



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [First underwater carpet cloak realized, with metamaterial](#)

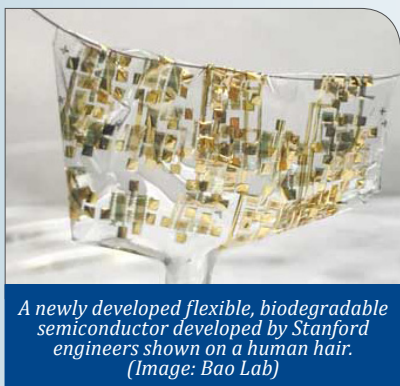
[Nanowerk, 05MAY2017](#)

An acoustic cloak is a material shell that can control the propagation direction of sound waves to make a target undetectable in an acoustic system. The parameters of the cloak shell in the design of new acoustic structures are too complex for practical use. Researchers in China adopted a scaling factor and simplified the structure of the carpet cloak using layers of brass plates featuring small channels filled with water to construct the model cloak. This material possesses effective anisotropic mass density in long-wavelength regimes. In tests, the cloaked object successfully mimicked the reflecting plane and was imperceptible to sound detection. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Sensors, S&T China, Featured Article*

### [Flexible, organic and biodegradable - a new wave of electronics](#)

[Nanowerk, 03MAY2017](#)



A United Nations Environment Program report found that almost 50 million tons of electronic waste were thrown out in 2017--more than 20 percent higher than waste in 2015. A team of researchers in the US (Stanford University, industry partner, UC Santa

Barbara) developed an innovative concept based on imine chemistry that allows totally disintegrable and biocompatible semiconducting polymers. Using an ultrathin biodegradable substrate, they successfully fabricated polymer transistors and logic circuits that show high performance, are ultralightweight, and can be fully disintegrable. Their

## S&T NEWS ARTICLES

work significantly advances organic materials to enable environmentally friendly and biointegrated electronic applications. [TECHNICAL ARTICLE](#)

*Tags: Environmental science, Flexible electronics, Featured Article*

### ADVANCED MANUFACTURING

#### [3-D printers open new design space for wireless devices](#)

[Physorg.com, 04MAY2017](#)

A team of researchers in the US (Duke University, University of Michigan) has demonstrated the expanded degrees-of-freedom made available by 3D metamaterial, by designing, fabricating, and testing a 3D-printed unit cell with a broadband permittivity as high as 14.4. The presented method not only allows reliable and convenient fabrication of microwave metamaterials with high conductivity but also opens the door to exploiting the third dimension of the unit cell design space to achieve enhanced electromagnetic properties. [TECHNICAL ARTICLE](#)

*Tags: Advanced manufacturing*

### ADVANCED MATERIALS

#### [Discovery of new transparent thin film material could improve electronics and solar cells](#)

[Nanowerk, 05MAY2017](#)

An international team of researchers (USA - University of Minnesota, Washington University, Lawrence Berkeley National Laboratory, UC Berkeley, Singapore) developed a new transparent conducting thin film by growing a BaSnO<sub>3</sub> thin film replacing elemental tin source with a chemical precursor of tin. The precursor enhanced the chemical reactivity and greatly improved the metal oxide formation process. With high conductivity and wide bandgap, the new material could lead to smaller, faster, and more powerful electronics, as well as more efficient solar cells. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science, Solar energy*

*continued...*

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## **Physicists demonstrate photonic hypercrystals for control of light-matter interaction**

Science Daily, 05MAY2017

A team of researchers in the US (City University of New York, Purdue University) developed “photonic hypercrystals” (PHCs) that combine the large broadband photonic density of states provided by hyperbolic metamaterials with the light-scattering efficiency of photonic crystals. Quantum dots embedded in the PHCs enhance radiative rate (20×) and light outcoupling (100×). Such designer photonic media with complete control over the optical properties provide a platform for broadband control of light-matter interaction. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Advanced materials, Materials science*

## **Thermodynamic disorder in GaN-based nanowires**

Nanowerk, 03MAY2017

GaN-based p-i-n power devices based on nanowires are suitable for attenuators, high-frequency switches, as well as photodetector applications. Nevertheless, non-radiate recombination affects the performance of devices based on such nanowires. Researchers in Saudi Arabia observed an increasing trend in the amount of photoinduced entropy of the system above 250 K. Since the entropy of a system sets an upper limit on the operational efficiency of a photoluminescent device, the findings have applications in developing and fabricating more efficient devices. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials, Materials science*

## **Water-repellent material sheds like a snake when damaged**

Physorg.com, 03MAY2017

Most of the superhydrophobic surfaces developed so far haven't been strong enough to stand up to damage by sharp objects. To create a new material, researchers in Germany stacked three layers: a water-repellant film made with poly-1H,1H,2H,2H-perfluorodecyl acrylate (PFA) “nanograss” on the top, a water-soluble polymer in the middle and a superhydrophobic silicon nanograss film on the bottom. When they scratched the coating, and submerged the material in water, the top layer then peeled off like molted skin and floated away, exposing the bottom, water-repellent film. Although further work is needed to strengthen the top coating so that a scratch won't be able to penetrate all three layers, the researchers say it offers a new approach to creating self-cleaning and water-repellent materials. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials, S&T Germany*

## AUTONOMOUS SYSTEMS & ROBOTICS

### **BAM! The Behance Artistic Media Dataset for Recognition Beyond Photography**

ArXiv, 27APR2017

To teach machines how to categorize images in ways that are valuable to humans, a team of researchers in the US (Cornell University, industry partner) collected a large-scale dataset of contemporary artwork and annotated the imagery with rich attribute labels for content, emotions, and artistic media. Researchers believe their dataset will be a good starting point for researchers wishing to study artistic imagery and relevant problems.

Tags: *Autonomous systems & robotics, Artificial intelligence*

## COMMUNICATIONS TECHNOLOGY

### **Building an Internet of Things**

American Physical Society Focus, 05MAY2017

In April, the American Physical Society organized a conference on the Actualization of the Internet of Things in Monterey, California. Part of what's driving the IoT is the proliferation of high-quality detectors, such as cameras and chemical sensors. Topics addressed included, the need for new sensors, advanced computing, “brain” to process and interpret the colossal amounts of data that the IoT generates and the need for devices with enough room for self-protection hardware, but at a cost that companies are willing to swallow.

Tags: *Communications technology, Science without borders*

### **Internet of things sensors could connect via ambient radio waves**

Eurekalert, 05MAY2017

Researchers at Disney Research devised an ultra-low-power ultra-wideband ambient backscatter system of sensors that transmits data to a central receiver by reflecting the ambient radio waves from commercial broadcasting systems that already bathe most office environments. Using multiple backscatter channels boosts the signal-to-noise ratio, substantially improves the sensitivity of the backscatter reader and decreases dead zones, substantially extends the range to 22 meters when using ambient signals from broadcast towers and 50 meters when using ambient signals generated by mobile phone up-link traffic. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Communications technology*

### **Combine Next-Generation Radio with Information Technology: What Do You Get?**

DARPA News, 03MAY2017

Software defined radios (SDR) have the electronic guts and, increasingly, the artificial intelligence needed to navigate and even coordinate activity at the interface of the physical and digital domains. To energize a community of SDR users to map out and get comfortable within this fast-evolving

“Many of the problems the world faces today are the eventual result of short-term measures taken last century.” JAY FORRESTER

landscape, and pave the way to a seamless and safe cyber-physical world, DARPA is hosting the DARPA Bay Area Hackfest in November. For those interested in participating in the Hackfest, there will be a [workshop on May 22](#) in San Jose.

*Tags: Communications Technology, DARPA*

## COUNTER WMD

### [DoD Seeks to Enhance Navy's Biological Warfare Agent Identification Systems](#)

[Global Biodefense, 04MAY2017](#)

The Enhanced Maritime Biological Detection (EMBD) program will be an automated sensor to rapidly detect, collect, identify and sample airborne Biological Warfare Agents assessed to pose a threat to the US Navy. It will consist of four Line Replaceable Units that perform Detection, Collection, Identification, and Local user interface. [Solicitation](#)

*Tags: Counter WMD, Bioweapons, Government S&T*

### [Future Defense Scientists Take on Challenge of Synthetic Biology](#)

[Armed with Science, 04MAY2017](#)

The DTRA Syn Bio Academies Challenge kicked off its inaugural year in 2016. The DoD has a broad interest in synthetic biology, and is investigating the field with a view toward both addressing potential security concerns and understanding how this field may be best engaged in the development of improved countermeasures, sensing, and production of specialty materials. It is critical to the development of the next generation of countermeasures to weapons of mass destruction.

*Tags: Counter WMD, Synthetic biology*

### [Forensic Approaches to Detect Possible Agents of Bioterror.](#)

[Pub med, 05APR2017](#)

In this review, a team of researchers in the US (University of Puerto Rico, California Polytechnic State University) examines how molecular tools have been used in combination with forensic research to resolve cases of unusual outbreaks and trace the source of the biocrime. They discuss new technologies and how the new methods in forensic science and health-related surveillance will be invaluable in determining the source of any new disease outbreak, and the data will allow for a quick response to any type of public health threat, whether accidental or purposely initiated.

*Tags: Counter WMD, S&T Policy*

## ENERGY

### [Using sulfur to store solar energy](#)

[Physorg.com, 05MAY2017](#)

Working under the PEGASUS project funded by the EU, researchers in Germany are developing a solar absorber combined with a thermochemical solar power storage system based on elementary sulfur and sulfuric acid. The focused sunlight of the solar power plant supplies the process with the energy and temperature required to close the sulfur cycle and to convert sulfuric acid back into sulfur dioxide in the presence of catalysts. Compared to current concepts, this promises to reduce costs significantly. They will test the technology under real conditions.

*Tags: Energy, Materials science, Solar energy*

### [Water, water, nowhere: Research indicates graphene could act as efficient and water-free hydrogen fuel cell membrane](#)

[Physorg.com, 05MAY2017](#)

The reliability of the hydrogen fuel cells is limited by the proton exchange membrane made of a polymer called Nafion, which only conducts protons when it has the right amount of water on it. Through computational modeling, a team of researchers in the US (University of Pittsburgh, New Mexico Tech) has shown that because of graphene's unique structure, it is well suited to rapidly conduct protons across the membrane and electrons across the circuit under anhydrous conditions. This would enable hydrogen fuel cell cars to be a more practical alternative vehicle. [TECHNICAL ARTICLE](#)

*Tags: Energy, Materials science*

### [New catalyst for water splitting developed](#)

[Science Daily, 03MAY2017](#)

Water-splitting systems require a very efficient catalyst to speed up the chemical reaction that splits water into hydrogen and oxygen, while preventing the gases from recombining back into water. An international team of researchers (Saudi Arabia, China, USA - Stanford University, Japan) reports that molybdenum-coated platinum prevents back reaction and works well in realistic operating conditions. Molybdenum was the best-performing material in acidic media, where the conditions for hydrogen evolution are favorable. The findings have applications in electrocatalysis and photocatalysis devices. [TECHNICAL ARTICLE](#)

*Tags: Energy, Materials science*

## ENVIRONMENTAL SCIENCE

**Scientists develop device to predict clear-sky turbulence for safer air travel**[Physorg.com, 05MAY2017](#)

Researchers in Russia suggest using a “muon hodoscope,” which traces muon trajectories in the atmosphere for detection of zones of possible turbulence. As muons pass through the atmosphere they lose energy, and their flow changes. The quantity of lost energy depends on characteristics of the atmosphere, electromagnetic fields, temperature, air rarity and water vapor content. They have a working stationary hodoscope called HURRICANE, and a mobile version of the detector. According to the researchers, using muon diagnostics, it is possible to predict the development of powerful atmospheric phenomena at heights of up to 15 km. It is only necessary to create a network of similar devices.

*Tags: Environmental science, S&T Russia, Space technology*

**Researchers develop radar simulator to characterize scattering of debris in tornadoes (with video)**[NSF News, 01MAY2017](#)

Researchers at the University of Oklahoma have developed a numerical polarimetric radar simulator to numerically construct scenes through representative simulations. The novel aspects of their work are the realistic trajectory derivation, which is based on a physical air-drag model, and the representative diversity of RCS contributions from each debris object, developed through realistic polarimetric RCS modeling and anechoic chamber measurements. [TECHNICAL ARTICLE](#)

*Tags: Environmental science, Simulation and modeling*

## FEATURED RESOURCE

**COSIS.net**

COSIS.net is an online community for scientists and their affiliated organizations for the exchange of information and the discussion of ideas and results. Membership is open to researchers affiliated with an organization.

## FORECASTING

**7 Wild Predictions Bill Gates Has Made About The World That Could Actually Happen**[Science Alert, 05MAY2017](#)

Bill Gates correctly predicted the rise of smartphones and social media, and a wealth of evidence suggests his latest predictions could be on the right track, too - Bioterrorism could wipe out 33 million people in less than a year;

When it comes to food, Africa will become entirely self-sufficient; Mobile banking will help the poor transform their lives; By 2030 the world will discover a clean-energy breakthrough to power our world; Countless jobs will be lost to automation; and, The world could eradicate polio by 2019.

*Tags: Forecasting, Science without borders*

## IMAGING TECHNOLOGY

**Shape-changing fog screen invented**[Science Daily, 05MAY2017](#)

Researchers in the UK have invented MistForm which is roughly the size of a 39-inch TV screen and is formed of fog stabilised by curtains of air. Making use of shape reconstruction and 3D projection algorithms, MistForm adjusts its shape to better support user interaction, while removing any image distortion caused by projecting on moving, curved fog surfaces. The display is projected from above and motion trackers detect the user's movements and intentions, allowing the display to adapt accordingly. This has the potential to enable new forms of interaction and collaboration with computers, liberating users from fixed, static screens and opening whole new interactive spaces.

[TECHNICAL ARTICLE](#)

*Tags: Imaging technology, S&T UK*

## INFORMATION TECHNOLOGY

**First one bit chemical memory unit: The 'chit'**[Science Daily, 04MAY2017](#)

Researchers in Poland have demonstrated a working memory based on chemical phenomena. They showed that in triplets of Belousov-Zhabotinsky (BZ) droplets, switching between two different, stable rotational modes (clockwise and anticlockwise) can be easily implemented. Therefore, such a system is an excellent candidate for a light controlled, reliable, one bit chemical memory unit. [TECHNICAL ARTICLE](#)

*Tags: Information technology*

**Engineering research focuses on bringing efficiency to network processes**[EurekaAlert, 03MAY2017](#)

Recently it has been shown that energy required to control a dynamical complex network is prohibitively large when there are only a few control inputs. Researchers at the University of New Mexico show that by controlling the states of a subset of the nodes of a network, rather than the state of every node, while holding the number of control signals constant, the required energy to control a portion of the network can be reduced substantially. The energy requirements exponentially decay with the number of target nodes. They validated their conclusions in model and real networks to arrive at an energy scaling law to better design control objectives. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Information technology, Energy*

*continued...*

## MATERIALS SCIENCE

**Sandwiched between superconductors, graphene adopts exotic electronic states**

Nanowerk, 05MAY2017

An international team of researchers (USA - MIT, Japan) found that a flake of graphene, when brought in close proximity with two superconducting materials, can inherit some of those materials' superconducting qualities. As graphene is sandwiched between superconductors, its electronic state changes dramatically, even at its center. Graphene's electrons, formerly behaving as individual, scattering particles, instead pair up in "Andreev states"—a fundamental electronic configuration that allows a conventional, non-superconducting material to carry a supercurrent. The graphene platform may be used for exploring Majorana fermions which are thought to arise from Andreev states and may be key particles for building powerful, error-proof quantum computers.

[TECHNICAL ARTICLE](#)*Tags: Materials science, Quantum science***Study looks to ice for fabricating useful porous materials**

Physorg.com, 03MAY2017

An international team of researchers (China, USA - University of Nebraska) report the discovery of an ion-specific effect on ice recrystallization. By simply changing the initial type and concentration of ions in an aqueous solution, the size of ice grains after recrystallization can be tuned from 27 to 277 microns. The ability of the ion to be incorporated into the ice phase plays a key role in the ultimate size of the ice grains after recrystallization. Using recrystallized ice crystals as templates, 2D and 3D porous networks with tunable pore sizes could be prepared from various materials, for example, NaBr, collagen, quantum dots, silver and polystyrene colloids. These porous materials are suitable for a wide range of applications in organic electronics, catalysis and bioengineering.

[OPEN ACCESS TECHNICAL ARTICLE](#)*Tags: Materials science***Super P carbon black for reversible lithium and sodium ion storage**

Nanowerk, 03MAY2017

Super P carbon black (SPCB) is the most commonly used conducting additive in lithium/sodium ion battery electrodes to improve the electronic conductivity. After a comprehensive study of SPCB, an international team of researchers (China, the Netherlands) reports that it is largely amorphous and contains substantial structural disorder, i.e. low graphitization level, exhibits considerable capacity for both lithium and sodium ion storage, a high cycling stability and excellent rate capability. They demonstrated that SPCB achieves a higher capacity for lithium ion than sodium ion storage. The findings will

provide an essential reference for the research on lithium and sodium ion battery electrodes that utilize SPCB as a conductive additive. [TECHNICAL ARTICLE](#)

*Tags: Materials science, Battery*

## MICROELECTRONICS

**Nanogaps in plasmonic gold wires enhance voltage when excited**

Nanowerk, 08MAY2017

Researchers at Rice University induced a temperature gradient using laser to study the nanoscale characteristics of the Seebeck effect in a single metal on the nanoscale. They found that the excited electrons can create a photovoltage about a thousand times larger than what is seen if there is no gap. The research shows that thermocouples can be made of a single material, laser can act as a local heat source and the photovoltage can be a thousand times larger. The technique can be used in sensors and electronics.

[OPEN ACCESS TECHNICAL ARTICLE](#)*Tags: Microelectronics, Advanced materials***Novel technique measures warpage in next-gen integrated circuits**

Physorg.com, 04MAY2017

The stress and resulting warpage of wafers during manufacturing can lead to malfunctions and altered performance. An international team of researchers (UK, Germany, Ireland) has developed a non-destructive technique to precisely and accurately measure the warpage of each wafer in a package through transmission X-ray diffraction imaging. To confirm their measurement technique, the team included samples with known curvature and displacement and proved that it can be done reliably and verifiably. The technique offers an opportunity not only to measure warpage during fabrication but also to improve the design process.

[OPEN ACCESS TECHNICAL ARTICLE](#)*Tags: Microelectronics*

## NEUROSCIENCE

**Mind Reading Algorithms Reconstruct What You're Seeing Using Brain Scan Data**

MIT Technology Review, 06MAY2017

fMRI scans are noisy and the activity in one voxel is influenced by activity in other voxels. Correlation is computationally expensive. Researchers in China process the data using deep-learning techniques that handle nonlinear correlations between voxels more capably. They use 90 percent of the data to train the network to understand the correlation between the brain scan and the original image. They then test the network on the remaining data by feeding it the scans and asking it reconstruct the original images. The research is important for creating better brain-machine interfaces.

[OPEN ACCESS TECHNICAL ARTICLE](#)*Tags: Neuroscience, Artificial intelligence, S&T China**continued...*

## S&T POLICY

### **NIH to limit the amount of grant money a scientist can receive**

Nature News, 03MAY2017

NIH will restrict the amount of funding that an individual scientist can hold at any one time, on the basis of a point system. The latest NIH policy does not set a hard limit on the number of grants or the dollar amount of funding that an individual researcher can receive. According to NIH, because scientific discovery is inherently unpredictable, there are reasons to believe that supporting more researchers working on a diversity of biomedical problems, rather than concentrating resources in a smaller number of labs, might maximize the number of important discoveries that can emerge from the science they support.

Tags: *S&T policy*

## SCIENCE WITHOUT BORDERS

### **Scientists Figure Out Possible New Threat to Spacecraft**

IEEE Spectrum, 05MAY2017

According to a team of researchers in the US (Boston University, MIT, Stanford University), micrometeoroids, dust-size particles streaking through space at tens of kilometers per second, don't pack enough punch to get through a spacecraft's hull, but when they hit, they vaporize into a plasma that generates a potentially crippling pulse of radio-frequency radiation. Through simulation, they show that the unusual behavior of the plasma explains the accompanying RF pulse. **TECHNICAL ARTICLE**

Tags: *Science without borders, Space technology*

## SENSORS

### **New self-sustained multi-sensor platform for environmental monitoring**

Physorg.com, 04MAY2017

A self-sustaining sensor platform is a core component for Internet-of-Things and smart-grid systems. Researchers in South Korea have developed a water-contact triboelectric nanogenerator which produces electrical energy, correlated with the repetitive squeezing and releasing of a water droplet. The circuit, integrated with the nanogenerator, harvests the energy and converts into binary codes to be displayed through LEDs powered by the gathered energy. The proposed platform would contribute to advanced sensing functions of a self-sustaining system for various targeted-ambient elements. **TECHNICAL ARTICLE**

Tags: *Sensors* ■

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