthroughs in neural-network research have revolutionized computer vision and natural-language processing. One promising way forward might be an approach called reinforcement learning. Here, the computer explores the possible actions it can take, guided only by some sort of reward signal.

*Tags: Autonomous systems & robotics*

### [Video Friday: Segway Robot Demo, Pepper the Retail Worker, and Megakopter World Record](#)

[IEEE Spectrum](#), 22JAN2016

An unmanned, electric, autonomous aircraft travelling at 75 kilometres per hour lands gently on the roof of a moving car. Developed by researchers in Germany, the system could be applied to ultralight solar-powered aircraft that complement conventional satellite systems while flying in the stratosphere. Eliminating the landing gear significantly increases the payload capability of a solar-powered aircraft—it is easier to land during

crosswind conditions, making landings in unfavourable weather conditions possible.

*Tags: Autonomous systems & robotics*

## BIOTECHNOLOGY

### [First Monkeys with Autism Created in China](#)

[MIT Technology Review](#), 25JAN2016

Scientists in China say they used genetic engineering to create monkeys with a version of autism, an achievement that could make it easier to test treatments but that raises thorny practical and ethical questions over how useful such animal models will be. The altered monkeys displayed shared psychiatric symptoms, including pacing in circles and interacting less with other monkeys. Some scientists questioned whether the model developed in China was close enough to autism to really shed any light on human disease.

*Tags: Biotechnology, S&T China*

## CYBER SECURITY

### [Cybersecurity: The Age of the Megabreach](#)

[MIT Technology Review](#), 25JAN2016

Since companies and other organizations can’t stop attacks and are often reliant on fundamentally insecure networks and technologies, the big question is how they can effectively respond to attacks and limit the damage—and adopt smarter defensive strategies in the future. New approaches and new ways of thinking about cybersecurity are beginning to take hold. Organizations are getting better at detecting fraud and other attacks by using algorithms to mine historical information in real time. New tools are emerging from a blossoming ecosystem of cybersecurity startups, financed by surging venture capital investment in the area.

*Tags: Cyber security*

### [Unlocking the potential of the Internet of Things](#)

[McKinsey Global Institute](#), 01JUN2015

To get a broader view of the IoT’s potential benefits and challenges across the global economy, McKinsey Global Institute analyzed more than 150 cases, ranging from people whose devices monitor health and wellness to manufacturers who utilize sensors to optimize the maintenance of equipment and protect the safety of workers. The bottom-up analysis for the applications estimates that the IoT has a total potential economic impact of \$3.9 trillion to \$11.1 trillion a year by 2025.

*Tags: Cyber security*

## ENERGY

### [Photosynthetic electrodes generate current](#)

[Nanotechweb](#), 25JAN2016

An international team of researchers (Israel, Germany) has produced the first photobioelectrochemical cell that

*continued...*

“There is no adequate defense, except stupidity, against the impact of a new idea.”

PERCY WILLIAMS BRIDGMAN

couples a native photosystem (known as photosystem I) and an enzyme (glucose oxidase or glucose dehydrogenase) to oxidize glucose and generate electrical power. The design could easily be adapted to convert solar light into photocurrent using biomass substrates other than glucose. [TECHNICAL ARTICLE](#)

*Tags: Energy, Advanced materials*

## IMAGING TECHNOLOGY

### [Augmented Reality Study Projects Life-Sized People into Other Rooms](#)

[MIT Technology Review](#), 19JAN2016

Room2Room, a project from Microsoft Research, does just this: it uses Kinect depth cameras and digital projectors to capture the image of a person in 3-D in one room and project a life-sized version of that person in real time onto a piece of furniture in another room, where someone else is actually hanging out, and vice versa. Each person then sees a digital image of the other with the correct perspective, looks at the other person from different viewpoints, and interacts accordingly. There are still plenty of issues to solve before something like Room2Room is likely to show up in boardrooms or living rooms.

*Tags: Imaging technology, Science without borders*

## INFORMATION TECHNOLOGY

### [How an AI Algorithm Learned to Write Political Speeches](#)

[MIT Technology Review](#), 19JAN2016

Researchers at UMass Amherst have created an artificial intelligence machine that has learned how to write political speeches that are remarkably similar to real speeches. They used a database of almost 4,000 political speech segments from 53 U.S. Congressional floor debates to train a machine-learning algorithm to produce speeches of its own. The speeches consist of over 50,000 sentences each containing 23 words on average. [Source code](#)

*Tags: Information Technology*

## MATERIALS SCIENCE

### [Physicists control electrons at femtosecond timescales](#)

[MIT News](#), 22JAN2016

An international team of researchers (USA - MIT, Spain, Japan) has come up with a way to manipulate electrons in graphene within the first few femtoseconds of photo-excitation. With their technique, the researchers can redirect these high-energy electrons before they interact with other electrons in the material. The team's ultrafast

control of high-energy electrons may ultimately lead to more efficient photovoltaic and energy-harvesting devices, which capture photo-excited electrons before they lose their energy to thermalization. [TECHNICAL ARTICLE](#)

*Tags: Materials science, Particle physics*

### [Physicists create magnetic state in atomic layers of transition metal oxide](#)

[PhysOrg.com](#), 22JAN2016

An international team of researchers (USA - University of Arkansas, Argonne National Laboratory, India) found a way to produce a novel magnetic state in a few atomic sheets of a transition metal oxide comprised of lanthanum, titanium, and nickel to help understand the electronic and orbital states emerging from interfacial charge transfer and their connections to the modified band structure at the interface. This work opens the door to devices based on junctions of correlated electronic materials beyond our current semiconductor devices. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

### [First materials to be woven at the atomic and molecular levels created](#)

[PhysOrg.com](#), 21JAN2016

An international team of researchers (USA - Lawrence Berkeley National Laboratory, Sweden, Spain, Japan, Saudi Arabia, China) has woven the first three-dimensional covalent organic frameworks (COFs) from helical organic threads. The woven COFs display significant advantages in structural flexibility, resiliency and reversibility over previous COFs. The technique enables us to design and make complex two- and three-dimensional organic extended structures. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

### [Graphene oxide 'paper' changes with strain](#)

[Science Daily](#), 19JAN2016

Researchers at Rice University found that random molecules scattered within layers of otherwise pristine graphene affect how the layers interact with each other under strain. In experiments and computer models, the team found that with gentle, slow stress, the oxides would indeed catch, causing the paper to take on a corrugated form where layers pulled apart. But a higher strain rate makes the material brittle. With this understanding we can choose the functional groups to make better structures at the molecular level for applications in flexible electronics. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

## MICROELECTRONICS

**Plasmonics - Left in the wake**

Nanowerk, 27JAN2016

An international team of researchers (Singapore, USA - Harvard University, Italy, industry partner) has generated the two-dimensional equivalent of Cherenkov radiation in a gold film containing a row of nanoscale slits oriented at various angles. The effect could be used to create new types of surface-plasmon-based optical components, such as plasmonic holograms and directional plasmonic lenses.

TECHNICAL ARTICLE

*Tags: Microelectronics*

## FEATURED RESOURCE

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**Scientists create graphene barrier to precisely control molecules for making nanoelectronics**

Science Daily, 26JAN2016

A team of researchers in the US (Cal Tech, UCLA) developed a sheet of graphene material with minuscule holes in it that they could then place on a gold substrate. The holes allow molecules to attach to the gold exactly where the scientists want them, creating patterns that control the physical shape and electronic properties of devices. With the advance, making nanoelectronic and nanobioelectronic devices could be much more efficient than current methods of molecular patterning.

TECHNICAL ARTICLE

*Tags: Microelectronics***Researchers go for the gold on a single chip**

Nanowerk, 21JAN2016

A team of researchers in the US (UC Davis, Lawrence Livermore National Laboratory) has developed a library of varying np-Au morphologies on a single chip via precise delivery of tunable laser energy. They were able to fabricate an on-chip material library consisting of 81 np-Au samples of nine different morphologies for use in the parallel study of structure–property relationships. The libraries have the potential to drastically increase the throughput of morphology interaction studies for np-Au, specifically in applications such as high capacity lithium ion batteries, cell-material interaction studies for neural interfaces, analytical biosensors, as well as nanoscale material science studies.

TECHNICAL ARTICLE

*Tags: Microelectronics***Nano-photonics meets nano-mechanics**

Nanowerk, 19JAN2016

An international team of researchers (Spain, Italy) has presented a novel type of hybrid system, consisting of an on-chip graphene NEMS suspended a few tens of nanometres above nitrogen-vacancy centres (NVCs), which are stable single-photon emitters embedded in nanodiamonds. Their work has confirmed that graphene is an ideal platform for both nanophotonics and nanomechanics.

TECHNICAL ARTICLE

*Tags: Microelectronics*

## NEUROSCIENCE

**New ‘moonshot’ effort to understand the brain brings AI closer to reality**

PhysOrg.com, 21JAN2016

Researchers at Harvard University will record activity in the brain’s visual cortex in unprecedented detail, map its connections at a scale never before attempted, and reverse engineer the data to inspire better computer algorithms for learning. These systems could be designed to do everything from detecting network invasions, to reading MRI images, to driving cars. This project is not only pushing the boundaries of brain science, it is also pushing the boundaries of what is possible in computer science.

*Tags: Neuroscience, Artificial intelligence*

## PHOTONICS

**In plasmonics, ‘optical losses’ could bring practical gain**

Nanowerk, 26JAN2016

The development of advanced optical technologies using plasmonics has been hampered because components under development cause too much light to be lost and converted into heat. But now researchers at Purdue University are finding that this “loss-induced plasmonic heating” could be key to the development of various advanced technologies. Harnessing the intrinsic loss in plasmonics could help to usher in transformative technological innovations affecting several fields, including information technology, life sciences and clean energy.

TECHNICAL ARTICLE

*Tags: Photonics***Invisible light flash ignites nano-fireworks**

Nanowerk, 23JAN2016

Intense laser pulses can transform transparent material into a plasma that captures energy of the incoming light very efficiently. An international team of researchers (Germany, UK) demonstrated a new way to turn initially transparent nanoparticles suddenly into strong absorbers for intense laser light and let them explode. They found that only a few seed electrons created by the ionizing radiation of the extreme-ultraviolet pulse are sufficient to start a process similar to a snow avalanche in the mountains. Their results

*continued...*

open unprecedented opportunities for both fundamental laser-matter research and applications. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Materials science*

### [Seeing the big picture in photosynthetic light harvesting](#)

[EurekaAlert, 21JAN2016](#)

A team of researchers in the US (Lawrence Berkeley National Laboratory, UC Berkeley) has created the first computational model that simulates the light-harvesting activity of the thousands of antenna proteins that would be interacting in the chloroplast of an actual leaf. The results from this model point the way to improving the yields of food and fuel crops, and developing artificial photosynthesis technologies for next generation solar energy systems.

*Tags: Photonics*

### [All-Around Single-Photon Source](#)

[American Physical Society Synopsis, 14JAN2016](#)

An international team of researchers (China, Denmark, Germany, UK) used infrared laser pulses to excite electronic resonance of a semiconducting quantum dot, triggering the emission of single photons at infrared frequencies with an efficiency of 66%. In the new scheme, the researchers exploit the Purcell effect, which enhances the emission rate of the quantum dot by embedding it in a micropillar cavity whose resonant frequency matches that of the dot. The cavity also efficiently funnels the dot's emission into a single-mode fiber. In experimental tests, the device emitted 3.7 million pure and indistinguishable photons per second.

[TECHNICAL ARTICLE](#)

*Tags: Photonics, Quantum science*

## QUANTUM SCIENCE

### [A new quantum approach to big data](#)

[MIT News, 25JAN2016](#)

Topological systems are especially useful for analyzing the connections in complex networks, such as the internal wiring of the brain, the U.S. power grid, or the global interconnections of the Internet. An international team of researchers (USA - MIT, University of Southern California) has developed a new approach that would use quantum computers to streamline these problems. The team explains that algebraic topology is key to the new method. This approach helps to reduce the impact of the inevitable distortions that arise every time someone collects data about the real world. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Information technology*

### [Mysterious behavior of quantum liquid elucidated, a world first](#)

[Science Daily, 25JAN2016](#)

An international team of researchers (Japan, France) shows a precise experimental demonstration of Landau Fermi-liquid theory extended to the non-equilibrium regime in a 0-D system. Combining transport and sensitive current noise measurements, they have identified the SU(2) and SU(4) symmetries of quantum liquid in a carbon nanotube tuned in the Kondo regime. The result provides a strong quantitative experimental background for further developments of the many-body physics. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Materials science*

### [Can three pigeons be in two pigeonholes with no two pigeons in the same hole?](#)

[Science Daily, 20JAN2016](#)

An international team of researchers (Israel, USA - Chapman University, Italy, UK) demonstrates how to put an arbitrarily large number of particles in two boxes without any two particles ending up in the same box. This discovery points to a very interesting structure of quantum mechanics that was hitherto unnoticed. This now requires us to revisit some of the most basic notions of nature. The paper also introduces a host of additional new findings that the researchers discovered concerning related quantum effects. It also calls into question some of the most fundamental notions including that of separability and correlations. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

## SENSORS

### [Flexible and transparent pressure sensor](#)

[Nanowerk, 25JAN2016](#)

An international team of researchers (Japan, USA - Harvard University) has developed a nanofiber-type pressure sensor consisting of organic transistors, electronic switches made from carbon and oxygen based organic materials, and a pressure sensitive nanofiber structure. The device can measure pressure distribution of rounded surfaces such as an inflated balloon and maintain its sensing accuracy even when bent over a radius of 80 micrometers. The sensor is roughly 8 micrometers thick and can measure the pressure in 144 locations at once. [TECHNICAL ARTICLE](#)

*Tags: Sensors, Advanced materials*

### [Hand-held Raman device detects nerve gases](#)

[Nanotechweb, 22JAN2016](#)

Until now, nerve gases could only be detected at high concentrations using Raman scattering. But now an international team of researchers (Sweden, Denmark) has used SERS to detect VX and Tabun down to femtomol levels

for the first time. Liquid droplets stick firmly to the substrates. So, if a water droplet containing nerve gas agents reaches the substrate surface, it will stick there. When it dries out, all the molecules within it will be delivered to the Raman instrument that contains both a laser source, a spectrometer and analysis software.

#### TECHNICAL ARTICLE

*Tags: Sensors* ■

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