



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Bioinspired memristor chips that see patterns over pixels](#)

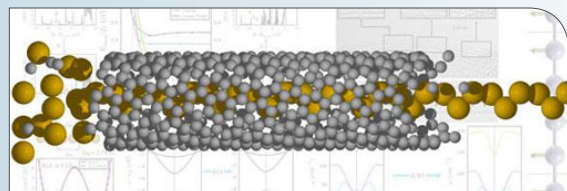
[Nanowerk, 22MAY2017](#)

Inspired by how mammals see, researchers at the University of Michigan have developed a new memristor computer circuit prototype which uses an algorithm based on sparse coding to recognise patterns. They trained the system to learn a “dictionary” of grayscale image patterns. The memristor network was able to reconstruct images of famous paintings and photos and other test patterns. If their system can be scaled up, they expect to be able to process and analyze video in real time in a compact system that can be directly integrated with sensors or cameras. **TECHNICAL ARTICLE**

*Tags: Imaging technology, Pattern recognition, Featured Article*

### [Scientists construct a stable one-dimensional metallic material](#)

[Nanowerk, 19MAY2017](#)



*Artistic representation of one of the encapsulated tellurium nanowire types predicted by researchers.  
(Image: Paulo Medeiros)*

An international team of researchers (UK, Ukraine) has produced stable one-dimensional wires from a single string of tellurium atoms inside CNTs. They have demonstrated that it is possible to alter the shape and electronic behaviour of the nanowires by varying the diameters of the tubes in which they are encapsulated. When working with materials at very small scales, the material of interest typically needs to be deposited onto a surface that is normally very reactive. The new technique solves this problem as carbon nanotubes are chemically quite inert. **TECHNICAL ARTICLE**

*Tags: Advanced materials, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [Precisely controlling the movement of levitating objects for many manufacturing applications](#)

[Physorg.com, 19MAY2017](#)

An international team of researchers (Singapore, USA - MIT) built a Maglev system by positioning four sets of permanent magnets arranged in Halbach arrays, which produces a strong magnetic field on one side but not the other, above several energized coils of wire. By carefully controlling the electrical current in different coils, they were able to move or rotate the square platform at several different speeds. The contactless nature of Maglev ensures that no contaminating particles are generated from friction between surfaces. The technique has applications in medicine and electronics. **TECHNICAL ARTICLE**

*Tags: Advanced manufacturing*

### ADVANCED MATERIALS

#### [Two simple building blocks produce complex 3-D material](#)

[Physorg.com, 22MAY2017](#)

An international team of researchers (USA - Northwestern University, Colorado School of Mines, Pacific Northwest National Laboratory, University of Washington, Arizona State University, Saudi Arabia) directed uranium atoms and organic linkers to self-assemble into a large, airy 3-D net of very roomy pores in which they nestled a large enzyme. The new set of design rules for bottom-up construction helps synthesize various novel materials with pre-designed and predictable complex structures. It highlights the potential of actinides, such as uranium, in materials synthesis. **TECHNICAL ARTICLE**

*Tags: Advanced materials, Materials science*

*continued...*

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## **Plasmon-powered upconversion nanocrystals for enhanced bioimaging and polarized emission**

Nanowerk, 19MAY2017

Although Lanthanide-doped upconversion nanocrystals (UCNCs) have excellent photostability and tunable spectral characteristics, their low quantum efficiency (typically less than 1%) limits potential applications in near-infrared bioimaging and nonlinear optoelectronic devices. An international team of researchers (China, Czech Republic) has successfully synthesized hybrid plasmonic upconversion nanostructures consisting of sub-10 nm  $\text{CaF}_2\text{:Yb}^{3+}, \text{Er}^{3+}$  UCNCs attached on silica-coated gold nanorods in a core-shell-satellite geometry and achieved a maximum luminescence enhancement factor of  $\sim 7$ -fold for the red emission band and  $\sim 3$ -fold for the green emission band. The finding opens the way to the accurate control of the UC emission anisotropy for various applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, Photonics

## **Shapeshifting materials: Using light to rearrange macroscopic structures**

Physorg.com, 15MAY2017

Ground state is preferred for self-assembling structures. However, in ground state the structure would be at its highest stability hence difficult to breakdown to alter the shape. An international team of researchers (Japan, China) inserted a weakness into their ground-state self-assembled structures, resulting in structures requiring only a small nudge from ultraviolet light to snip a specific bond between two atoms within the molecule, splitting the structure into smaller fragments. The fragments are then able to co-assemble into metastable but novel and exotic shapes. The technique holds great potential for biological applications in pharmaceutical design. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Biotechnology, Materials science

## **Stretching the limits of elastic conductors**

Physorg.com, 15MAY2017

A team of researchers in Japan mixed micrometer-sized silver flakes, fluorine rubber, fluorine surfactant and an organic solvent to dissolve the fluorine rubber. When stretched by 200 percent, conductivity measured 1,070 S/cm, when stretched by 400 percent, it retained high conductivity of 935 S/cm. The high performance of the conductor was due to the self-formation of silver nanoparticles after the conductive composite paste was printed and heated. The new material, produced in paste-like ink form, can be printed in various patterns on textiles and rubber surfaces as stretchable wiring for wearable devices incorporating sensors, as well as give human skin-like functions to robot exteriors. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Flexible electronics, S&T Japan

## **BIOTECHNOLOGY**

### **Researchers design moisture-responsive workout suit (w/video)**

MIT News, 18MAY2017

An international team of researchers (USA- MIT, Singapore) demonstrated that the hygroscopic and biofluorescent behaviors of living cells can be engineered to design biohybrid wearables. By depositing genetically tractable microbes on a humidity-inert material to form a heterogeneous multilayered structure, they obtained biohybrid films that can reversibly change shape and biofluorescence intensity within a few seconds in response to environmental humidity gradients. They have also fashioned a running shoe with an inner layer of similar cell-lined flaps to air out and wick away moisture. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Biotechnology

### **Microrobots inspired by nature**

Physorg.com, 16MAY2017

Researchers in South Korea built microrobots from a glass substrate using a 3-D laser lithography system, and later partially coated it with nickel and titanium deposits. It is 220  $\mu\text{m}$  long and 60  $\mu\text{m}$  high and mimics the ciliary movement of Paramecium using eight 75  $\mu\text{m}$ -long cilia on each side of its body. They were remotely triggered to move and orientate with magnetic fields from eight electromagnetic coils. They were tested in a purified water and silicon oil mixture, and demonstrated average speeds of 340  $\mu\text{m/s}$ . The microrobots have applications in healthcare for drug delivery.

Tags: Biotechnology, Biomimetics, Medical technology

## **COMMUNICATIONS TECHNOLOGY**

### **Advances in nanotechnology will give next-generation paper a whole new lease of digital life**

Nanowerk, 19MAY2017

Researchers in the UK are developing a new form of paper with hyperlinks to the web. Readers will be able to obtain related information on nearby digital devices, just by turning a page or touching the surface of paper documents, photographs, posters or books. This could lead to documents "interacting" with their readers as they impart information. The project envisions full document recognition and even instrumentation of the paper itself with electronic sensors and chips. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Communications technology

### **Ultralow power all-optical switch**

ArXiv, 11MAY2017

Optical logic requires two-mode non-linearities. An international team of researchers (France, Brazil, Denmark) has implemented an all-optical logical component



“Everything is theoretically impossible, until it is done.”

ROBERT A. HEINLEIN

taking advantage of the large coupling efficiency and the broadband operation of a photonic wire containing a semiconductor quantum dot. Two-ports operation is a necessary requirement for the implementation of any non-trivial optical data processing. This involves a non-linear interaction between two distinct optical modes. Such a functionality operating at the single photon level can be achieved with a giant cross non-linearity obtained via resonant interactions in an atomic-like system featuring discrete energy levels. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Communications technology*

## ENERGY

**[China extracts gas from largest global carbon energy source Methane Hydrates](#)**

[Next Big Future](#), 22MAY2017

Methane hydrates, also called “flammable ice”, hold vast reserves of natural gas. China has, for the first time, extracted gas from the ice-like methane hydrate from under the South China Sea which is considered key to future global energy supply. Many countries including the US and Japan are working on how to tap those reserves, but mining and extracting are extremely difficult. It is believed that there is as much as 10 times the amount of gas in methane hydrates than in shale for instance.

*Tags: Energy, S&T China, S&T Policy*

**[Advancing next-generation batteries towards 4S: Stable, safe, smart, sustainable](#)**

[Physorg.com](#), 19MAY2017

Researchers in Australia reviewed the development of functional membrane separators in liquid-electrolyte next-generation batteries, based on which they report four important criteria for guiding the advancement of novel battery systems. The covered battery types are Li-S, room-temperature Na-S, Li-organic, organic redox-flow and Li-air batteries. Safe, smart and sustainable separators are then described in sequence following the first criterion of stable cycling. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Energy, Battery*

**[Plasma jet engines that could take you from the ground to space](#)**

[New Scientist](#), 17MAY2017

Researchers in Germany are working to develop a system that can operate above an altitude of 30 kilometres where standard jet engines cannot go. They have tested plasma jet engines that can operate on air at a pressure of one atmosphere. The team used a rapid stream of nanosecond-long electric discharges to fire up the propulsion mixture.

But there are several hurdles to overcome before the technology can propel an actual plane. The biggest limitation, though, is the lack of lightweight batteries. The researchers are hoping for a breakthrough in compact fusion reactors to power their system. Other possible options could be solar panels or beaming power wirelessly to the engines. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Energy, S&T Germany, Space technology*

## ENVIRONMENTAL SCIENCE

**[Extreme weather has greater impact on nature than expected](#)**

[Science Daily](#), 16MAY2017

According to an international team of researchers (Australia, the Netherlands, USA - Woods Hole Oceanographic Institution, France), it is now increasingly clear that the impact of extreme events on animal behaviour, ecology and evolution could well be greater than that of the ‘normal’ periods in between. Most of the evidence suggests that the impact varies depending on the species and the circumstances. They suggest a ‘roadmap’ for further development of this new area of research, aimed at making it easier to compare and synthesize information across fields. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Environmental science, Climatology*

## EXPLOSIVES

**[3D printing of fusing and bomb structure could make bombs times lighter but still as deadly](#)**

[Next Big Future](#), 19MAY2017

According to researchers at AFRL, the Advanced Ordnance Technologies program will make bombs structured to be lighter by using 3D-printed reconstructed loads within the bomb instead of in the casing—plus distributed blast yields. They will also use 3D printing for distributed fusing for more survivable bombs and greater options and control for the explosions. Separating the fuse from the case could make the bomb more flexible when it hits and how it hits.

*Tags: Explosives, Government S&T*

## FORECASTING

**[A new approach to forecasting solar flares](#)**

[Physorg.com](#), 22MAY2017

Using a complex mathematical approach based on the separation of the magnetic field into several components, an international team of researchers (France, USA - NRL, NASA Goddard Space Flight Center, UK, Belgium) successfully obtained a proxy capable of predicting eruptions. The

*continued...*

proxy, which compares two helicities in the potentially eruptive region, remains low in non-eruptive scenarios; whereas in every other case it increases significantly before the eruption. The European Flarecast project, which aims to set up an automatic system for forecasting flares, is analyzing observations of active solar regions to confirm these theoretical findings. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

*Tags: Forecasting*

## IMAGING TECHNOLOGY

### [Focus: Making Shear Waves for Ultrasonic Imaging](#)

[American Physical Society Focus](#), 19MAY2017

Ultrasound imaging could produce far better pictures with shear waves which are difficult to generate. Researchers in South Korea designed and tested a filter that transforms easy-to-generate pressure waves into shear waves more efficiently than previous devices. This filter can be easily fabricated with laser micromachining techniques and may lead to higher-resolution industrial and medical ultrasound imaging. The research could be useful for nondestructive testing of materials. As the shear waves can propagate long distances and adapt to curved surfaces without suffering much distortion, they could be used for monitoring gas pipelines for leaks.

[TECHNICAL ARTICLE](#)

*Tags: Imaging technology*

## FEATURED RESOURCE

### [IOP Asia-Pacific](#)

Research highlights from Korea, India, Pakistan, Thailand, Taiwan, Japan, China, Vietnam, Australia and New Zealand.

## MATERIALS SCIENCE

### [Explosive crystallization produces logarithmic spirals](#)

[Nanotechweb](#), 19MAY2017

Logarithmic spirals are found in nature, in bacterial colonies, sunflowers, cyclones and galaxies. Researchers in Germany have detected two different types of nearly-perfect logarithmic crystallization spirals in a Ge:Mn layer sputtered on a Ge wafer which can be classified as ripples, tangents and spirals on micron length scales. According to the researchers, these deformations point to an explosive crystallisation mechanism. As the annealing technologies are used in the semiconductor industry, they can use this technique to process materials with a variety

of adjustable parameters that can contribute to optimizing different material systems. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

*Tags: Materials science, S&T Germany*

### [Researchers create first significant examples of optical crystallography for nanomaterials](#)

[Physorg.com](#), 18MAY2017

The unique optical properties of nanocrystals result from the type of crystal from which they are composed. An international team of researchers (USA - University of Illinois at Urbana-Champaign, South Korea) has developed an optical crystallographic analysis technique to determine crystal type by identifying the unique ways in which these crystals absorb light. The theoretical and experimental insights gained from their research provide simple and accurate analysis for liquid-dispersed nanomaterials that can improve the precision of nanocrystal engineering and improve our understanding of nanocrystal reactions. The technique is simple, rapid, high-throughput, and potentially more accurate for structural characterization compared with solid phase X-ray techniques. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

*Tags: Materials science*

### [Energy decay in graphene resonators](#)

[Physorg.com](#), 16MAY2017

Energy decay plays a central role in a wide range of phenomena, such as optical emission, nuclear fission, and dissipation in quantum systems. An international team of researchers (Spain, Sweden, Switzerland) found that in nanomechanical systems based on multilayer graphene, the rate of energy decay changes abruptly to a lower value. They explained it by a model where the measured mode hybridizes with other modes of the resonator at high energy. Below a threshold energy, modes are decoupled, resulting in comparatively low decay rates. The findings could open new possibilities to manipulate vibrational states, engineer hybrid states with mechanical modes at completely different frequencies, and study the collective motion of highly tunable systems. [TECHNICAL ARTICLE](#)

*Tags: Materials science, Advanced materials*

### [Precision control of superconductivity in atomic layers using magnetic molecules](#)

[Physorg.com](#), 15MAY2017

Researchers in Japan fabricated an ideal heterostructure consisting of a superconducting atomic layer and a layer of highly ordered organic molecules on top of the atomic layer to show that the metal atoms at the center of the organic molecules retained electron spins which could generate magnetism. They demonstrated that the superconducting transition temperature of the heterostructures can be modified in a controllable manner. The research shows the effectiveness of molecule-induced surface doping and the significance of microscopic understanding of the molecular states in these 2D heterostructures. [TECHNICAL ARTICLE](#)

*Tags: Materials science, S&T Japan*

*continued...*



## MEDICAL SCIENCES

### Luminous bacteria will help to measure radioactivity

Eurekalert, 20MAY2017

Studying the effect of low-dose gamma radiation, researchers in Russia report that it can only be destructive unlike alpha and beta radiation; if the radiation is low intensity, the absorbed dose is not as important as its duration, which is the most significant factor in terms of toxic effect on organisms; at a temperature of +20 °C, it increased the speed of metabolic processes thus making organisms more sensitive to radiation; and it did not cause any genetic changes. The research helps comprehend the nature of low-intensity radiation's biological impact at the cellular level.

Tags: Medical Sciences, Nuclear energy, S&T Russia

## MICROELECTRONICS

### A Circuit That Sees Radiation Strikes Could Keep Errors at Bay

IEEE Spectrum, 16MAY2017

To keep electronics safe from radiation, researchers at the University of Minnesota are building a circuit that could help bring down the rate of logic soft errors, signals temporarily flipped by a radiation strike. The circuit called a back-sampling chain (BSC) is a kind of cross-connected chain of inverters. It allowed them to reconstruct the strike pulse—called a single event transient—resulting from the radiation strike. They show that the BSC can detect orders of magnitude higher number of strikes compared to previous approaches. The BSC could also be integrated into chips destined for complex systems in spacecraft and other things that operate in harsh environments.

Tags: Microelectronics

## PHOTONICS

### Two-resonance tapping cavity optimally traps light

Nanotechweb, 18MAY2017

Thin film photovoltaic technologies are not as good at harvesting light. Researchers in Spain developed a new resonating optical cavity for thin film solar cells that absorbs light at two different “non-harmonic” frequencies. It is formed by combining two optical cavities resonating at different non-harmonic frequencies. The cavity is non-resonant at either one of the two frequencies, but at the same time light propagation within it has a reminiscence of both resonances. The cavity could also be used for other kinds of thin films, and in particular for those made from perovskites. The cavities might be used to improve thin film solar cells. TECHNICAL ARTICLE

Tags: Photonics, Energy

## QUANTUM SCIENCE

### Scientists demonstrate ballistic nanowire connections, a potential key component for quantum computing

Nanowerk, 19MAY2017

Using their recently developed Template-Assisted-Selective-Epitaxy (TASE) technique to build ballistic cross-directional quantum communication links, researchers at IBM (Switzerland) pioneered devices which can coherently link multiple functional nanowires for the reliable transfer of quantum information across nanowire networks. The nanowire acts as a perfect guide for the electrons, such that the full quantum information of the electron (energy, momentum, spin) can be transferred without losses. The research has implications for the development of quantum computing. TECHNICAL ARTICLE

Tags: Quantum science, Materials science, S&T Switzerland

### Using graphene to create quantum bits

Nanotechweb, 19MAY2017

Using superconducting circuits to produce stable qubits precludes compact integration. An international team of researchers (Iran, Switzerland, India) developed a device insulating boron nitride sandwiched between two graphene sheets. Due to this sandwich structure and graphene's unusual properties, the incoming charge is not proportional to the voltage that is generated. This nonlinearity is a necessary step in the process of generating quantum bits. This device could significantly improve the way quantum information is processed, used to create very nonlinear high-frequency circuits, all the way up to the terahertz regime, or for mixers, amplifiers, and ultra-strong coupling between photons. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science

### Scientists Have Set a Limit For Quantum Entanglement - And It's Really Freaking Powerful

Science Alert, 13MAY2017

An international team of researchers (Austria, Australia) mounted a source of entangled photon pairs in a crate. The crate was dropped from a height of 12 meters and spun in a centrifuge accelerated up to 30g. They found that the photons remained firmly entangled through such extreme testing. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science

### Introduction to Topological Quantum Computation

ArXiv, 11MAY2017

In this review article, an international team of researchers (Germany, UK) presents an entry-level introduction to topological quantum computation. They introduce the

concept of anyon models and review the literature on condensed matter systems where anyons can emerge and discuss the general steps for using anyons to encode and process quantum information, as well as discuss various ways topological protection might fail. [OPEN ACCESS](#)

#### TECHNICAL ARTICLE

*Tags: Quantum science, Information technology*

## S&T POLICY

### Taking the guesswork out of designing extremely complex military systems

[DARPA News, 17MAY2017](#)

DARPA's Enabling Quantification of Uncertainty in Physical Systems (EQUIPS) program has recently made a number of seminal advances addressing this problem by developing mathematical tools and methods to tackle the challenges associated with large systems of many variables and account for the uncertainty in every step of the modeling and design process. The program is advancing the field of uncertainty quantification (UQ). With advanced UQ tools, designers can better understand the risks involved in pursuing certain designs.

*Tags: S&T policy, DARPA*

### Quantum Communications Hub

[Physics World, 16MAY2017](#)

The Quantum Communications Hub, part of the UK National Quantum Technologies Programme, is a collaboration of eight universities and numerous commercial and other strategic partners. The strategy of the HUB is to focus on taking proven quantum key distribution technologies and advancing these to commercialisation-ready status. They are developing: short-range, free-space technologies for many-to-one consumer, commercial and defence applications.

*Tags: S&T policy, S&T UK*

## SCIENCE WITHOUT BORDERS

### The future of sensory technology

[MIT News, 22MAY2017](#)

Massive networks of small, inexpensive sensors will enable large-scale global data collection—impacting the distribution of agriculture and water, environmental monitoring, disaster recovery, disease-outbreak detection and intervention, and the operation of cities. To unite experts as they develop a new generation of sensors, and sensing and measurement technologies, MIT is creating a singular hub SENSE.nano. It will support collaboration between people from a range of specialty areas—engineering, business, Earth science, electronics, computation, nanoscience, materials science, neuroscience, chemistry, physics, computer science, biology, and advanced manufacturing.

*Tags: Science without borders, S&T Policy ■*

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