



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

[Advanced materials \(5\)](#)

[Autonomous systems & robotics \(4\)](#)

[Biotechnology \(1\)](#)

[Communications technology \(2\)](#)

[Cyber security \(3\)](#)

[Energy \(1\)](#)

[Forecasting \(1\)](#)

[Imaging technology \(1\)](#)

[Information technology \(1\)](#)

[Materials science \(5\)](#)

[Microelectronics \(1\)](#)

[Neuroscience \(1\)](#)

[Quantum science \(3\)](#)

[S&T policy \(1\)](#)

[Science without borders \(2\)](#)

[Sensors \(2\)](#)

## FEATURE ARTICLES

### [The path to perfection: Quantum dots in electrically-controlled cavities yield bright, nearly identical photons](#)

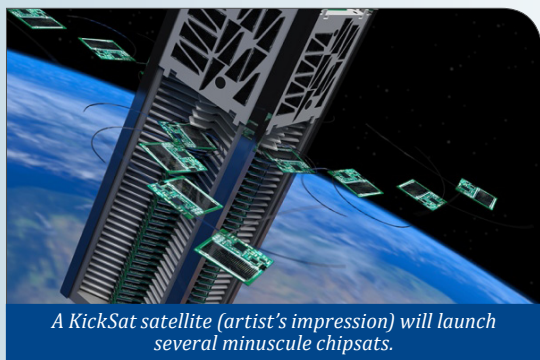
[PhysOrg.com, 07JUN2016](#)

An international team of researchers (France, Australia) has developed devices made of quantum dots in electrically-controlled cavities that provide large numbers of highly indistinguishable photons with strongly reduced charge noise that are 20 times brighter than any source of equal quality. The researchers state that by demonstrating efficient generation of a pure single photon with near-unity indistinguishability, their novel approach promises significant advances in optical quantum technology complexity and scalability. **TECHNICAL ARTICLE**

*Tags: Quantum science, Featured Article*

### [Tiny 'chipsat' spacecraft set for first flight](#)

[Nature News, 01JUN2016](#)



*A KickSat satellite (artist's impression) will launch several minuscule chipsats.*

The chip-sats are flat squares that measure just 3.2 cm to a side and weigh about 5 grams a piece. Their upcoming

test in space is a baby step to send tiny probes on an interstellar voyage. They are smaller and cheaper and are seen as disposable sensors that could be sent on suicide missions to explore hostile environments, such as Saturn's rings. They're all part of the toolbox for next-generation space missions.

*Tags: Communications technology, Satellite technology, Space technology, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [Physicists predict previously unseen phenomena in exotic materials](#)

[MIT News, 06JUN2016](#)

Researchers at MIT report a new theoretical characterization of topological semimetals' electrical properties that accurately describes all known topological semimetals and predicts several new ones. Guided by their model, the researchers also describe the chemical formula and crystal structure of a new topological semimetal that should exhibit electrical characteristics never seen before. Better understanding of topological semimetals could help usher in future electronics.

*Tags: Advanced materials, Materials science*

#### [Graphene-based transparent electrodes for highly efficient flexible OLEDs](#)

[Science Daily, 04JUN2016](#)

Researchers in South Korea have fabricated a transparent anode in a composite structure in which a TiO<sub>2</sub> layer with a high refractive index and a hole-injection layer of conducting polymers with low refractive index sandwich graphene electrodes. Synergistic collaboration between the high-n and low-n layers increases the effective reflectance of TEs. The optical cavity resonance is maximized resulting in the improvement of efficiency and color gamut in OLEDs. The presence of the low-n conducting polymers reduces the loss from surface plasmon polariton. **TECHNICAL ARTICLE**

*Tags: Advanced materials*

#### [New alloy promises to boost rare earth production while improving energy efficiency of engines](#)

[Science Daily, 04JUN2016](#)

A team of researchers in the US (Oak Ridge National Laboratory, industry partner, Lawrence Livermore National Laboratory, Ames National Laboratory) has developed aluminum-cerium alloys that are stable at 300 degrees Celsius, a temperature that would cause traditional alloys to begin disintegrating. The stability of

*continued...*

[BACK TO TOP](#)

the alloy eliminates the need for heat treatments typically needed for aluminum alloys. Aluminum-cerium alloys would allow engines to increase fuel efficiency directly by running hotter. [TECHNICAL ARTICLE](#)

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

### [Exoskin: a Programmable Hybrid Shape-Changing Material \(w/video\)](#)

[IEEE Spectrum, 03JUN2016](#)

Researchers at MIT have developed a membrane-backed rigid material, called [Exoskin](#), which is made up of tessellated triangles of firm silicone mounted on top of a stack of flexible silicone bladders. By selectively inflating these air bladders, the Exoskin can dynamically change its shape to react to touch, communicate information, change functionality, and more.

*Tags: Advanced materials*

### [Graphene device could substantially increase the energy efficiency of fossil fuel-powered cars](#)

[Nanowerk, 02JUN2016](#)

The nano-rectifier, built by an international team of researchers (UK, China), utilises graphene's high conversion efficiency from an alternating current to a direct current at room temperature. The rectifier is able to convert heat, which would otherwise be wasted from the car exhaust and engine body, into a usable electrical current. The recovered energy can then be used to power additional automotive features such as air conditioning and power steering, or be stored in the car battery.

[TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Energy*

## AUTONOMOUS SYSTEMS & ROBOTICS

### [CODE Takes Next Steps toward More Sophisticated, Resilient, and Collaborative Unmanned Air Systems](#)

[DARPA News, 03JUN2016](#)

DARPA's [Collaborative Operations in Denied Environment \(CODE\)](#) program seeks to help the U.S. military's UASs conduct dynamic, long-distance engagements of highly mobile ground and maritime targets in denied or contested electromagnetic airspace, all while reducing required communication bandwidth and cognitive burden on human supervisors.

*Tags: Autonomous systems & robotics, DARPA, Government S&T*

### [Video Friday: ATLAS on the Edge, Plant-Robot Hybrid, and Kuka Smash](#)

[IEEE Spectrum, 03JUN2016](#)

According to researchers at Carnegie Mellon University, natural systems move through unstructured, complex

environments with an adaptability and robustness that motion-control scientists have yet to deeply understand, let alone reliably emulate. They look to biology, not to mimic or replay motions back on robotic devices, but to better understand the composition of successful motion-control strategies as they exist in the natural world.

*Tags: Autonomous systems & robotics*

### [Hitachi develops basic artificial intelligence technology that enables logical dialogue in Japanese](#)

[PhysOrg.com, 02JUN2016](#)

Researchers in Japan applied the deep learning process to develop a basic AI technology that analyzes huge volumes of Japanese text data on issues that are subject to debate, and presents in Japanese both affirmative and negative opinions on those issues together with reasons and grounds. This may be the core technology in achieving a multi-lingual AI system capable of offering opinion.

*Tags: Autonomous systems & robotics, Artificial intelligence, S&T Japan*

### [Dogo - a Weaponized Robot Designed for Close Combat](#)

[Defense Update, 01JUN2016](#)

At a mission gross weight of only 12 kg the tactical tracked robot dubbed 'DOG0', developed by researchers in Israel, packs enough battery power to last for a 2-5 hour mission, eight cameras covering 360 degrees, a fully loaded Glock 26 pistol and accessories mounted on Picatinny rails. The equipment carried on the rails provides various non-lethal effects, such as pepper spray module or a dazzler that temporarily blinds an aggressor from a distance of 5-10 meters.

*Tags: Autonomous systems & robotics, Military technology*

## BIOTECHNOLOGY

### [From living computers to nanorobots: how we're taking DNA beyond genetics](#)

[Nanowerk, 07JUN2016](#)

DNA carries instructions needed to create almost any lifeform in a microscopic package. Now scientists are finding ways to push DNA even further, using it not just to store information but to create physical components in a range of biological machines. By precisely designing different A,G,T and C sequences, they are turned into a Lego-like material for building objects. DNA-based materials are now being used for a variety of applications, ranging from templates for electronic nano-devices, to ways of precisely carrying drugs to diseased cells. [TECHNICAL ARTICLE 1, 2, 3, 4, 5](#)

*Tags: Biotechnology*

“All inquires carry with them some element of risk. There is no guarantee that the universe will conform to our predispositions” **CARL SAGAN**

## COMMUNICATIONS TECHNOLOGY

### [Quantum satellite device tests technology for global quantum network](#)

EurekaAlert, 02JUN2016

An international team of researchers (Singapore, UK) has put a compact device carrying components used in quantum communication and computing into orbit. The whole satellite weighs just 1.65-kilogramme. The device dubbed SPEQS creates and measures photons. Results from space show that SPEQS is making pairs of photons with correlated properties—an indicator of performance.

[TECHNICAL ARTICLE](#)

*Tags: Communications Technology, Quantum science*

## CYBER SECURITY

### [Software-defined perimeter security for cloud-based infrastructures](#)

Government Computer News, 03JUN2016

None of the technologies used for Software Defined Perimeter security (SDP) are new, and all of the concepts—such as geolocation and federation used for connectivity—are well understood. However, most of the SDP implementations up to now have been highly customized and proprietary and designed for an organization's specific needs. The push behind the Cloud Security Alliance program is to develop a more general approach to SDP that can be readily applied across all organizations.

*Tags: Cyber security*

### [De-coding the character of a hacker](#)

Science Daily, 01JUN2016

Researchers in the UK found a positive association between an individual's drive to build and understand systems—called 'systemizing'—and hacking skills and expertise. In particular, they found that this drive is positively and specifically correlated with code-breaking performance. These results give insight into the psychology and skillset that might predispose an individual towards a variety of security professions. [TECHNICAL ARTICLE](#)

*Tags: Cyber security, Neuroscience, S&T UK*

### [Why Autocorrect for Passwords Is a Great Idea](#)

MIT Technology Review, 01JUN2016

A team of researchers in the US (Cornell University, MIT, industry partner) analyzed logins to the data-storage service Dropbox to prove that letting people in even when they get a few characters wrong can reduce headaches without significantly harming security. They argue that the idea isn't dangerous if it's implemented in a way that

takes into account how people choose passwords and the typos they make. They created two typo-tolerant password checkers that won't accept typos for certain passwords where it could be risky. [TECHNICAL ARTICLE](#)

*Tags: Cyber security*

## ENERGY

### [Towards building next-generation batteries using a pigment electrode](#)

PhysOrg.com, 07JUL2016

Calcium ion batteries (CIBs) have attracted much attention as next-generation batteries to replace lithium ion batteries (LIBs) because the theoretical capacity of CIBs is twice that of LIBs, lower cost and higher safety. However, there is no suitable electrode material in which calcium ions can be inserted and extracted reversibly. Researchers in Japan used Prussian blue (PB) and Prussian blue analogues (PBAs) as CIB electrodes. They demonstrated the excellent cyclability of the PBA electrodes, and explained their poor reversibility by the durable structure of the PBAs and their excellent charge balance during the insertion and extraction of calcium ions. [TECHNICAL ARTICLE](#)

*Tags: Energy, Battery, S&T Japan*

## FORECASTING

### [Better forecasting for solar and wind power generation](#)

Science Daily, 03JUN2016

Researchers in Germany have launched a platform for a transmission system for the 1.9 million photovoltaic facilities and wind farms operating in Germany to test the better models they developed for forecasting the generation of renewable electricity. The new models help operators calculate precisely how much wind and solar power will be fed into which grid nodes and check the reliability of the forecasts.

*Tags: Forecasting, S&T Germany*

## IMAGING TECHNOLOGY

### [High-efficiency flat lenses shrink down to the nanoscale](#)

Physics World, 02JUN2016

An international team of researchers (USA - Harvard University, Canada) has fabricated titanium-oxide metalenses designed to focus light at different visible wavelengths. They demonstrated imaging with the metalenses for the first time in the visible region, showing

that they could produce highly magnified images of several different test objects and resolve features less than one wavelength apart. The devices could be used in laser-related imaging, microscopy and spectroscopy mobile-phone cameras and wearable electronics.

#### TECHNICAL ARTICLE

*Tags: Imaging technology*

### INFORMATION TECHNOLOGY

#### **Magnetic memory - Keeping cool with graphene**

Nanowerk, 02JUN2016

Heat-assisted magnetic recording is used to circumvent problems associated with hard drives used for storing data. Researchers in Singapore investigated the thermal performance of graphene which could be used as a protective overcoat layer that surrounds the magnetic film. They found that the resistance between the graphene overcoat layer and the layer beneath may increase the temperature between the layers, but the thermal conductivity of graphene can reduce the local temperature rise in the overcoat layer and thus avoid overheating. TECHNICAL ARTICLE

*Tags: Information technology*

### FEATURED RESOURCE

#### **Directory of Open Access Journals (DOAJ)**

DOAJ is a white list of open access journals and aims to be the starting point for all information searches for quality, peer reviewed open access material. [New Journals RSS](#)

### MATERIALS SCIENCE

#### **Spintronics development gets boost with new findings into ferromagnetism in Mn-doped GaAs**

PhysOrg.com, 07JUN2016

An international team of researchers (Japan, USA - South Dakota School of Mines and Technology, Poland) directly observed that doped Mn atoms extract electrons from As atoms, leaving holes in the As orbital. This then causes the ferromagnetism in (Ga,Mn)As. The finding resolves a long-standing problem in the mechanism of ferromagnetism in (Ga,Mn)As. It also accelerates the materials engineering of magnetic semiconductors, as well as the tunable controlling of spin states in spintronic devices.

#### TECHNICAL ARTICLE

*Tags: Materials science, Microelectronics*

#### **Using terahertz laser, scientists change the macromolecular conformation of a polymer**

PhysOrg.com, 07JUN2016

Researchers in Japan successfully used a terahertz laser to induce permanent changes in the conformation of a polymer, giving it an increased pattern of crystallization. Conformational changes are very important for macromolecular science because they can change the characteristics of a material and, in the case of proteins, can make it either possible or impossible for them to perform a certain biological function. TECHNICAL ARTICLE

*Tags: Materials science, S&T Japan*

#### **Non-invasive analysis of damages to materials based on advanced signal processing techniques**

Science Daily, 02JUN2016

The technique developed by researchers in Spain is based on advanced signal processing and analyses of signals obtained from the ultrasonic inspection of the materials being tested. By running different frequency ranges, it is possible to know the internal structure of the material and quantify the extent of the damages much more precisely than using traditional techniques.

*Tags: Materials science*

#### **Programmable materials find strength in molecular repetition**

Nanowerk, 02JUN2016

Researchers at Pennsylvania State University made varying lengths of amino acid strings based on those found in a variety of squid species' ring teeth. They found that in the synthetic material, toughness and extensibility increase as the molecular weight increases. They also found that the balance between elasticity and plasticity remained unchanged. The material can be processed to form a variety of 3-dimensional shapes including ribbons, lithographic patterns and nanotubes with a vast array of potential uses.

#### TECHNICAL ARTICLE

*Tags: Materials science, Biomimetics*

#### **Beaming Repairs to Some Optoelectronic Crystals**

Optics and Photonics News, 01JUN2016

Perovskites have many promising applications in optoelectronics. The photoluminescent properties of  $\text{CH}_3\text{NH}_3\text{PbI}_3$  vary from grain to grain due to the migration of ions. To fix these defects an international team of researchers (UK, USA - University of Washington, MIT) exposed  $\text{CH}_3\text{NH}_3\text{PbI}_3$  film to intense simulated sunlight. According to the team, the light causes the negatively charged iodide ions to redistribute themselves in the crystal to reduce the number of traps.

#### TECHNICAL ARTICLE

*Tags: Materials science, Advanced materials*

## MICROELECTRONICS

**Off the beaten track****Nanowerk, 02JUN2016**

An international team of researchers (Singapore, USA - MIT) explored silicon–nitride ratios to achieve a better balance of properties for waveguides and discovered that alloys with a higher silicon composition—roughly twice as much silicon as nitrogen—show much more favorable properties. In one case, it achieved an optical nonlinearity almost 500 times stronger than the typical composition. This serves as a starting point for more sophisticated systems leveraging nonlinear optics, especially within the telecommunications wavelength, where many other materials experience either low nonlinearities or large nonlinear losses. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, Materials science*

## NEUROSCIENCE

**How the brain merges the senses****Science Daily, 06JUN2016**

Researchers in Germany report that despite originating from the same physical events, visual and auditory information are processed in largely independent neural pathways, and yet, with no apparent effort, we can instantly tell which signals belong together. Such a task would be challenging, even for the most advanced robots. [TECHNICAL ARTICLE](#)

*Tags: Neuroscience, S&T Germany*

## QUANTUM SCIENCE

**First Experimental Demonstration of a Quantum Enigma Machine****MIT Technology Review, 04JUN2016**

A team of researchers in the US (University of Rochester, NIST at Boulder, CO, MIT) presents the first feasible experimental demonstration of quantum data locking for direct communication and propose a scheme for a quantum enigma machine that encrypts 6 bits per photon (containing messages, new encryption keys, and forward error correction bits) with less than 6 bits per photon of encryption key while remaining information-theoretically secure. [TECHNICAL ARTICLE](#)

*Tags: Quantum science***Experimental test verifies Heisenberg's measurement uncertainty principle****PhysOrg.com, 02JUN2016**

In his original proposal, Heisenberg predicted a tradeoff between error and disturbance. Researchers in China have verified a related tradeoff that is based on Busch, Lahti, and Werner's theory. In this tradeoff, measurement inaccuracies are quantified geometrically.

Overall, the work provides a deeper understanding of Heisenberg's original idea about the uncertainty principle, and could also have practical applications. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, S&T China*

## S&amp;T POLICY

**China placing a hospital and a small farm on the manmade South China Sea islands****Next Big Future, 07JUN2016**

China is building military and civilian facilities on the manmade South China sea islands. They are making lighthouses, a tourist resort, a hospital and a farm. Fiery Cross Reef has a one acre vegetable farm and 500 livestock—including pigs, chicken, and geese. Fiery Cross Reef will also get a hospital, now under construction and expected to be finished later this month. It covers 160,000 square meters and has its own garden with coconut trees and tropical plants.

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

## SCIENCE WITHOUT BORDERS

**Just what sustains Earth's magnetic field anyway?****Science Daily, 01JUN2016**

The motion of liquid iron in the planet's outer core, the geodynamo, generates the magnetic field that shields us from deadly cosmic radiation. But how it was first created and then sustained throughout Earth's history has remained a mystery to scientists. New work by an international team of researchers (Germany, UK, Colombia, China, USA - Carnegie Institution of Washington) sheds light on the history of this incredibly important geologic occurrence. [TECHNICAL ARTICLE](#)

*Tags: Science without borders***Spinning electrons yield positrons for research****PhysOrg.com, 01JUN2016**

An international team of researchers (USA - Hampton University, Idaho State University, North Carolina Central University, France) demonstrated a new technique for producing polarized positrons. The method could enable new research in advanced materials and offers a new avenue for producing polarized positron beams for a proposed International Linear Collider and an envisioned Electron-Ion Collider. [TECHNICAL ARTICLE](#)

*Tags: Science without borders, Materials science*

## SENSORS

**Air Force looking for next-gen sensors****Defense Systems, 02JUN2016**

The new presolicitation notice issued by the Air Force Research Laboratory expresses interest in advancing its portfolio of electro-optical sensors and related technology

for intelligence, surveillance and reconnaissance (ISR), as well as targeting and situation awareness.

*Tags: Sensors, S&T Policy*

## **Drone Anti-Collision System Completes Operational Test**

**Defense Update, 01JUN2016**

The first operational testing of a Detect and Avoid (DAA) system on board the Predator B Remotely Piloted Aircraft has been successfully completed. The system included a Due Regard Radar, Traffic Alert and Collision Avoidance System (TCAS) and Sensor Tracker, specifically designed for DAA. The scenarios included 'intruder' aircraft such as a Cessna C-210 and UH-60 Black Hawk equipped with a mix of Mode A/C Transponders, TCAS, and Automatic Dependent Surveillance-Broadcast transponder capabilities.

*Tags: Sensors, Autonomous systems & robotics ■*

## **ABOUT THIS PUBLICATION**

The appearance of external hyperlinks in this publication does not constitute endorsement by the United States Department of Defense (DoD) of the linked web sites, nor the information, products or services contained therein. In addition, the content featured does not necessarily reflect DoD's views or priorities.

To **SUBSCRIBE** or **UNSUBSCRIBE**, visit <https://tin-ly.sainc.com/ASDRE>. To provide feedback or ask questions, contact us at [asdre-st-bulletin-reply@sainc.com](mailto:asdre-st-bulletin-reply@sainc.com). This publication is authored and distributed by:

**Ryan Zelnio, Ph.D.**, Associate Director - Tech Watch / Horizon Scans, Office of Net Technical Assessments, OSD AT&L/OASD(R&E)

**Ms. Hema Viswanath**, OTI Corporate Librarian