



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Researchers demonstrate new type of laser](#)

[Physorg.com, 03MAR2017](#)

Researchers in the Netherlands coupled a single Josephson junction to a superconducting micro-cavity and cooled the device down to ultra-low temperatures (<1 Kelvin). When a small DC voltage was applied to the Josephson junction, the device emitted a coherent beam of microwave photons. As the on-chip laser is made entirely from superconductors, it is stable and energy efficient using less than a picoWatt of power to run. Such a device opens the door to many applications in which microwave radiation with minimal dissipation is the key, for example in controlling qubits in a scalable quantum computer. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Foreign S&T, Featured Article*

### [Sudoku Hints at New Encoding Strategy for DNA Data Storage](#)

[IEEE Spectrum, 02MAR2017](#)



Photo: iStockphoto

DNA has the potential for large-capacity information storage. However, current methods have only been able to use a fraction of the theoretical maximum. Researchers at Columbia University present the DNA Fountain, which approaches

the theoretical maximum for information stored per nucleotide. They demonstrated efficient encoding of information—including a full computer operating system—into DNA that could be retrieved at scale after multiple rounds of a polymerase chain reaction. They achieved a 60% increase in storage capacity over previously reported efforts, resulting in storage density of 215 petabytes per gram of DNA. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Information technology, Biotechnology, Featured article*

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [New research could trigger revolution in computer electronics manufacturing](#)

[Science Daily, 02MAR2017](#)

An international team of researchers (UK, Russia, Ireland, France) proposed a novel approach for wafer-scale integration of 2D materials on CMOS photonic chip using synthetic chemistry and microfluidics technology. They demonstrated that the design of an optofluidic waveguide system can be optimised to enable simultaneous in-situ Raman spectroscopy monitoring of 2D dispersed flakes during the operation. They analysed their methodology to confirm the technique is successful and provided a blueprint for others to use to help manufacture the chips. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced manufacturing, Microelectronics*

### ADVANCED MATERIALS

#### [Czech scientists develop magnetic carbon](#)

[Physorg.com, 06MAR2017](#)

An international team of researchers (Czech Republic, Greece) describes a series of room temperature organic magnets prepared by a simple and controllable route based on the substitution of fluorine atoms in fluorographene with hydroxyl groups. Depending on the chemical composition, the new graphene derivatives show room temperature antiferromagnetic ordering. Such 2D magnets undergo a transition to a ferromagnetic state at low temperatures showing an extraordinarily high magnetic moment. Magnetic graphene-based materials have applications in spintronics, electronics, targeted drug delivery and separating molecules using external magnetic fields. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

#### [Most complex nanoparticle crystal ever made by design](#)

[Science Daily, 03MAR2017](#)

An international team of researchers (USA - Northwestern University, University of Michigan, Germany) assembled DNA-modified triangular

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bipyramids into clathrate architectures. Clathrates contain extended pore structures that can trap other molecules. The images revealed that at least three different structures form as large single-domain architectures or as multi-domain materials. These structures are the most sophisticated architectures made via programmable assembly. Potential applications of the cage-like structures include controlling light, capturing pollutants and delivering therapeutics. New types of lenses, lasers and cloaking materials are possible. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### [New graphene-like material could have a band gap](#)

[Nanotechweb](#), 03MAR2017

An international team of researchers (USA - University of Nebraska, State University of New York at Buffalo, Boston College, Tufts University, Poland, Germany) made hexagonal boron-carbon-nitrogen (h-BCN) by heating an organic molecule containing boron, nitrogen and carbon on an iridium substrate. h-BCN has a direct electronic band gap of a size that falls between that of gapless graphene and hexagonal boron nitride which could make the material better suited than graphene for electronics applications. The research could be the starting point for a new generation of electronic transistors, circuits and sensors that are much smaller and more bendable than the electronic elements used to date. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### [Bioinspired process makes materials light, robust, programmable at nano- to macro-scale](#)

[Science Daily](#), 02MAR2017

Structural proteins are nature's building blocks. When scientists try to emulate this structure, control at one scale hinders control at other scales. Researchers at Tufts University combined bottom-up self-assembly characteristic of natural materials with directed, top-down assembly to simultaneously control geometry at all scales, micro-mechanical constraints and solvent-removal dynamics. They demonstrated their technique using aqueous fibroin protein gel derived from silkworm cocoons. The material's final shape and mechanical properties were precisely engineered by controlling the micro-scale mold pattern, gel contraction, mold deformation and silk dehydration. They believe this approach is applicable to other biomaterials, composites and synthetic hydrogels. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Biomimetics*

### [Water-Repellent Nanotextures Found to Have Excellent Anti-Fogging Abilities](#)

[Brookhaven National Laboratory](#), 02MAR2017

An international team of researchers (France, USA - Brookhaven National Laboratory) investigated the underlying antifogging mechanism in model materials designed to mimic natural systems, and explained the importance of the texture's feature size and shape. While exposure to fog strongly compromises water-repellency of hydrophobic structures, this failure can be minimized by scaling the texture down to nanosize. It becomes non-measurable if the hydrophobic surface consists of nanocones, which generate antifogging efficiency close to unity. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Government S&T*

### [Nano 'sandwich' offers unique properties](#)

[Physorg.com](#), 27FEB2017

Researchers at Rice University explored the diverse electronic and optical properties of mono- and double-layer graphene encapsulating various MgO clusters. By correlating the stability of adsorption, geometry, charge transfer, band structures, optical absorption spectrum, and the van der Waals pressure, they decoded various synergies in electro- and opto-mutable properties of MgO/graphene systems. They found that 2D-MgO flakes on graphene layers exhibit surface polarization effects—in contrast to their isolated neutral flakes—and show a significant charge transfer from graphene to n-doped flakes, breaking the symmetry of graphene layers. The findings have applications in optoelectronics. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## BIG DATA

### [The Department of Defense Wants to Double Down on Renewables](#)

[MIT Technology Review](#), 02MAR2017

Researchers at MIT have developed a system called the Synthetic Data Vault (SDV) that builds machine learning models out of real databases to create artificial, or synthetic, data. Recursive conditional parameter aggregation exploits the hierarchical organization of data common to all databases. After the algorithm has modeled and assembled parameters for each customer, it can then form a multivariate model of the parameters themselves, and recursively model the entire database. Once a model is learned, it can synthesize an entire database, filled with artificial data. Synthetic data will allow data scientists to continue ongoing work without involving real, potentially sensitive data. The model can be easily scaled to create very small or very large synthetic data sets, facilitating rapid development cycles or stress tests for big data systems. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Big data, Information technology*

“The nations may be divided in everything else, but they all share a single body of science.”

ISAAC ASIMOV

## BREAKTHROUGH TECHNOLOGY

### [MIT researchers create new form of matter](#)

MIT News, 02MAR2017

Researchers at MIT have created a new form of matter, a supersolid, which combines the properties of solids with those of superfluids. By using lasers to manipulate Bose-Einstein condensate, the team was able to coax the condensate into a quantum phase of matter that has a rigid structure like a solid and can flow without viscosity like a superfluid. Studies into this apparently contradictory phase of matter could yield deeper insights into superfluids and superconductors, which are important for improvements in technologies such as superconducting magnets and sensors, as well as efficient energy transport. [TECHNICAL ARTICLE](#)

Tags: *Breakthrough technology, Advanced materials*

## COMMUNICATIONS TECHNOLOGY

### [Total global satellite plans could have around 20,000 satellites in low and mid earth orbits in the 2020s](#)

Next Big Future, 04MAR2017

The five companies—SpaceX, OneWeb, Telesat, O3b Networks and Theia Holdings—all told the FCC they have plans to field constellations of V-band satellites in non-geosynchronous orbits to provide communications services in the United States and elsewhere. So far, the V-band spectrum of interest, which sits directly above Ka-band from about 37 GHz to the low 50 GHz range, has not been heavily employed for commercial communications services. Most companies are describing their potential use of V-band satellites as follow-ons to pre-existing plans for constellations in Ku- or Ka-band.

Tags: *Communications technology, Satellite technology*

### [Plasmonic device offers broadband modulation to optical links at 100Gbit/s](#)

Physorg.com, 02MAR2017

An international team of researchers (Switzerland, Germany, USA) has developed broadband plasmonic modulators which feature two sets of gold electrode pairs separated by a narrow slot less than one hundred nanometers wide. The slots are filled with an organic electro-optic material whose light refraction properties change predictably in an applied electric field. The modulated signal arises from the combination of the signals travelling through each of the two electro-optic material paths. As the devices are short, plasmonic losses due to high nonlinearities are low. The paper will be presented at the upcoming conference on Optical Fiber Communications in Los Angeles.

Tags: *Communications technology*

## CYBER SECURITY

### [Amazon's \\$150 Million Typo Is a Lightning Rod for a Big Cloud Problem](#)

MIT Technology Review, 03MAR2017

Amazon is the world's largest cloud computing provider. On Tuesday [2/28/2016], large parts of the Internet simply stopped working. Amazon has admitted that the root cause of the outage was an incorrect command executed by a staff member during routine maintenance that took more servers out than intended—including two that were used to power fundamental processes used across the entire system. Cloud services need extra insurance policies if they're to be robust—sub-systems which work independently should be separated. Even then, centralized Web services may still be vulnerable. Amazon has put safeguards in place.

Tags: *Cyber security*

### [UW security researchers show that Google's AI platform for defeating Internet trolls can be easily deceived](#)

University of Washington, 28FEB2017

Perspective is a project by Google's technology incubator Jigsaw, which uses artificial intelligence to combat internet trolls and promote more civil online discussion by automatically detecting online insults, harassment and abusive speech. Researchers at the University of Washington evaluated Perspective in adversarial settings and found the system to be vulnerable to both missing incendiary language and falsely blocking non-abusive phrases. According to the researchers, machine learning systems are generally designed to yield the best performance in benign settings. But in real-world applications, these systems are susceptible to intelligent subversion or attacks. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Cyber security*

### [Browser Fingerprinting Tech Works Across Different Browsers for the First Time](#)

IEEE Spectrum, 24FEB2017

Browser fingerprinting is an online tracking technique commonly used to authenticate users for retail and banking sites and to identify them for targeted advertising. A team of researchers in the US (Lehigh University, Washington University) has developed a method which allows third parties to reliably track users across browsers by incorporating several new features that reveal information about their devices and operating systems. It accurately identifies 99.24 percent of users across browsers, compared to 90.84 percent of users identified by the most advanced single-browser technique. [Open source code](#) for their technique is available for anyone to use.

Tags: *Cyber security*

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## ENERGY

**Sustainable, high energy density battery created**

Science Daily, 03MAR2017

To access the full capacity of manganese dioxide, researchers at the City College of New York intercalated bismuth oxide cathodes with  $\text{Cu}^{2+}$  that deliver near-full two-electron capacity reversibly for >6,000 cycles. They exploited the redox potentials of Cu to reversibly intercalate into the Bi-birnessite-layered structure during its dissolution and precipitation process for stabilizing and enhancing its charge transfer characteristics. This process has applications in catalysis and intercalation of metal ions into layered structures. The battery is intended for use at the scale of the power grid. This would make widespread use of solar and wind power possible. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

Tags: Energy, Battery

## FEATURED RESOURCE

**Asia Research News**

Research SEA is a one-stop centre where journalists and members of the public can gain access to news and local experts from the research world in Asia. [RSS - Science, Technology](#)

**Unique photo-catalyst material turns  $\text{CO}_2$  emissions into renewable hydrocarbon fuels**

Physorg.com, 03MAR2017

Using artificial photosynthesis, researchers at Texas A&M are working on a project to convert  $\text{CO}_2$  and waste into solar fuels. In this process, the photo-catalyst material has some unique properties and acts as a semiconductor, absorbing sunlight which excites the electrons in the semiconductor and gives them the electric potential to reduce water and  $\text{CO}_2$  into carbon monoxide and hydrogen, which together can be converted to liquid hydrocarbon fuels. The project is still in the fundamental research stage.

Tags: Energy

**New path suggested for nuclear fusion**

Eurekalert, 02MAR2017

An international team of researchers (Chile, USA - University of Illinois at Urbana-Champaign, Rice University) proposes that instead of thermonuclear fusion by compression, it might be possible to nudge atoms close enough to fuse by using shaped laser pulses. Coherent laser control can manipulate nuclear motion precisely, achieving large phase space densities for the colliding nuclei. They combined quantum wavepacket propagation of deuterium and tritium nuclei in a field-bound molecule

with coherent control by a shaped laser pulse to demonstrate enhancement of nuclear collision rates which may assist muonic fusion. [TECHNICAL ARTICLE](#)

Tags: Energy, Nuclear energy

 **Tweaking electrolyte makes better lithium-metal batteries**

Science Daily, 01MAR2017

To address the dendrite problem in lithium batteries and provide super-efficient charging, a team of researchers in the US (Pacific Northwest National Laboratory, Argonne National Laboratory) added small amounts of lithium hexafluorophosphate to a fast-charging electrolyte. They paired the newly juiced-up electrolyte with a lithium anode and a lithium nickel manganese cobalt oxide cathode. It resulted in a fast, efficient, high-voltage battery. The battery performed well largely because the additive helps create a robust protective layer of carbonate polymers on the battery's lithium anode. This thin layer prevents lithium from being used up in unwanted side reactions, which can kill a battery. [TECHNICAL ARTICLE](#)

Tags: Energy, Government S&T

## ENVIRONMENTAL SCIENCE

**Iron dissolved by air pollution may increase ocean potential to trap carbon**

Science Daily, 01MAR2017

An international team of researchers (China, Japan, UK, Saudi Arabia, USA- Georgia Institute of Technology, Greece) collected three types of iron-bearing particles from the Yellow Sea. They showed that iron-rich fly ash particles contained a significant amount of sulphate containing soluble iron. The research shows that the airborne particles became acidic after being transported to the Yellow Sea. Human activities may have led to an increase of atmospherically soluble iron in the oceans by several times which could have a major impact on how effective our oceans are regulating our climate. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

Tags: Environmental science, Climatology

**Climate-friendly aircraft routing could cut environmental damage**

Physics World, 28FEB2017

An international team of researchers (Germany, the Netherlands, UK) modelled routings for 800 daily flights across the Atlantic under five typical winter weather patterns and three typical summer patterns. They combined the EMAC chemistry-climate model with an air-traffic simulator, choosing 85 variations for each flight path – 17 horizontal and five vertical. Then they picked the most “eco-efficient”, which is the path with the best ratio of climate-impact reduction to cost increase. The most climate-friendly path could damage the climate 10% less for an increase in costs of just 1%. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

Tags: Environmental science

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## FORECASTING

**Researchers can predict terrorist behaviors with more than 90 percent accuracy**[Physorg.com, 02MAR2017](#)

Using data on more than 150,000 terrorist attacks between 1970 and 2015, an international team of researchers (Turkey, USA - Binghamton University, Buffalo University) proposes Networked Pattern Recognition (NEPAR) by defining the useful patterns of suicide attacks to analyze the terrorist activity patterns and relations, to understand behaviors and their future moves. The structure of the relations is analyzed to infer knowledge about terrorist attacks. An Evolutionary Simulating Annealing Lasso Logistic Regression (ESALLOR) model is proposed to select key features for similarity function. A new weighted heterogeneous similarity function is proposed to estimate the relationships among attacks.

**TECHNICAL ARTICLE***Tags: Forecasting***Understanding and predicting snow behaviour**  
[Science Daily, 01MAR2017](#)

Researchers in Luxembourg are developing a model that calculates the properties and behaviour of snow masses under high and low strain rates based on the structure of microscopic snow particles. The model can directly factor in microstructural information, includes contacts and bonding between the snow grains and explicitly account for the large displacements and rearrangement of the snow grains during deformation. The model could be used to anticipate avalanches, determine the load on buildings caused by snow or calculate the traction of vehicles on snow-covered surfaces by predicting the behaviour of snow.

*Tags: Forecasting, Simulation and modeling*

## FOREIGN S&amp;T

**Russia has drone delivered by rocket launcher for surveillance of targets up to 60 miles away**[Next Big Future, 02MAR2017](#)

A drone enclosed in a projectile of Russia's Smerch multiple launch rocket system will be capable of reconnoitering targets at an altitude of 500 meters for 20 minutes. The aircraft can reconnoiter an area of up to 25 square kilometers. A rocket with a drone can be fired to a maximum distance of 90 km. The drone is designated for prompt target reconnaissance.

*Tags: Foreign S&T, Military technology, S&T Russia***China also working to add hypersonic warheads to shorter range missiles**[Next Big Future, 01MAR2017](#)

A state-owned firm is engaged in the "089 Project" aimed at developing such weapons to be launched atop long-range ballistic missiles to breach the U.S. mainland

missile defense shield. U.S. media reported that China has conducted seven tests of a hypersonic glide missile in recent years, six of which have been successful. While Beijing has acknowledged such testing, it was previously unknown that it is also working on a short-range hypersonic weapons development program for East Asian targets.

*Tags: Foreign S&T, Military technology, S&T China***Home Grown Syrian Soft Kill System Successfully Defeated TOW Missiles**[Defense Update, 01MAR2017](#)

The Syrians claim that the deployment of new countermeasures locally developed by the Syrian Scientific Research Center dramatically reduced the vulnerability of their armor to rebel guided missiles attacks. This article tracks the evolution of such countermeasure systems and outlines the progress, based on combat experience gained by the Syrians.

*Tags: Foreign S&T, Military technology***More technical details about China's Quantum Radar claims and quantum radar lab work**[Next Big Future, 27FEB2017](#)

In September 2016, there were claims from China that they had developed quantum radar. There has been recent articles discussing China's quantum radar. The quantum radar system was developed by the Intelligent Perception Technology Laboratory of the 14th Institute of CETC. Researchers completed experiments on quantum detection and target scattering characterization. In the target detection experiment, conducted in a real atmospheric environment, the detection ability of the system was proven to be over 100 kilometers (62 miles).

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

## MATERIALS SCIENCE

**New thin membranes can self-repair following damage**[Nanowerk, 02MAR2017](#)

2D materials have attracted intense interest for applications in filtration, sensing, nanoelectronics, and biomedical devices. Peptoids self-assemble into 2D crystalline materials with properties that mimic those of cell membranes. An international team of researchers (China, Pacific Northwest Laboratory, University of Washington) demonstrated that the lipid-like design of these membranes could essentially be rewritten by inserting patterns of new distinct functional groups into them with nanometer-scale precision to produce multifunctional 2D materials by design. The ability to self-repair can be exploited to create nm-sized patterns of distinct functional groups within a single coherent membrane. **TECHNICAL ARTICLE**

*Tags: Materials science**continued...*

## [Scientists discover magnetic ‘persuasion’ in neighboring metals](#)

Science Daily, 02MAR2017

An international team of researchers (USA - Argonne National Laboratory, NIST, University of Illinois at Urbana-Champaign, Brookhaven National Laboratory, UK) found that as electrons flowed out of manganite into the neighboring nickelate, it created a magnetization with a twisting pattern as in a helix. The nickelate magnetic susceptibility varies from atom to atom within the material. The different magnetic orientations could be used to encode data in a novel kind of magnetic memory, or to nucleate new kinds of superconducting states that might be useful in a quantum computer. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

## NEUROSCIENCE

### [Brain-controlled robots](#)

MIT News, 06MAR2017

For robots to do what we want, they should learn the intricacies of human language. A team of researchers in the US (Boston University, MIT) is creating a feedback system that lets people correct robot mistakes instantly with nothing more than their brains. Using data from an EEG monitor that records brain activity, the system can detect if a person notices an error as a robot performs an object-sorting task. The team’s novel machine-learning algorithms enable the system to classify brain waves in the space of 10 to 30 milliseconds. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Neuroscience, Autonomous systems & robotics*

## PHOTONICS

### [Optical generation of ultrasound via photoacoustic effect](#)

Nanowerk, 02MAR2017

The photoacoustic effect occurs when a short pulse or modulated source of light is absorbed by a material, producing a sound wave. The initial shape of the sound that is generated is determined by where the light is absorbed. Researchers in the UK developed an algorithm that allows users to input a desired sound field in 3-D, and it outputs a 3-D printable surface profile that generates this field making it quick and easy to design surfaces or ‘lenses’ for a desired application. The research has applications in acoustic tweezers and drug delivery. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Photonics, S&T UK ■*

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