



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Robert W. Taylor, whose early vision helped create the Internet, dies at 85](#)

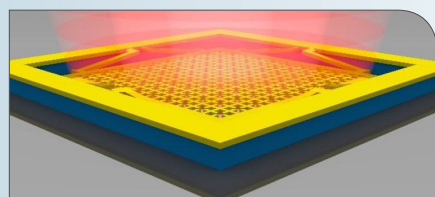
[Washington Post, 15APR2017](#)

In 1968, Mr. Taylor and J.C.R. Licklider co-wrote a paper, *The Computer as a Communication Device*, that proposed the revolutionary notion that ordinary people would someday communicate directly through their computers. "In a few years, men will be able to communicate more effectively through a machine than face to face," it predicted. By 1969, researchers under Mr. Taylor's guidance had developed ARPAnet, a system recognized as a forerunner of the modern Internet. From his early days as a research manager at NASA, he had an intuitive sense that computers could be used as communications devices, not merely as high-powered adding machines.

*Tags: Science without borders, Communications technology, Featured Article*

### [New infrared-emitting device could allow energy harvesting from waste heat](#)

[Science Daily, 13APR2017](#)



*This illustration shows the room temperature MEMS metamaterial, which can achieve reconfigurable infrared intensities equivalent to a temperature change of nearly 20 degrees Celsius. Credit: Xinyu Liu, Duke University*

Researchers at Duke University used metamaterial engineered to absorb and emit infrared wavelengths with very high efficiency to develop an infrared-emitting device consisting of an

$8 \times 8$  array of individually controllable pixels. It achieved a range of infrared intensities and wavelengths, displays patterns at speeds of up to 110 kHz and operates at room temperature. The technology can improve thermophotovoltaics, achieve dynamic infrared optical cloak or a negative refractive index in the infrared and create dynamic infrared patterns for friend or foe identification during combat. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Energy, Solar energy, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [New method for 3-D printing extraterrestrial materials](#)

[Science Daily, 12APR2017](#)

Researchers at Northwestern University have demonstrated the ability to 3D-print structures with lunar and martian dust simulants, which have similar compositions, particle shapes and sizes to the dusts found on lunar and martian surfaces. Despite being made of rigid micro-rocks, the resulting 3D-printed material is flexible, elastic, and tough like rubber. The material can be cut, rolled, folded, and otherwise shaped after being 3D printed. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced manufacturing*

### ADVANCED MATERIALS

#### [‘Twist and shine’: Development of a new photoluminescent sensor material](#)

[Physorg.com, 17APR2017](#)

Light-based sensing molecules, called photoluminescent mechanophores, currently available are for single-use only. Researchers in Japan designed a phosphorescent copper complex and incorporated the molecule into polyurethane. Stretching the material with increasing force causes brighter glow under UV light. When the mechanical traction stops, the polymer material and the mechanophore reverse to their initial position, decreasing the light readout. The sensor has applications in mapping stress distribution patterns and tracking dynamic phenomena in polyurethanes. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science, S&T Japan*

#### [Magnets built atom-by-atom in first effort of its kind](#)

[Nanowerk, 14APR2017](#)

Based on an extensive electronic structure library of Heusler alloys containing 236,115 prototypical compounds, an international team of researchers (Ireland, USA - Duke University) filtered those displaying magnetic order and established whether they can be

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fabricated at thermodynamic equilibrium. Among the possible 36,540 prototypes, 248 were thermodynamically stable but only 20 were magnetic. They synthesized a few of the predicted compounds and produced two new magnets:  $\text{Co}_2\text{MnTi}$ , which displays remarkably high TC in perfect agreement with the predictions, and  $\text{Mn}_2\text{PtPd}$ , which is an antiferromagnet. The work paves the way for large-scale design of novel magnetic materials at potentially high speed. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### **A novel semiconductor nanofiber with superb charge conductivity**

**Nanowerk, 13APR2017**

Using electrospinning, researchers in Hong Kong inserted highly conductive carbon nanotubes into semiconductor nanofiber Titanium Dioxide. The novel nanocomposite provides a dedicated super-highway for electron transport, eliminating the problem of electron-hole recombination. They have demonstrated that the nanocomposite increases the energy conversion of solar cells by 40-60%. It converts 90% of NO to  $\text{NO}_2$ , a 35% increase compared to composite without graphene. The technology has applications in biological-chemical sensors and lithium batteries.

*Tags: Advanced materials*

### **Discovery of 'helical molecular glue'**

**Physorg.com, 10APR2017**

To bind two polymers coiled in the same direction was previously impossible. Researchers in Japan have found the action of a counterclockwise-helical molecule to glue two structurally-different clockwise-helical molecules together. This finding indicates that a clockwise-helical molecule would also have the action to glue two structurally-different counterclockwise-helical molecules. The increased degree of freedom in polymer combination shown by the research could lead to the development of new polymer materials with different properties. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T Japan*

### **Dual-phase nanostructuring makes high-strength magnesium alloy**

**Nanotechweb, 10APR2017**

Using magnetron sputtering, researchers in China have developed an alloy based on nanocrystalline magnesium cores embedded in magnesium-enriched amorphous glassy shells. It is 10 times stronger than conventional crystalline magnesium alloys and has a super deformation capacity that is twice as high as magnesium-based metallic glasses. It could be used in hard-wearing biodegradable medical implants for extending the life of different microelectromechanical systems in consumer electronics, aerospace and automotive industries. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T China*

### **Ultra-thin multilayer film for next-generation data storage and processing**

**Science Daily, 10APR2017**

In layered systems where skyrmions exist, the Dzyaloshinskii-Moriya interaction (DMI) helps stabilize the skyrmions. However, without an out-of-plane magnetic field present, the stability of the skyrmion is compromised. An international team of researchers (Singapore, USA - Stony Brook University, Brookhaven National Laboratory, Louisiana State University) found that a large DMI could be maintained in multilayer thin films composed of cobalt and palladium which they engineered. The skyrmions persisted even after the removal of an external biasing magnetic field. The findings could be useful for the design of next-generation spintronic devices. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## **AUTONOMOUS SYSTEMS & ROBOTICS**

### **Building a better model of human-automation interaction**

**Science Daily, 15APR2017**

According to researchers at AFRL, current taxonomies used to classify systems or teams of humans and computers include only conscious, deliberation-type thinking and neglect the role of intuitive cognition. They suggest that intuitive cognition should be encouraged whenever automation fosters a quick grasp of the meaningful gist of information based on experience or perceptual cues, without working memory or precise analysis. Humans and machines may need to train together in some fashion so the interaction can be based on learned unconscious pattern recognition which may promote novel human-machine system design in the future.

*Tags: Autonomous systems & robotics, Government S&T*

### **Biased bots: Human prejudices sneak into artificial intelligence systems**

**Physorg.com, 13APR2017**

An international team of researchers (USA - Princeton University, UK) used the Word-Embedding Association Test and developed a Word-Embedding Factual Association Test that went beyond mere word associations to show that AI in many online services and apps may readily mimic the biases encoded in their training datasets. AI learning from existing English language texts will exhibit the same human biases found in those texts. Scrubbing biases out of the datasets used to train AI may come at the cost of losing some useful linguistic and cultural meanings. [Machine Bias](#) helps understand the possible implications. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, Artificial intelligence*



“Science can give mankind a better standard of living, better health and a better mental life, if mankind in turn gives science the sympathy and support so essential to its progress.” VANNEVAR BUSH

## BIOTECHNOLOGY

### Nanotubes that build themselves

EurekaAlert, 13APR2017

An international team of researchers (Sweden, China, Lithuania) used molecular self-recognition to attach molecules with weak hydrogen bonds to form nanotubes. The molecule can construct different shapes, depending on its environment, which can be modified through solvent and a “guest molecule”. The diameter of the nanotubes can be regulated. The research contributes to the future development of transport channels for drugs through the cell membrane. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Biotechnology, Advanced materials*

## COMMUNICATIONS TECHNOLOGY

### Scientists develop a novel algorithm inspired by bee colonies to help dismantling criminal social networks

Physorg.com, 17APR2017

Researchers in Spain propose an artificial bee colony algorithm, which is a swarm intelligence approach inspired in the foraging behaviour of honeybees. In this framework, bees produce new candidate solutions for the problem by exploring the vicinity of previous ones, called food sources. The proposed method exploits useful problem knowledge in this neighbourhood exploration by considering the partial destruction and heuristic reconstruction of selected solutions. The researchers empirically show the performance of the method with respect to other models from literature. [TECHNICAL ARTICLE](#)

Tags: *Communications technology, Biomimetics*

### Method improves semiconductor fiber optics, paves way for developing devices

Science Daily, 13APR2017

Silica fibers can only transmit electronic data converted to light which requires enormous amounts of electricity. Using finite element modeling, a team of researchers in the US (Pennsylvania State University, Argonne National Laboratory) constructed a laser processing diagram that reveals a parameter space within which single crystals can be grown. Utilizing this diagram, they created single-crystal silicon core fibers by laser crystallizing amorphous silicon deposited inside silica capillary fibers. The fibers were up to 5.1 mm long, had a very well-defined core/cladding interface and a chemically pure silicon core that has very low optical losses. [TECHNICAL ARTICLE](#)

Tags: *Communications technology, Advanced materials*

### Software system connects devices for the Internet of Things

Science Daily, 05APR2017

Researchers in Germany are leading an EU sponsored project called ‘VICINITY’ to develop a user-friendly software system that connects devices from different manufacturers. The technology may be used on network devices already available in private households. The user retains control over access and use of the appliances. Data would be encrypted before being transmitted from sender to recipient according to the latest security standards. Researchers will present their work at an upcoming conference.

Tags: *Communications technology, S&T EU*

## COUNTER WMD

### Applications of optical techniques to detect chemical and biological agents

Global Biodefense, 16APR2017

Using the same approach as LIDAR to detect chemical agents, researchers in Italy assessed the potential of optical techniques for standoff detection for biological agents using different fluorescence. The challenges for the future are to optimize the systems by reducing the dimensions and cost, while at the same time improving the performances in terms of reduction of false alarms, an increase of robustness and acquisition speed, and an increase in reliability and determinism.

Tags: *Counter WMD, S&T Italy*

## CYBER SECURITY

### Baking Hack Resistance Directly into Hardware

DARPA News, 10APR2017

DARPA’s new System Security Integrated Through Hardware and Firmware (SSITH) program seeks to address seven classes of hardware vulnerabilities: permissions and privileges, buffer errors, resource management, information leakage, numeric errors, crypto errors, and code injection. The program centers on two technical areas: 1) Development and demonstration of hardware architectures that protect against one or more of the seven vulnerability classes, and 2) Methodologies and metrics for measuring the security status of the newly designed electronic systems. [More information](#)

Tags: *Cyber security, DARPA, S&T Policy*

## ENERGY

**Battery prototype powered by atmospheric nitrogen**

Science Daily, 13APR2017

The “proof-of-concept” design developed by researchers in China works by reversing the chemical reaction that powers existing lithium-nitrogen batteries. Instead of generating energy from the breakdown of lithium nitride into lithium and nitrogen gas, the researchers’ battery prototype runs on atmospheric nitrogen in ambient conditions and reacts with lithium to form lithium nitride. Its energy output is brief but comparable to that of other lithium-metal batteries. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Battery, S&amp;T China

**Researchers capture excess photon energy to produce solar fuels**

Nanowerk, 13APR2017

A team of researchers in the US (National Renewable Energy Laboratory, New Jersey Institute of Technology, Colorado School of Mines, San Diego State University, University of Colorado) generated charge carriers by the Multiple Exciton Generation (MEG) process within quantum dots and captured and stored them within the chemical bonds of a H<sub>2</sub> molecule. Testing the chemical reaction driven by the extra electrons in a lead sulfide (PbS) QD photoelectrochemical cell has demonstrated a new direction in exploring high-efficiency approaches for solar fuels. [TECHNICAL ARTICLE](#)

Tags: Energy, Photonics, Solar energy

## FEATURED RESOURCE

**Breaking Science News**

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## ENVIRONMENTAL SCIENCE

**Next 10 years critical for achieving climate change goals**

Science Daily, 13APR2017

An international team of researchers (Austria, France, Belgium, Spain, the Netherlands) reports that it will be necessary to both reduce greenhouse gas emissions while preserving carbon sinks, with net emissions peaking in the next 10 years, to have a good chance of meeting the limits set by the Paris Agreement. The study compares four different scenarios for future energy development, with a range of mixtures of renewable and fossil energy

and the overall amount of energy consumed including ranges for high energy consumption and low energy consumption. It is based on the FeliX model, a system dynamics model of social, economic, and environmental earth systems and their interdependencies. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Environmental science, Climatology

## FOREIGN S&amp;T

**Russia hypersonic Zircon missile reaches 6200 mph**

Next Big Future, 16APR2017

According to Russian sources, Russia’s new hypersonic anti-ship Zircon missile has reached eight times the speed of sound (about 6100 mph) during tests. It can be launched from universal launching platforms 3C14 which are also used for the Onyx and Caliber missiles. It is expected that the new missiles will be installed at the heavy nuclear-powered cruisers Peter the Great and Admiral Nakhimov. The US has had several hypersonic missile and vehicle tests. The main US systems were the X-51 and the HTV-2.

Tags: Foreign S&amp;T, Military technology, S&amp;T Russia

**China reveals hypersonic scramjet developments and plans**

Next Big Future, 14APR2017

China will test a prototype combined-cycle hypersonic engine later this year that they hope will pave the way for the first demonstration flight of a full-scale propulsion system by 2025. If successful, the engine could be the first of its type in the world to power a hypersonic vehicle or the first stage of a two-stage-to-orbit spaceplane. Combined-cycle systems have long been studied as a potential means to access to space and long-range hypersonic vehicles. They claim that China will master the spaceplane’s technologies in the next three to five years, and a full-scale spaceplane would then enter service by 2030.

Tags: Foreign S&amp;T, Military technology, S&amp;T China

## IMAGING TECHNOLOGY

**SAVI camera ditches long lens for distant images**

Physorg.com, 14APR2017

Extending synthetic aperture techniques to the visible light domain is not straightforward because optical receivers cannot measure phase information. A team of researchers in the US (Rice University, Northwestern University, Columbia University) used macroscopic Fourier Ptychography as a practical means of creating a synthetic aperture for visible imaging to achieve subdiffraction-limited resolution. They demonstrated the first working prototype that is capable of imaging optically rough objects. They introduced image space denoising regularization to reduce the effects of speckle and improve perceptual quality of the image. Their technique improved the resolution of various diffuse objects six fold. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Imaging technology

continued...



## MATERIALS SCIENCE

**Researchers discover a surprising property of glass surfaces**[Physorg.com, 10APR2017](#)

Using a virus as a needle, researchers at the University of Pennsylvania developed a technique to investigate how interfaces affect the properties of glasses. They found the surface molecules slowly trying to form a meniscus around the virus. While the molecules in the center of the material may take millions of years to move, for the molecules at the top it would be more like a few hundred seconds. The technique is very efficient and mathematically simple and can be easily extended to other systems. Their findings could pave the way for developing better glass materials. [TECHNICAL ARTICLE 1, 2, 3](#)

*Tags: Materials science*

## MICROELECTRONICS

**Engineers invent method to control light propagation in waveguides**[Physorg.com, 17APR2017](#)

A team of researchers in the US (Columbia University, UT Brownsville, Harvard University, MIT, Brookhaven National Laboratory) found that the most efficient way to control light in waveguides is to “decorate” the waveguides with optical nano-antennas which pull light from inside the waveguide core, modify the light’s properties, and release it back into the waveguides. They created waveguide mode converters which make it possible for the same color of light in several different waveguide modes to transport several independent channels of information simultaneously, all through the same waveguide. The findings could lead to faster, more powerful, and more efficient optical chips. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, Communications technology, Government S&T*

## PHOTONICS

**Bistatic laser monitor sees through fire**[Science Daily, 13APR2017](#)

Researchers in Russia have developed a two-laser monitor in which the first one highlights an object or process under study, while the other filters illuminate and enhance the resulting image. The monitor allows the observer to move dozens of meters away from an object and visualize complex processes. It provides for more contrast and enhances the system’s vision. The new technique makes it possible to obtain better images and even to observe X-ray processes from a safe distance.

*Tags: Photonics, S&T Russia*

## QUANTUM SCIENCE

**Ten superconducting qubits entangled by physicists in China**[Physics World, 13APR2017](#)

An international team of researchers (China, USA) entangled 10 qubits [one more than the UC Santa Barbara, Google team] connecting to a bus resonator in a superconducting circuit. The resonator-mediated qubit-qubit interactions are used to control the entanglement of multiple qubits and to operate on the different pairs of qubits in parallel. The research contributes towards large-scale quantum computation. [TECHNICAL ARTICLE](#)

*Tags: Quantum science***Recent advances and new insights into quantum image processing**[Science Daily, 11APR2017](#)

An international team of researchers (China, Saudi Arabia, Japan) presents an overview of the advances made in quantum image processing (QIP) including image representations, operations realizable on them and the likely protocols and algorithms for their applications. They focus on recent progresses on QIP-based security technologies including quantum watermarking, quantum image encryption and quantum image steganography. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Imaging technology*

## S&amp;T POLICY

**Research integrity revisited**[Science Magazine, 14APR2017](#)

The U.S. public and private sectors invest billions of dollars and countless hours of highly skilled labor into scientific research every year. Regrettably, there have been some well-publicized breakdowns in scientific integrity and reported cases of irreproducible research. A new report [OPEN ACCESS Fostering Integrity in Research](#) from the U.S. National Academies of Sciences, Engineering, and Medicine (NASEM) recommends specific steps to secure a future based on integrity and reliability. These include establishing a new Research Integrity Advisory Board (RIAB) and taking stronger actions to discourage and eliminate practices that are clearly detrimental to research.

*Tags: S&T policy***Policymakers ‘flying blind’ into the future of work**[Physorg.com, 13APR2017](#)

A National Academy [OPEN ACCESS report Information Technology and the U.S. Workforce](#), authored by a team of researchers in the US (Carnegie Mellon University, MIT) explores the interactions between technological, economic, and societal trends and identifies possible near-term

developments for work. The report emphasizes the need to understand and track these trends and develop strategies to inform, prepare for, and respond to changes in the labor market. It offers evaluations of what is known, notes open questions to be addressed and identifies promising research pathways moving forward.

*Tags: S&T policy, Artificial intelligence, Autonomous systems & robotics*

### **U.S. companies performed 18% of R&D outside the United States in 2013**

**NSF News, 12APR2017**

U.S. companies spent \$73 billion on R&D performed outside the United States and \$323 billion within the United States in 2013, according to a new [OPEN ACCESS](#) report by NSF's National Center for Science and Engineering Statistics. Almost 50 percent of the foreign R&D performance by U.S. companies was in Europe, largely in the United Kingdom and Germany. The Asia-Pacific region accounted for 31 percent of foreign R&D. Software publishing, pharmaceuticals and medicines, semiconductor and other electronic components and automobiles accounted for 52% of foreign R&D.

*Tags: S&T policy*

## **SCIENCE WITHOUT BORDERS**

### **Explained: Neural networks**

**MIT News, 14APR2017**

Deep learning is in fact a new name for neural networks, which has been going in and out of fashion for more than 70 years. Neural networks were first proposed in 1944 by two University of Chicago researchers. The networks' opacity is still unsettling to theorists, but there's headway on that front, too. There are still plenty of theoretical questions to be answered, but researchers' work could help ensure that neural networks finally break the generational cycle that has brought them in and out of favor for seven decades.

*Tags: Science without borders, Artificial intelligence*

## **SENSORS**

### **High-flying experiments demonstrate potential of balloon-borne infrasound detection**

**Science Daily, 13APR2017**

In ground sensors, detecting nuclear explosions, meteorite strikes, volcanic eruptions and sometimes earthquake ruptures, very small infrasound signals can be swamped by wind and other ambient noises. A team of researchers in the US (a non-profit organization, Sandia National Laboratory) tethered the sensors to high-altitude balloons flying at an altitude of 35 kilometers above three man-made ground explosions. The sensors could detect all three explosions at that height, and at a lateral distance of about 350 to 400 kilometers away from the explosions. The sensors are sensitive to objects about the size of bowling balls coming in and exploding in Earth's atmosphere.

*Tags: Sensors ■*

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