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## FEATURE ARTICLES

### [Design your own custom drone](#)

[MIT News, 05DEC2016](#)

Researchers at MIT have developed a system which allows users to design drones by choosing from a database of parts and specifying their needs for things like payload, cost, and battery usage. The system computes the sizes of design elements like rod lengths and motor angles, and looks at metrics such as torque and thrust to determine whether the design will actually work. It also uses an “LQR controller” that takes information about a drone’s characteristics and surroundings to optimize its flight plan. [OPEN ACCESS TECHNICAL ARTICLE](#)

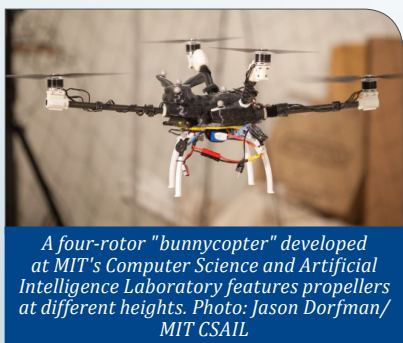
*Tags: Advanced manufacturing, Autonomous systems & robotics, Featured Article*

### [Researchers make one-way street for light](#)

[Physorg.com, 29NOV2016](#)

An international team of researchers (the Netherlands, USA - UT Austin) temporarily trapped light that passes through an optical fibre in a perfectly formed ring. As light circulates, it strengthens the force it exerts on the walls and slightly expands the ring. They introduced a second light wave with a slightly different colour than the first. Due to the interference of both light waves, the ring vibrates, but only if the two waves move through the ring in the same direction. The system has been designed in such a way that the light from the opposite direction is blocked. The new functionality provides a new way to route data encoded in the light signals. They demonstrated that the isolator could also work for radio waves, which could make its application in future quantum computers possible. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Photonics, Featured Article*



A four-rotor “bunnycopter” developed at MIT’s Computer Science and Artificial Intelligence Laboratory features propellers at different heights. Photo: Jason Dorfman/MIT CSAIL

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [Making graphene using laser-induced phase separation](#)

[Science Daily, 01DEC2016](#)

An international team of researchers (South Korea, USA - Columbia University) discovered a graphene synthesis mechanism using laser-induced solid-state phase separation of single-crystal silicon carbide. They found that a single-pulse irradiation of xenon chloride excimer laser of 30 nanoseconds melts SiC, leading to the separation of a liquid SiC layer below carbon layer. Giving additional pulses causes the sublimation of the separated silicon, while the disordered carbon layer is transformed into a multilayer graphene. While the traditional methods to make graphene use temperatures above 1,000°C, the laser technique is below 300°C. The technique can be used to synthesize new types of two dimensional materials. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced manufacturing, Advanced materials*

### ADVANCED MATERIALS

#### [Photonic water shows nanosheets’ true colors](#)

[Nanowerk, 02DEC2016](#)

Researchers in Japan report that a dilute aqueous colloidal dispersion of negatively charged titanate nanosheets, ‘photonic water’, spontaneously adopt a cofacial geometry with an ultralong periodic distance of up to 675 nm due to a strong electrostatic repulsion. Consequently, the photonic water can even reflect near-infrared light up to 1,750 nm. The structural colour becomes more vivid in a magnetic flux that induces monodomain structural ordering of the colloidal dispersion. The reflective colour can be modulated over the entire visible region in response to appropriate physical or chemical stimuli. The liquid could be used in telecommunication systems and lasers. [OPEN ACCESS TECHNICAL ARTICLE](#)

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

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## **Physicists decipher electronic properties of materials in work that may change transistors**

Science Daily, 02DEC2016

Energy gap in transition metal dichalcogenides (TMD) allows for the current to be switched on and off which makes TMD ideal for use in transistors. An international team of researchers (China, USA - UT Dallas) constructed layers of TMD sandwiched between two sheets of boron nitride molecules. The team discovered that how electrons behave in the TMDs depends on whether an even or odd number of TMD layers were used. Using an odd number of layers combined with a low magnetic field also resulted in a 6-step quantum Hall conductance in the TMDs, but under stronger magnetic fields, it became a 3-step by 3-step phenomenon. TMDs could be used in detectors and next generation electronics. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

## **Improving the mechanical properties of polymer gels through molecular design**

Science Daily, 01DEC2016

Most conventional polymer gels are brittle because stress concentration readily occurs in their cross-linked network structure. Researchers in Japan increased the fracture resistance by modifying cyclodextrin rings, which are threaded onto polyethylene glycol threads. The cyclodextrin rings contain groups that allow the threaded structures to be cross-linked to form a three-dimensional polymer network that can be used as a polymer gel. The research facilitates polymer gel application in molecular sieves and superabsorbent materials. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials, S&T Japan*

## **Metamaterials open up entirely new possibilities in optics**

Science Daily, 29NOV2016

An international team of researchers (Belgium, Sweden) has developed low loss dielectric waveguides that require metamaterials only inside the core. They have verified the versatility of their theory with full wave simulations of three crucial functionalities: beam bending, beam splitting, and lensing. With the help of a mathematical design tool it is possible to create metamaterials that guide the light along the path of your choice. The technique can be used in optical chips to achieve reliable data delivery. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

## AUTONOMOUS SYSTEMS & ROBOTICS

### **New Tool Lets AI Learn to Do Almost Anything on a Computer**

MIT Technology Review, 05DEC2016

Open AI has released Universe, a platform that will let AI programs learn through experimentation and positive reward. The Universe is compatible with AI agents that use reinforcement learning. It lets AI agents take screen pixels as input and provide input in the form of keyboard strokes and mouse clicks. Open AI believes the most important product of Universe will be general-purpose algorithms able to learn from its vast experience across lots of domains and apply it to a new problem. AI algorithms can sometimes match or surpass human abilities, but only within very narrow domains. Most algorithms cannot learn to do lots of different tasks, and they generally cannot apply what they have learned in one domain to a different one.

Tags: *Autonomous systems & robotics, Artificial intelligence*

## BIOTECHNOLOGY

### **New computational model provides a tool for improving the production of valuable drugs**

Science Daily, 02DEC2016

Chinese hamster ovary cells (CHO) produce more than half of the top selling therapeutic proteins on the market today. An international team of researchers (USA - UCSD, Johns Hopkins, Singapore, Austria, Australia, Denmark, Chile, Iceland, Saudi Arabia) has developed a robust model which allows scientists to make comprehensive simulations without doing tedious experiments in the laboratory. The model will show which metabolic pathways are involved and which growth conditions will presumably give the optimized production potential for a specific human antibody in a CHO cell. [TECHNICAL ARTICLE](#)

Tags: *Biotechnology, Medical sciences*

## ENERGY

### **Energy hybrid: Battery meets super capacitor**

Science Daily, 07DEC2016

An international team of researchers (France, Austria) has developed a novel redox active ionic liquid which consists of an organic salt that is liquid at a temperature of just below 30 °C. Similar to a solid storage medium this liquid can store many ions, but allows them to be much more mobile. These ionic liquids are able to decouple charge storage from an ion-accessible electrode surface to minimize self-discharge and leakage current as a result of retaining the redox species in the pores, and to raise working voltage due to their wide electrochemical window. [TECHNICAL ARTICLE](#)

Tags: *Energy*

“Research is creating new knowledge.” NEIL ARMSTRONG

### Improving the performance of lithium-sulfur batteries with coaxial nanotubes

Nanowerk, 24NOV2016

Specific capacity and cyclic stability of lithium-sulfur batteries are hindered by poor conductivity of sulfur and the dissolution of redox intermediates. An international team of researchers (USA - UT Austin, China) has designed polypyrrole-MnO<sub>2</sub> (PPy-MnO<sub>2</sub>) coaxial nanotubes with adjustable content of MnO<sub>2</sub> to encapsulate sulfur as a high-performance cathode for Li-S batteries. The S/PPy-MnO<sub>2</sub> composites show greatly improved electrochemical performance, including Coulombic efficiency, cyclic stability, and rate capability. The controlled deposition of discharging product (lithium sulfide) is another key factor for cyclic stability. They have achieved a stable Coulombic efficiency of ~98.6% and a decay rate of less than 0.07% per cycle with 500 cycles at 1C-rate (charge/discharge at 1 hour).

TECHNICAL ARTICLE

*Tags: Energy, Battery*

### FORECASTING

#### Team finds new method to improve predictions

Physorg.com, 30NOV2016

A team of researchers in the US (Princeton University, Columbia University, Harvard University) proposed a new measure called the influence score, or I-score, to better measure a variable's ability to predict. It fares especially well in high dimensional data and with many complex interactions between variables. It is effective in differentiating between noisy and predictive variables in big data and can significantly improve the prediction rate. The I-score can be applied in a variety of fields, including terrorism, civil war, elections and financial markets. For example, it improved the prediction rate in breast cancer data from 70 percent to 92 percent. TECHNICAL ARTICLE

*Tags: Forecasting*

### FOREIGN S&T

#### Asia's AI Agenda: Executive Summary

MIT Technology Review, 01DEC2016

This synopsis offers highlights from a recent survey of senior executives about trends in artificial intelligence and robotics that are affecting Asian businesses. Asia's business landscape is poised not only to benefit greatly from AI's rise, but also to define it. Outside of global robotics industry leaders Korea and Japan, most of Asia currently lacks the depth of technical skills and R&D facilities needed to keep pace with AI development. However, China, India, and other large Asian economies generate a copious

amount of data, a tremendous “natural resource” that is critical to pushing AI's capabilities forward.

*Tags: Foreign S&T, Artificial intelligence*

### INFORMATION TECHNOLOGY

#### New ultra-high density optical storage technology

Physorg.com, 01DEC2016

An international team of researchers (Russia, USA - Harvard University, University of Arizona, UK) proposes a new principle of optical storage based on tip-enhanced Raman scattering effect. Based on optical anisotropy of azo-dye polymer films, localization of laser light is provided by an optical nanoantenna that is illuminated by a focused laser beam with radial and azimuthal polarization. Switching between radial and azimuthal polarization enables the recording of optical information in the azo-dye absorption band and reading beyond that band. The switching speed depends on the local mobility of the dyes in a glassy environment—a parameter critically dependent on the thickness of polymer film. TECHNICAL ARTICLE 1, 2

*Tags: Information technology*

### MATERIALS SCIENCE

#### Names and symbols of four newly discovered elements announced

Science Daily, 02DEC2016

The International Union of Pure and Applied Chemistry has approved the name and symbols for four elements: nihonium (Nh), moscovium (Mc), tennessine (Ts), and oganesson (Og), respectively for element 113, 115, 117, and 118. The exploration of new elements continues, and scientists are searching for elements beyond the seventh row of the periodic table. Researchers from the USA (Carnegie Mellon University, Michigan State University), Canada, Italy, Japan, Switzerland, Ireland, Spain, and the Netherlands discovered the new elements. TECHNICAL ARTICLE 1,

OPEN ACCESS 2, OPEN ACCESS 3

*Tags: Materials science, Science without borders*

#### Creating new physical properties in materials

Science Daily, 29NOV2016

Researchers in Germany have demonstrated that when a static electric field is applied to a single crystal of strontium titanate it forms a strained near-surface layer through the migration of oxygen vacancies out of the area beneath the positively charged electrode and the phase is strongly piezoelectric. They discuss possible atomistic origins

*continued...*

of the piezoelectric activity as a coupling between the electrostrictive effect and spontaneous polarization of this near-surface phase. The research could be important for designing new materials and with unusual properties.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science, S&T Germany*

## FEATURED RESOURCE

### [Science Research](#)

ScienceResearch.com is a free, publicly available deep web search engine that uses advanced federated search technology to return high quality collated, ranked and de-duplicated results in real time.

## NEUROSCIENCE

### [Imaging technique can see you think](#)

[Science Daily](#), 30NOV2016

By significantly increasing the speed of functional MRI (fMRI), a team of researchers in the US (Harvard University, Mass General Hospital, Harvard Medical School) has been able to image rapidly fluctuating brain activity during human thought. This technique provides a method for obtaining much more detailed information about the complex brain activity that takes place during sleep, as well as other dynamic switches in brain states, such as when under anesthesia and during hallucinations.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Neuroscience, Imaging technology*

## PHOTONICS

### [Quantum dots offer new platform for fingertip terahertz devices](#)

[Physorg.com](#), 05DEC2016

An international team of researchers (UK, Russia, Lithuania) has constructed versatile, configurable terahertz transceiver systems based on energy-dependent optical and electronic characteristics of quantum-dot-based semiconductor devices. Terahertz signal generation and detection at energies that resonantly excite only the implanted quantum dots opens the potential for using compact quantum dot-based semiconductor lasers as pump sources. Proof-of-concept experiments show quantum dot-based samples have higher optical pump damage thresholds and reduced carrier lifetime with increasing pump power. The devices have applications in medicine and biology for tumor visualization and in the aerospace industry for high-speed communication systems. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Terahertz technology*

### [Mapping the interaction of a single atom with a single photon may inform design of quantum devices](#)

[Physorg.com](#), 02DEC2016

Researchers in Singapore, working with Rubidium atoms and infrared photons shone the photons one at a time onto a single atom and mapped the probability of the atom absorbing the photon as a function of time. The team tested two different photon shapes—one rising in brightness, the other decaying. They found that the probability of absorption at each moment depends on the photon's shape. The research is useful for technologies that rely on light-matter interactions, quantum technologies such as communication networks and sensors. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Photonics, Quantum science*

### [Squeezed states of light can improve feedback cooling significantly](#)

[Science Daily](#), 29NOV2016

In a thermally excited system, the amplitude of the mechanical vibrations are directly linked to the system's temperature. By eliminating vibrations the system is cooled to a lower effective temperature. An international team of researchers (Denmark, Australia) has shown the implementation of quantum feedback control of a micro-mechanical oscillator using squeezed probe light. This allows quantum-enhanced feedback cooling with a measurement rate greater than it is possible with classical light, and a consequent reduction in the final oscillator temperature. Their results have significance for future applications in areas ranging from quantum information networks, to quantum-enhanced force and displacement measurements and fundamental tests of macroscopic quantum mechanics. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Photonics, Quantum science*

### [Researchers develop single-photon converter—a key component of quantum internet](#)

[Physorg.com](#), 28NOV2016

To modify individual photons, an international team of researchers (UK, Poland, USA - University of Oregon) made use of the electro-optic effect occurring in certain crystals which provides a way to alter the index of refraction for light in the crystal by varying the intensity of an external magnetic force that is applied to it and not introducing any additional photons. Using the new device, they achieved a six-fold lengthening of the duration of a single-photon pulse without disrupting the quantum superposition while preserving very high conversion efficiency. The converter is efficient, has low-noise, and is stable and compact. It is easy to install in an optical fiber system channeling individual photons. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Quantum science*

## QUANTUM SCIENCE

### [Discovery of critical phenomena in a quantum spin liquid](#)

Nanowerk, 02DEC2016

Researchers in Japan grew a high-quality single crystal of an organic spin-liquid material,  $\kappa$ -(BEDT-TTF)<sub>2</sub>Cu<sub>2</sub>(CN)<sub>3</sub>, and took precise measurements of its magnetic susceptibility up to 17 tesla at extreme temperatures as low as 0.03 kelvin. They found that the material's magnetic susceptibility tends to diverge with decreasing temperature, and the magnetic susceptibilities exhibit a universal scaling function across very wide ranges of temperatures and magnetic fields. The results indicate that the material exhibits critical spin-liquid states near a quantum critical point at zero magnetic field. Research will help to model and understand what drives quantum spin liquid phenomena and its relation to high-temperature superconductivity. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science, Medical sciences, S&T Japan

## S&T POLICY

### [An open harbor for research data](#)

Eurekaalert, 02DEC2016

Within the next five years the Helmholtz Association of German Research Centers will invest about 49.5 million euros to establish the Helmholtz Data Federation (HDF), a multi-thematic data center. The first phase will partner with centers focusing on Earth, Environment, Materials, Health and Energy. The HDF represents the nucleus of a national research data infrastructure across science organizations which is open to users in the whole German science community. International connections will make it compatible with the future European Science Cloud.

Tags: S&T policy, Big data, S&T Germany, Science without borders

### [Bridging the University-Industry Divide in R&D Collaborations](#)

R&D Magazine, 01DEC2016

According to researchers at the University of Delaware, the challenges associated with bridging cultural and communication divides between academia and the industry that has remained a constant impediment are due to the cultural divide associated with conducting R&D—in academia research priorities are set by an investigator, whereas in industry priorities are set by management; academia seeks grants, industry seeks profits; in academia patenting is driven by publications; in industry patenting is driven by business decisions. Some of the ingredients to make a collaboration a reality include—instigating good leadership in both parties that “understand” each other's situations and conditions; putting the right people in charge; establishing

long-term strategic partnerships with built-in flexibility; starting with a shared vision and developing a strategy; encouraging cross-fertilization of ideas; not getting hung up on intellectual property; and by promoting a multidisciplinary approach to research and learning.

Tags: S&T policy

### [Advancing the science of cybersecurity](#)

NSF News, 30NOV2016

The National Science Foundation has announced \$76 million in research grants through its Secure and Trustworthy Cyberspace (SaTC) program to study the scientific, engineering and socio-technical aspects of cybersecurity. The grants support 241 projects across 36 states and 129 institutions, and touch on all aspects of the field. These include hardware, software, network security, human incentives and behaviors, and the integration of computation with the physical world. The awards are part of a portfolio of approximately \$160 million invested in cybersecurity research across the agency in Fiscal Year 2016.

Tags: S&T policy, Cyber security

### [Neuroscience hasn't been weaponized - it's been a tool of war from the start](#)

The Conversation, 30NOV2016

The stark divide between help and harm elides the fact that many technologies can do both simultaneously. Brain-machine interfaces may be a boon for veterans and soldiers in need of better prosthetic devices, but the same technologies can be used in warfare. While the military, medical and rehabilitative practices seek to diagnose and treat traumatic brain injuries in the clinical settings. The therapies are also part of a system of military medicine aimed at producing war readiness and potential redeployment of soldiers. It is not possible to say that neuroscience has been “militarized” or “weaponized.”

Tags: S&T policy, Military technology, Neuroscience

## SCIENCE WITHOUT BORDERS

### [More than 100,000 people challenge Einstein in a unique worldwide quantum physics experiment](#)

Physorg.com, 05DEC2016

Coordinated by ICFO-The Institute of Photonic Sciences, on November 30th, 12 laboratories from around the world collaborated for the [BIG Bell Test](#): worldwide quantum experiments powered by human randomness with the aim of demonstrating experimentally that the nanoscale world is as strange as quantum physics predicts, consisting of particles in superstates that collapse only when observed; strange instantaneous interactions at a distance; and predictions that were questioned by Einstein, who rejected them completely.

Tags: Science without borders

*continued...*

**Tiny device pumps out one electron at a time**

Physics World, 02DEC2016

The move to revamp the ampere is part of a more general overhaul of the SI system of units. It is envisaged that all seven base units—the ampere, second, metre, kilogram, kelvin, mole and candela—will be anchored to unvarying constants of nature. Researchers in Germany made single-electron pumps from quantum dots and applied fixed voltage across each dot to set up a time-varying potential well that briefly captures and then ejects single electrons. They were able to measure the current transmitted by the pumps with an accuracy of 0.16 parts per million. Their technique will allow scientists in a number of different disciplines to make better measurements of tiny currents.

Tags: *Science without borders, S&T Germany*

**SENSORS****ANU invention to inspire new night-vision specs**

Australian National University, 07DEC2016

An international team of researchers (Australia, China, Italy) fabricated a specialized III-V semiconductor of high-quality AlGaAs nanostructures embedded in optically transparent low-index material, thus allowing for simultaneous forward and backward nonlinear emission. They showed that the nanodisk AlGaAs antennas can emit second harmonic in preferential direction with a backward-to-forward ratio of up to five and can also generate complex vector polarization beams, including beams with radial polarization. The nano crystals are so small they could be fitted as an ultra-thin film to normal eye glasses to enable night vision. Other applications include anti-counterfeit devices, imaging cells for medical applications and holograms. [TECHNICAL ARTICLE](#)

Tags: *Sensors, Photonics*

**Graphene aerogel makes for ultra-lightweight pressure sensors**

Nanotechweb, 02DEC2016

An international team of researchers (Romania, Moldova) decorated graphene aerogel with SnO<sub>2</sub> and GaN films, as this significantly increases the piezoresistance of graphene aerogels. Both pressure sensors are flexible, ultra-lightweight (weight around 500µg) and exhibit a good responsivity which is one order of magnitude higher than that inherent to pressure sensors based on graphene suspended membranes. [TECHNICAL ARTICLE](#)

Tags: *Sensors, Advanced materials*

**Computer learns to recognize sounds by watching video**

Science Daily, 01DEC2016

Researchers at MIT trained the system on video. First, existing computer vision systems that recognize scenes and objects categorized the images in the video. The new system then found correlations between those visual categories and natural sounds capitalizing on the natural synchronization between vision and sound. On a data set with 10 different sound categories, it could categorize sounds with 92 percent accuracy, and on a data set with 50 categories it performed with 74 percent accuracy. On those same data sets, humans are 96 percent and 81 percent accurate, respectively.

Tags: *Sensors, Artificial intelligence*

**Sniffing like a dog can improve trace detection of explosives**

Science Daily, 01DEC2016

A dog uses fluid dynamics and entrainment to increase its aerodynamic reach to sample vapors at increasingly large distances. Applying this bio-inspired design principle could lead to significantly improved vapor samplers for detecting explosives, narcotics, pathogens—even cancer. A team of researchers in the USA (NIST, MIT Lincoln Laboratory, FDA) replicated the external features of a dog's nose, including the shape, direction, and spacing of the nostrils, moving air through the artificial nose at the same rate that a dog inhales and exhales. In tests, the dog nose was four times better 10 centimeters away from the vapor source and 18 times better at a stand-off distance of 20 centimeters. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Sensors, Explosives* ■

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