



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [New form of carbon that's hard as a rock, yet elastic, like rubber](#)

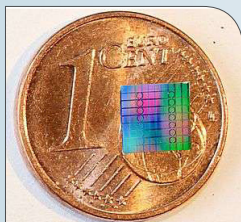
[Nanowerk, 09JUN2017](#)

A team of researchers in the US (Carnegie Institution of Washington, The University of Chicago, Pennsylvania State University) subjected glassy carbon to about 250,000 times normal atmospheric pressure and heated it to approximately 1,800 degrees Fahrenheit to create a new strong and elastic carbon. The newly created carbon is comprised of both graphite-like and diamond-like bonding motifs, which gives rise to the unique combination of properties. Under the high-pressure synthesis conditions, disordered layers within the glassy carbon buckle, merge, and connect in various ways which creates an overall structure that lacks a long-range spatial order, but has a short-range spatial organization on the nanometer scale. The material could serve a wide variety of applications from aerospace engineering to military armor. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Featured Article*

### [Optical communication at record-high speed via soliton frequency combs generated in optical microresonators](#)

[Physorg.com, 08JUN2017](#)



Optical chip carrying a multitude of silicon nitride microresonators. Credit: J. N. Kemal/ P. Marin Palomo/KIT

An international team of researchers (Germany, Switzerland) used silicon nitride microresonators within which solitons circulate continuously, thus generating broadband optical frequency combs. They used two interleaved frequency combs to transmit data on 179 individual optical carriers, which completely cover the optical

telecommunication C and L bands and allow transmission of data at rate of 55 terabits per second over a

distance of 75 kilometers. The comb sources dramatically increase scalability of the respective systems and enable highly parallel coherent data transmission with light. According to the researchers, this is an important step towards highly efficient chip-scale transceivers for future petabit networks. [TECHNICAL ARTICLE](#)

*Tags: Communications Technology, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [Chemists perform surgery on nanoparticles](#)

[Science Daily, 12JUN2017](#)

A team of researchers in the US (Carnegie Mellon University, University of Pittsburgh) performed nano-surgery on a gold nanoparticle made up of 23 gold atoms surrounded by a protective surface of ligands in staple-like motifs. Using a two-step metal exchange method, they removed two S-Au-S staples from the particle's surface revealing the structural factors that determine the particle's optical properties and established the role that the surface plays in photoluminescence. The surgery increased the particle's photoluminescence by about 10-fold. The technique allows researchers to enhance nanoparticles' functional properties. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

#### [Transformer-like carbon nanostructure engineered](#)

[Science Daily, 10JUN2017](#)

Researchers in South Korea have designed and synthesized hybrid carbon nanosheets (CNSs). It hosts clusters of carbon nanorings on the surface of graphene-oxide (GO) nanosheets as the product of the hydrothermal reaction. Under UV and visible-light excitation, the hybrid CNS exhibits tunable emission spanning the wide range of colors in a series of solvents with different polarities. According to the research team, this spectroscopic behavior is found to originate from hydrogen-bonding

*continued...*

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interactions between CNS and solvents. The findings may help improve the physical characteristics of hybrid materials and expand its application fields. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### [A two-dimensional electron microscope inside graphene](#)

[Nanowerk](#), 09JUN2017

An international team of researchers (Denmark, Germany) has proposed to use graphene as a two-dimensional vacuum chamber, and build a two-dimensional electron microscope where the electrons fly from the electron gun to the target without ever leaving the graphene sheet. Simulations showed that the high-performance graphene devices and the existing electron optics components are sufficient to make it work in practice, and the focused electron beam could be used to probe the shape, the electronic properties of edges as well as deposited objects on top of the graphene. It can improve room-temperature ballistic electronics and provide faster switching and more complex functionality. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### [Smart sponge demonstrates tunable surface slipperiness](#)

[Nanotechweb](#), 08JUN2017

Researchers in China covered graphene with smart polymer trans-1,4-polyisoprene (TPI) with graphene. When the TPI-graphene sponge was covered with a lubricant, its shape control was linked to wettability. When the sponge expands, the applied lubricant flows inside the sponge pores, causing the surface to become rough and irregular. But when the sponge contracts, the lubricant is forced out to create a slippery, sleek surface. The sponge could be used in microfluidics, biomedical instruments, fuel storage and enclosure of micro-scale chemical reactions. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T China*

## AUTONOMOUS SYSTEMS & ROBOTICS

### [Autonomous machines edge towards greater independence](#)

[Eurekaalert](#), 08JUN2017

Researchers in Argentina have developed a discrete-time formulation for autonomous smart systems' learning. To increase their autonomy, the researchers have built in delayed dynamics and a feedback loop with the system's performance. The delayed dynamics provides information on the history of the system, thus presenting the past relationships between its structure and performance. They applied their approach to a neural network responsible for classifying several patterns, which yielded 66% robustness. Applications range from nanotechnology to biological systems. [TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics*

### [Engineers design drones that can stay aloft for five days \(w/video\)](#)

[MIT News](#), 06JUN2017

UAVs can only remain in the air for a day or two, as is the case with most autonomous surveillance aircraft operated by the U.S. Air Force. Researchers at MIT have designed, built, and tested a UAV resembling a thin glider with a 24-foot wingspan. The vehicle can carry 10 to 20 pounds of communications equipment while flying at an altitude of 15,000 feet. Weighing in at just under 150 pounds, the vehicle is powered by a 5-horsepower gasoline engine and can keep itself aloft for more than five days. [Jungle Hawk Owl's First Flight](#)

*Tags: Autonomous systems & robotics*

## BIG DATA

### [TOP 10 inside BIGDATA Articles for May 2017](#)

[Inside Big Data](#), 11JUN2017

A monthly heads-up for the top 10 most viewed articles appearing on insideBIGDATA.

*Tags: Big data*

### [Forecasting in the light of Big Data](#)

[ArXiv](#), 31MAY2017

Researchers in Italy assess the role of big data in reshaping the key aspects of forecasting and the claim that bigger data leads to better predictions. Drawing on the representative example of weather forecasts, they argue that this is not generally the case. They conclude by suggesting that a clever and context-dependent compromise between modelling and quantitative analysis stands out as the best forecasting strategy, as anticipated nearly a century ago by Richardson and von Neumann. [TECHNICAL ARTICLE](#)

*Tags: Big data, Forecasting*

## ENERGY

### [Scientists develop divide and conquer approach for more stable power generation](#)

[Physorg.com](#), 07JUN2017

As wind farms are often located in remote locations far from cities, where electricity demand is high, researchers in China use an algorithm to virtually relocate the traditional power generation units to their wind counterparts reducing the need for expensive high-capacity batteries to store reserve power. They divide power generation of conventional units into two components, one estimates future wind states based only on the current states, and the second component provides limitations, based on global information. The overall approach produces power consistent with expected wind behavior, but it can adjust as needed. In tests, the model has proved accurate and effective.

[TECHNICAL ARTICLE](#)

*Tags: Energy, S&T China*

“Those [scientists] who dislike entertaining contradictory thoughts are unlikely to enrich their science with new ideas.” **MAX PLANCK**

## FOREIGN S&T

### [China builds largest floating solar power farm at 40 MW and will complete 150 MW system in September](#)

Next Big Future, 08JUN2017

China has built a 40-megawatt floating solar farm with 166,000 panels on a lake created when a nearby mine collapsed. By the end of September, they will complete more than 150 megawatts of new floating capacity. The project could yield 5 percent to 10 percent more power compared with a conventional solar plant because the panels are expected to be cooled as surface water evaporates.

Tags: Foreign S&T, S&T China, S&T Policy, Solar energy

### [The Pentagon's 2017 Report On Chinese Military Affairs](#)

Federation of American Scientists, 08JUN2017

The Pentagon's latest Annual report to Congress on Chinese military and security developments describes a nuclear force that is similar to previous years but with a couple of important new developments in the pipeline. They are developing a new strategic nuclear bomber to replace the aging (but upgraded) H-6.

Tags: Foreign S&T, S&T China

## INFORMATION TECHNOLOGY

### [Nanophotonic system allows optical 'deep learning'](#)

Nanowerk, 12JUN2017

To improve the speed and efficiency of certain deep learning computations, an international team of researchers (USA - MIT, industry partner, Canada) has developed a device, they call a programmable nanophotonic processor, that uses multiple light beams directed in such a way that their waves interact with each other, producing interference patterns that convey the result of the intended operation. An array of waveguides is interconnected in a way that can be modified as needed. The processor guides light through a series of coupled photonic waveguides. In demonstrations, they were able to achieve a 77 percent accuracy level compared to about 90 percent for conventional systems. According to the researchers, accuracy can be scaled up. [TECHNICAL ARTICLE](#)

Tags: Information technology

### [A general strategy for reprogrammable assembly molecular motors on solid surfaces](#)

Nanowerk, 09JUN2017

Researchers in China have designed a general strategy for the reprogrammable assembly of molecular motors on solid surfaces based on dynamic bonds where molecular motors with disulfide bonds can be remotely, reversibly, and precisely attached to solid surfaces with disulfide bonds, regardless of their chemical composition and micro-structure. It allows encoding of geometric information and enables erasing and re-encoding of geometric information. Thus, solid surfaces can be regarded as “computer hardware”, where molecular motors can be reformatted and reprogrammed as geometric information. [TECHNICAL ARTICLE](#)

Tags: Information technology, S&T China

### [New computing system takes its cues from human brain](#)

Physorg.com, 09JUN2017

A team of researchers in the US (Georgia Institute of Technology, University of Notre Dame) has designed a computing system taking cues from the human brain, where processing is handled collectively, such as a neural oscillatory network, rather than with a central processor. To solve vertex coloring of graphs, they propose a vanadium dioxide oscillator network which harnesses the natural analogue between optimization problems and energy minimization processes in highly parallel, interconnected dynamical systems to approximate optimal coloring of graphs. Their work opens opportunities for building customized analog co-processors for efficiently solving hard problems. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Information technology, Science without borders

### [New ways of representing information could transform digital technology](#)

DARPA News, 02JUN2017

DARPA's Topological Excitations in Electronics program aims to investigate new ways to arrange moments in novel geometries that are much more stable than the conventional parallel arrangement. If successful, these new configurations could enable bits of data to be made radically smaller than possible today, potentially yielding a 100-fold increase in the amount of storage achievable on a chip. It could also enable designs for completely new computer logic concepts and even for topologically protected quantum bits. [BAA](#)

Tags: Information technology, Government S&T

## MATERIALS SCIENCE

**Mind the liquid gap: Liquids are capable of supporting waves with short wavelengths only**

Science Daily, 09JUN2017

To understand how solid-like waves propagate in liquids, an international team of researchers (UK, Russia) performed extensive molecular dynamics simulations and provided direct evidence that liquids develop a gap in a solid-like transverse spectrum in the reciprocal space, with no propagating modes between zero and a threshold value. They showed that the emerging gap increases with the inverse of liquid relaxation time and discuss how the gap affects properties of liquid and supercritical states. The results are important for widening and optimising industrial processes where supercritical fluids are used in cleaning, extracting and environmental applications.

TECHNICAL ARTICLE

Tags: Materials science

## FEATURED RESOURCE

**The Conversation**

The Conversation is an independent source of news and views, sourced from the academic and research community and delivered direct to the public. A team of professional editors work with university, CSIRO and research institute experts. [RSS](#)

**The first nano-sized superelastic alloy**

Nanowerk, 09JUN2017

Researchers in Spain built micropillars and nanopillars of copper-aluminium-nickel alloy with diameters ranging from 2  $\mu\text{m}$  and 260 nm and applied stress to measure their behaviour. They confirmed and quantified that in diameters of less than a micrometre there is a considerable change in the properties relating to the critical stress for superelasticity. They have proposed an atomic model that allows one to understand why and how the atomic structure of these pillars changes when a stress is applied. The research opens new channels in the application of microsystems involving flexible electronics and microsystems that can be implanted into the human body.

TECHNICAL ARTICLE

Tags: Materials science, Biotechnology

**Physicists have finally created a 2D magnet**

Nature News, 07JUN2017

A team of researchers in the US (MIT, University of Washington) grew chromium triiodide crystals and flaked off single- and multi-layer sheets. They found that a single atomic layer of chromium triiodide is magnetic and this property emerged at about  $-228\text{ }^\circ\text{C}$ . They discovered that a two-layered sheet of this material isn't magnetic, but when a third is added the substance becomes a ferromagnet again. The material remains magnetic if a fourth layer is added, but gains other properties the researchers say they're still investigating. The discovery could eventually lead to new data-storage devices and designs for quantum computers. For now, the 2D magnets will enable physicists to perform previously impossible experiments and test fundamental theories of magnetism.

Tags: Materials science

**Electrocatalyst nanostructures key to improved fuel cells, electrolyzers**

Science Daily, 05JUN2017

A team of researchers in the US (Purdue University, Argonne National Laboratory) has identified a structure for an electrocatalyst made of nickel nanoislands deposited on platinum that is both active and stable. They plan to test similar structures with different metals, such as replacing platinum with gold or the nickel with cobalt, as well as modifying pH and voltages. Other, more stable and active combinations may be found using this computational analysis. The findings may lead to a cost-effective design of electrocatalysts with enhanced stability and activity for the next generation energy conversion systems, including fuel cells and electrolyzers. TECHNICAL ARTICLE

Tags: Materials science, Energy

## MICROELECTRONICS

**Breakthrough in CMOS-compatible ferroelectric memory**

Physorg.com, 07JUN2017

Researchers at IMEC have demonstrated a vertically stacked ferroelectric Al doped  $\text{HfO}_2$  device with attractive characteristics for power consumption, switching speed, scalability and retention for NAND applications. It is suitable for both stand-alone and embedded memories at various points in the memory hierarchy, going all the way from non-volatile DRAM to Flash-like memories. It has particularly interesting characteristics for future storage-class memory, which will help overcome the current bottleneck caused by the differences in speed between fast processors and slower mass memory.

Tags: Microelectronics, Advanced materials

## [A Cheaper, Easier Resistance Standard on a Chip](#)

IEEE Spectrum, 06JUN2017

An international team of researchers (USA - NIST, Carnegie Mellon University, Taiwan) deposited graphene film on silicon carbide to produce a quantized ohm-on-a-chip. It promises a practical device for measuring electrical-resistance that is easier and less expensive to make and less demanding to operate than the current generation of standards for fabricating gallium arsenide and aluminum gallium arsenide. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics*

## PHOTONICS

### [Tiny glow sticks](#)

Nanowerk, 08JUN2017

Researchers in China have developed microscale optical waveguides using microrods of lanthanide metal-organic frameworks. Under certain synthetic conditions, benzenetricarboxylic acid (BTC) molecules and lanthanide ions assemble into crystalline microrods. Within the crystal, the BTC molecules function as tiny “light antennas” capturing light and very efficiently pass it on to the lanthanide ions in a radiationless energy-transfer process. The lanthanide ions then emit the energy as luminescence whose color varies depending on the lanthanide used. The spectrum of the emitted light is constant along the length of the rods. This could serve as an effective platform for the development of new systems of color tunable optical waveguides with polarized emissions. [TECHNICAL ARTICLE](#)

Tags: *Photonics, Advanced materials*

## QUANTUM SCIENCE

### [Quantum nanoscope](#)

Nanowerk, 08JUN2017

An international team of researchers (Spain, USA - University of Columbia, Iran, Belgium, Spain, Japan, Italy) excited and imaged the plasmons in ultra-high quality graphene using a special antenna for light that scans over the surface at a distance of a few nanometers. With this near field nanoscope they saw that the plasmons on the graphene moved more than 300 times slower than light, and dramatically different from what is expected from classical physics laws. This technique paves the way for exploring many new types of quantum materials, including superconductors and topological materials. It could be the beginning of a new era of near field nanoscopy. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

## [Magnetocapacitance Turned Upside Down Offers a New Tool in Spintronics](#)

IEEE Spectrum, 07JUN2017

A normal Magnetocapacitance (MC) effect exhibits a higher capacitance when spins in the electrodes are parallel to each other and a lower capacitance when spins are antiparallel. An international team of researchers (Japan, USA - Brown University) reports an inverse tunnel magnetocapacitance (TMC) effect in Fe/AlO<sub>x</sub>/Fe<sub>3</sub>O<sub>4</sub> magnetic tunnel junctions (MTJs) reaching up to 11.4% at room temperature. Their theoretical calculations predict that the inverse TMC effect could potentially reach 150% in MTJs with a positive and negative spin polarization. The findings provide new insights into both static and dynamic spin-dependent transports which open broader opportunities for device applications, such as magnetic logic circuits and multi-valued memory devices. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science, Materials science*

## [Quasiparticles that could lead to faster circuits, higher bandwidths, imaged](#)

Science Daily, 07JUN2017

A team of researchers in the US (Iowa State University, University of Washington, Oak Ridge National Laboratory, University of Tennessee) launched exciton-polaritons by shining a laser on the sharp tip of a nano-imaging system aimed at a thin flake of molybdenum diselenide and measured its propagation length of more than 12 microns at room temperature. The finding is significant for developing future applications for quasiparticles and may be used to build nanophotonic circuits to replace electronic circuits for nanoscale energy or information transfer. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

## S&T POLICY

### [The Early Age of Hypersonic Weapons](#)

Next Big Future, 08JUN2017

The continuing successful tests of Hypersonic missiles and anti-missiles by Russia, China and the United States will see a few dozen mostly short range hypersonic missiles and anti-missiles deployed by 2020. These will mainly be mach 5 to mach 10 missiles with ranges of 250 to 600 miles. Longer ranges and larger numbers of hypersonic missiles will appear throughout the 2022-2030 time frame.

Tags: *S&T policy, Military technology*

## SENSORS

**Developing high-performance broadband graphene-based photodetectors**

Nanowerk, 09JUN2017

An international team of researchers (China, USA - State University of New York, UCLA, UK) has developed a photodetector based on van der Waals heterostructures of graphene and its fluorine-functionalized derivative. It showed photoresponse from the ultraviolet (255 nm) to the mid-infrared (4.3  $\mu\text{m}$ ) wavelengths, with three orders of magnitude enhanced responsivity compared to pristine graphene photodetectors. The proposed scheme paves the way toward implementing high-performance broadband graphene-based photodetectors in surveillance, medical diagnostics, bioimaging, navigational aids and consumer electronics. [TECHNICAL ARTICLE](#)

*Tags: Sensors, Photonics*

**Team improves remote detection of hazardous radioactive substances**

Physorg.com, 09JUN2017

Researchers in South Korea have demonstrated an experimental method for remote detection of radioactive materials by inducing plasma breakdown with high-power pulsed electromagnetic waves. Measurements of the plasma formation time and its dispersion lead to enhanced detection sensitivity compared to the theoretically predicted one based only on the plasma on and off phenomena. They showed that lower power of the incident electromagnetic wave is sufficient for plasma breakdown in atmospheric-pressure air and the elimination of the statistical distribution is possible in the presence of radioactive material. According to the researchers, depending on the equipment used, this method could scale to detect radioactivity at distances of at least tens of kilometers and possibly as far as 100 km.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Sensors*

**Carbon nanotube electronic skins for motion detection**

Nanowerk, 07JUN2017

An international team of researchers (China, Singapore, USA - Duke University) has developed piezoresistive electronic skins (E-skins) based on a composite of polymer and arrays of aligned few-walled carbon nanotubes (AFWCNTs). They demonstrated that it can serve as efficient anisotropic conductive fillers better than randomly dispersed CNTs. E-skin has high fatigue durability, high precision, low power consumption (<10  $\mu\text{W}$ ), and simple fabrication process. The material has applications in future bionic robots and wearable smart detectors. [TECHNICAL ARTICLE](#)

*Tags: Sensors, Advanced materials*

**Nanocup Array Enhances Plasmonic Sensor**

Optics and Photonics, 07JUN2017

A team of researchers in the US (University of Illinois at Urbana-Champaign, Louisiana State University) has developed a new plasmonic refractive-index comprised of an insulating layer of cadmium sulfide sandwiched between two layers of gold that provide strong confinement of the electromagnetic field on the nanoscale. It is punctuated with 500-nm deep nanocups. Light entering the nanocups is amplified in the nanocavity, increasing the transition-signal intensity before it is transmitted out and picked up by the photonic sensor. The sensor requires less instrumentation and has a small footprint, making it potentially more suitable for point-of-care diagnostics and use in low-resource areas. [TECHNICAL ARTICLE](#)

*Tags: Sensors, Biotechnology* ■

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