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## FEATURE ARTICLES

### [3-D antibody arrays offer better sensing](#)

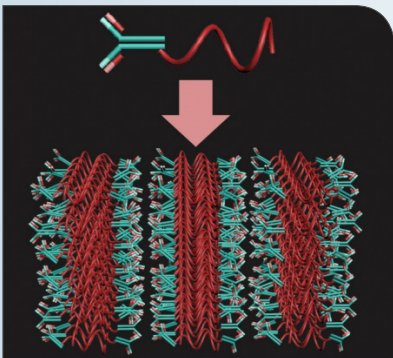
[MIT News, 04JAN2017](#)

Using molecular self-assembly, researchers at MIT built three-dimensional arrays of antibodies that could be used as sensors to diagnose diseases such as malaria or tuberculosis. The sensors contain up to 100 stacked layers of antibodies, the more antibodies you put on a surface, the lower the concentration of molecules you can detect. The technology could have a big impact on biosensors by potentially improving the sensitivity by several orders of magnitude. [TECHNICAL ARTICLE](#)

*Tags: Sensors, Featured Article*

### [Scientists turn memory chips into processors to speed up computing tasks](#)

[Science Daily, 03JAN2017](#)



*MIT chemical engineers discovered that they could force antibodies and other proteins to form layers by attaching each protein to a polymer tail. The proteins and polymers repel each other, so the molecules arrange themselves in a structure that minimizes the interactions between the protein and polymer segments. Courtesy of the researchers.*

An international team of researchers (Germany, Singapore) has built memory chips known as Redox-based resistive switching random access memory (ReRAM). The ReRAM circuit processes data in four states instead of two. For example, it can store and process data as 0, 1, 2, or 3. Because ReRAM uses different electrical resistance to store information, it is possible to

store the data in an even higher number of states, hence speeding up computing tasks beyond current limitations. The new chip could lead to much faster and thinner mobile devices and computers. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Microelectronics, Information technology, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [High performance Cu\(OH\)<sub>2</sub> supercapacitor electrodes fabricated](#)

[Science Daily, 29DEC2016](#)

Researchers in Iran have developed a fast, simple and low cost electric field enhanced synthesis method for fabricating high performance Cu(OH)<sub>2</sub> nanostructure supercapacitance electrodes. By applying electric field in the ammonium hydroxide based solutions, dense arrays of copper based nanostructures have been achieved. According to the researchers, these structures have applications in energy devices, such as supercapacitors and lithium ion batteries. [TECHNICAL ARTICLE](#)

*Tags: Advanced manufacturing, Advanced materials*

### ADVANCED MATERIALS

#### [Light opens and closes windows in membranes](#)

[Nanowerk, 23JAN2017](#)

Researchers in Germany have developed membranes, whose selectivity can be switched dynamically with the help of light. They integrated azobenzene molecules into membranes made of MOFs. Depending on the irradiation wavelength, azobenzene units in the MOFs adopt a stretched or angular form. In this way, it is possible to dynamically adjust the permeability of the membrane and the separation factor of gases or liquids. Control of these important properties by external stimuli is required for efficient sustainable applications and energy-saving separation of molecular mixtures. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T Germany*

#### [Responsive filtration membranes by polymer self-assembly](#)

[Nanowerk, 29DEC2016](#)

Researchers at Tufts University reviewed approaches to impart stimuli responsive behavior to membrane filters using polymer self-assembly. Membrane technologies are essential for water treatment, bioprocessing and

*continued...*

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chemical manufacturing. Stimuli-responsive membranes respond to changes in feed conditions (e.g., temperature, pH) or external stimuli (e.g., magnetic field, light) with a change in performance parameters (permeability, selectivity). This enables new functionalities such as tunable performance, self-cleaning and smart-valve behavior.

#### TECHNICAL ARTICLE

*Tags: Advanced materials*

## AUTONOMOUS SYSTEMS & ROBOTICS

### Expect Deeper and Cheaper Machine Learning

[IEEE Spectrum](#), 29JAN2017

Supercharged hardware will speed up deep learning in everything from tiny devices to massive data centers. According to researchers at Stanford University, there are three separate realms to consider in advancing deep learning: training in the data center; adjusting many millions of connections between neurons so that the network can carry out its assigned task; inference at the data center, ongoing operation of cloud-based artificial neural networks that have previously been trained to carry out some job; and inference in embedded devices, such as smartphones, cameras, and tablets.

*Tags: Autonomous systems & robotics, Artificial intelligence*

### Novel hardware-based modeling approach for multi-robot tasks

[Science Daily](#), 29JAN2017

Researchers in Russia propose the implementation of a hardware-based modeling system for multi-robot collaborative tasks focusing on the development and implementation phase of an algorithm/system creation. Their approach results in speeding up implementation iterations, ultimately leading to enhanced communication capabilities of research objects. The new method integrates different ideas concerning the algorithm design process, event-driven robot software design, and an autonomous mobile research robot equipped with an advanced sensor subsystem. [OPEN ACCESS](#) TECHNICAL ARTICLE

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

## CYBER SECURITY

### Study: Ad-tech use shines light on fringe, fake news sites

[Physorg.com](#), 29DEC2016

According to a new study by a web analytics firm, what distinguishes mainstream news sites from those devoted to fake news or other hyper-partisan takes on events is not just the stories they run, but also the way they use online technology that tracks readers and shows them ads. Although Google says it will prohibit its ads from being placed on “misrepresentative content,” it doesn’t explicitly single out “fake news” as part of this. Facebook has said that it bans fake news articles it knows about from its advertising network, but it doesn’t do so for entire sites.

*Tags: Cyber security*

### NIST guide provides way to tackle cybersecurity incidents with recovery plan, playbook

[Physorg.com](#), 28DEC2016

NIST has published the Guide for Cybersecurity Event Recovery to help organizations develop a game plan to contain the opponent and get back on the field quickly. It helps to consolidate existing NIST recovery guidance such as on incident handling and contingency planning. It also provides a process that each organization, federal or otherwise, can use to create its own comprehensive recovery plan to be ready when a cybersecurity event occurs. The publication supplies tactical and strategic guidance for developing, testing and improving recovery plans, and calls for organizations to create a specific playbook for each possible cybersecurity incident.

*Tags: Cyber security, Government S&T*

## ENERGY

### New insights into fluctuations of wind energy, with implications for engineering and policy

[Science Daily](#), 31DEC2016

On particularly windy days, surges in power generated by wind turbines have been known to overwhelm the electrical grid, causing power outages. Researchers in Japan used turbulence theory combined with experimental wind plant data to explain the statistical nature of wind power fluctuations. They showed that long time-scale, low frequency eddies can span hundreds of kilometres. Inside large eddies are shorter time-scale, high frequency eddies that might span a few kilometres. If all of the turbines in the same wind plant fall within the same short and long time-scale eddies, the energy they produce fluctuates as if the entire plant were one giant turbine. Research helps manage fluctuations in renewable energy.

*Tags: Energy*

### The Biggest Clean Energy Advances in 2016

[MIT Technology Review](#), 28DEC2016

Clean energy made critical strides in 2016. The Paris Climate accords went into effect, the price of solar installations continued to drop, investments in renewable energy soared, offshore wind finally got under way in the United States, and scientists made a series of technical advances that promise to make sustainable energy increasingly efficient and affordable. Artificial photosynthesis, solar thermophotovoltaics, perovskite solar cells, carbon storage and carbon dioxide to ethanol made notable strides.

*Tags: Energy*



“Basic research, to which we owe everything, is relatively very cheap when compared with other outlays of modern society.” ALBERT SZENT-GYÖRGYI

## FORECASTING

### 2017 Top Tech to Watch

IEEE Spectrum, 29DEC2016

Here are some of the technologies we will be reading about this year according to IEEE Spectrum.

*Tags: Forecasting, Science without borders*

### How to Think Like a Futurist

MIT Technology Review, 28DEC2016

Some technological trends fizzle out while others overturn everything. By asking the right questions just about anyone can separate real trends from hype and glean the paths that technologies will take. If there's a way to make the future a little less exciting and a little bit more boring, that's good for everybody because that means that we're not continually shocked by new ideas, that we're not continually discounting people on the fringe.

*Tags: Forecasting*

## FOREIGN S&T

### Russia will complete a new advanced nuclear missile submarine and an improved attack submarine in 2017

Next Big Future, 01JAN2017

Borei II-class submarines are fitted with four additional missile tubes, boast smaller hulls and cons, and feature improved acoustics and lower sound levels, next to a number of other technical improvements. Both variants of Borei-class subs will be armed with Bulava (RSM-56) intercontinental ballistic missiles. The Borei-class will be capable of carrying up to 16 Bulava ICBMs, whereas the improved Borei II-class can carry up to 20 ballistic missiles. The improved variant of the Borei-class will be capable of launching 96-200 hypersonic, independently maneuverable warheads, yielding 100-150 kilotons apiece.

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

### Russian test reported, but was it ASAT?

Defense Systems, 22DEC2016

While the exact parameters of the reported anti-satellite test remain unclear, it could be part of the Russian military's missile defense system. Any ballistic missile used for missile defense could also be used as an ASAT. The test was reportedly the latest in a series of checkout flights of the Russian PL-19 Nudol missile, a component of Moscow's antimissile system.

*Tags: Foreign S&T, Military technology, S&T Russia, Space technology*

## IMAGING TECHNOLOGY

### Quasi noise-free digital holography

Science Daily, 28DEC2016

The use of coherent light sources introduces speckle noise. Digital Holography (MLDH) and 3D Block Matching filtering (BM3D) are used to improve the quality of reconstructions and denoising respectively. An international team of researchers (Italy, USA - University of Connecticut) proposed a method referred to as MLDH-BM3D. In particular, MLDH pre-processing permits to achieve the enhanced grouping step ensuring better working conditions for the iterative processing. They demonstrated that this approach works efficiently for both single- and multi-wavelengths digital holography, achieving an enhancement up to 98% noise suppression. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Imaging technology*

## INFORMATION TECHNOLOGY

### Random access memory on a low energy diet

Science Daily, 03JAN2017

MRAMs are used as alternatives to electrical memory chips. To address MRAMs disadvantages, an international team of researchers (Germany, Switzerland) developed a novel antiferromagnetic magnetoelectric memory (AF-MERAM) prototype based on a thin layer of chromium oxide. This is inserted between two nanometer-thin electrodes. When voltage is applied, chromium oxide "flips" into a different magnetic state—and the bit is written. They attached a nanometer-thin platinum layer on top of the chromium oxide to readout through the Anomalous Hall Effect. According to the researchers, the voltage could be reduced by a factor of fifty. The findings are important for mobile applications and big data computing centers. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Information technology*

## MATERIALS SCIENCE

### Diamonds are technologists' best friends

Nanowerk, 29JAN2017

An international team of researchers (Russia, France, Finland) has obtained diamond crystals in the form of a regular pyramid of micrometer size. They described structural peculiarities of micrometer size diamond crystals of needle- and thread-like shapes, and their interrelation with luminescence features and efficiency of field electron emission. The luminescence properties of such thread-like diamond crystals could be used in different types of

sensors, quantum optical devices, creation of element base for quantum computers and in other areas of science and technology. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science*

### **Stability challenge in perovskite solar cell technology**

**Nanowerk, 23DEC2016**

Methylammonium lead iodide perovskite is widely studied for photovoltaic technology as it reaches efficiency exceeding 20%. However, its short lifespan has prevented it from becoming a viable silicon solar cell alternative. Researchers in Japan have shown that iodide-based perovskites will universally produce a gaseous form of iodine during operation, which causes degradation of perovskite. The gas can quickly permeate the rest of the perovskite material causing damage of the whole perovskite solar cells. The findings show it is necessary to develop new materials with a reduced concentration of iodine or a reinforced structure that can suppress iodine-induced degradation. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science, S&T Japan, Solar energy*

## FEATURED RESOURCE

### **Inside Big data**

Inside Big Data is a news outlet that distills news, strategies, products and services in the world of Big Data analytics for data scientists, IT and business professionals. [RSS](#)

## MICROELECTRONICS

### **Scientists design new heat-guiding device that is thinner than a hair**

**Nanowerk, 27JAN2017**

One of the requirements for achieving faster CMOS electronics is to mitigate the unacceptably large chip areas required to steer heat away from or toward the critical nodes of state-of-the-art devices. An international team of researchers (Singapore, UK) demonstrated control of the thermal-diffusion properties of thermal-guiding structures by using nanometer-scale, CMOS-integrable, graphene-on-silica stacked materials through finite-element-methods simulations. They demonstrated that it is possible to implement novel, controllable, thermally based Boolean-logic and spike-timing-dependent plasticity operations for advanced (neuromorphic) computing applications using such thermal-guide architectures. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics*

### **Nanowire 'inks' enable paper-based printable electronics**

**Eurekaalert, 03JAN2017**

Printed electronics has to be heated to melt all the nanoparticles together into a single conductive wire, making it impossible to print circuits on inexpensive plastics or paper. Researchers at Duke University found electrons flowed so easily through the nanowire films that they could function in printed circuits without the need to melt them all together. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics*

### **HPE's New Chip Marks a Milestone in Optical Computing**

**IEEE Spectrum, 02JAN2017**

Based on the Ising approach, Hewlett Packard has developed a chip that integrates 1,052 optical components in which all the photonic components work together to perform a computation. It is designed to be a compact approach that doesn't need electronic feedback and eliminates the vibrational problem faced by the 2014 Ising machine. In the future, Ising chips such as these might be able to act as accelerators, speedy specialists much like the graphics processing units used in many of today's machines. The team is investigating designs that could be used to scale up to a larger number of spins.

*Tags: Microelectronics*

### **Intel Finds Moore's Law's Next Step at 10 Nanometers**

**IEEE Spectrum, 30DEC2016**

Sometime in 2017, Intel will ship the first processors built using the company's new, 10-nanometer chip-manufacturing technology. According to Intel, this aggressive level of miniaturization than in years past helps counteract a recent trend: a slower cadence to the introduction of new chip-manufacturing generations. This node and the products that Intel will be making on it will hopefully dispute some of the concerns of the industry that Moore's Law is slowing down.

*Tags: Microelectronics*

### **Negative Resistance with a Single Atom**

**American Physical Society Focus, 30DEC2016**

Researchers in Canada created a robust, single-atom negative differential resistance device. Using a computer model, they showed that the current flowing through a single silicon atom can be made to decrease with increasing voltage, potentially allowing the integration of a new type of component into microelectronic circuits. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, Particle physics, S&T Canada*

## PHOTONICS

**The researchers created a tiny laser using nanoparticles**

Eurekalert, 03JAN2017

A plasmonic nanolaser, developed by researchers in Finland, is based on silver nanoparticles arranged in a periodic array utilizing radiative coupling between silver nanoparticles for lasing feedback. The 100-nanometer-sized particles act as tiny antennas. To produce high intensity laser light, the interparticle distance was matched with the lasing wavelength so that all particles of the array radiate in unison. Organic fluorescent molecules were used to provide the input energy needed for lasing. The research opens new prospects for on-chip coherent light sources, such as lasers, that are extremely small and ultrafast. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Photonics, S&amp;T Finland

## QUANTUM SCIENCE

**Quantum computers ready to leap out of the lab in 2017**

Nature News, 03JAN2017

Computing giants Google and Microsoft have set challenging goals for this year. Their ambition reflects a broader transition taking place at start-ups and academic research labs alike: to move from pure science towards engineering. Google hopes this year, or shortly after, to perform a computation that is beyond even the most powerful 'classical' supercomputers. Microsoft is betting on topological quantum computing and hopes to perform a first demonstration of the technology. Other researchers are more cautious.

Tags: Quantum science

## S&amp;T POLICY

**High-tech agriculture can prevent oncoming global water wars**

The Conversation, 23DEC2016

More than a billion people around the world have no reasonable access to fresh water. Only 3% is fresh and can be used for farming and drinking, and in any case most of this is frozen in glaciers and polar ice caps. That means just 0.5% of the Earth's water is accessible and, of this, more than two thirds is used in agriculture. One option to grow crops would be to find a sustainable way to remove salt from sea water. Genetic engineering remains controversial even though extensive scientific studies report GE crops available in the markets are safe for consumption.

Tags: S&amp;T policy

## SCIENCE WITHOUT BORDERS

**A Parallel Air Traffic Control System Will Let Delivery Drones Fly Safely**

IEEE Spectrum, 29DEC2016

The strategy being used to control drone traffic mimics the system used to manage full-size aircraft, whereby those aircraft determine their positions using GPS or some other form of satellite navigation and broadcast that information by radio to everyone else. While it might seem sensible to include small drones in the upcoming ADS-B regime, doing so could easily overwhelm that system. NASA, Google, and Amazon have all been contemplating what such a system should entail. While the concepts that have been outlined vary in many ways, they are all similar in that they would restrict drones to the first few hundred feet above the ground and to locations that are well separated from any airports.

Tags: Science without borders

**Five Technologies Silicon Valley Killed in 2016**

MIT Technology Review, 29DEC2016

As important as the new things that are born, are the old things that die. In 2016 MIT Technology Review saw several high-profile tech ideas die in Silicon Valley. Vine, Google Fiber, Pebble, the headphone jack and Project Ara are among them.

Tags: Science without borders

**Highlights of 2016**

Nanotechweb, 27DEC2016

Articles included in the Nanotechweb during the year relating to the application of nanotechnology in the following fields are highlighted - Biology and medicine, Electronics and photonics, Energy, and Synthesis and properties.

Tags: Science without borders

**Highlights of the Year 2016**

American Physical Society Focus, 19DEC2016

APS favorite stories from 2016 include LIGO Detects Gravitational Waves, Gender Stereotyping in Physics Labs, Hawking Says Black Holes Have "Soft Hair", Photon Wind Buffets Nanosphere, Trouble for Sterile Neutrinos, Crystal's Symmetry Lies in How it Moves, Color Duality in Photons and Physicists Perfect the Art of Bubble Blowing.

Tags: Science without borders

## SENSORS

**The lie-detecting security kiosk of the future**

Physorg.com, 28DEC2016

Researchers at San Diego State University have developed a kiosk, Automated Virtual Agent for Truth Assessments in Real Time (AVATAR), that asks questions of travelers and



can detect changes in physiology and behavior during the interview. The system can detect changes in eyes, voice, gestures and posture to determine potential risk. The kiosk would also ask a series of innocuous questions to establish baseline measurements so people just nervous about flying, for example, wouldn't be unduly singled out. Once the kiosk detects deception, it flags those passengers for further scrutiny by human agents. AVATAR has been tested in labs, in airports and at border crossing stations.

*Tags: Sensors* ■

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