



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

[Advanced manufacturing \(1\)](#)

[Advanced materials \(6\)](#)

[Autonomous systems
& robotics \(2\)](#)

[Cyber security \(1\)](#)

[Energy \(2\)](#)

[Environmental science \(1\)](#)

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

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

[Materials science \(2\)](#)

[Microelectronics \(1\)](#)

[Photonics \(4\)](#)

[Quantum science \(4\)](#)

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

[Science without borders \(1\)](#)

[Sensors \(6\)](#)

FEATURE ARTICLES

[Dendrite-proof batteries made possible by Zylon nanofibers](#)

[PhysOrg.com, 17MAY2016](#)

Researchers at Northwestern University have shown that when Zylon microfibers are exfoliated into nanofibers and then cast into thin membranes, the combination of strength, electrical resistance, and high heat tolerance make them exceptionally good membrane separators for preventing dendrite growth in lithium batteries.

TECHNICAL ARTICLE

Tags: Advanced materials, Battery, Featured Article

[Supersensitive Needle Magnetometer](#)

[American Physical Society Spotlight, 13MAY2016](#)



A compass for the nanoworld. A 10-micrometer-long needle of ferromagnetic material—like a miniature compass needle—could serve as a magnetometer 1000 times more sensitive than today's best instruments, possibly detecting a field smaller than 1 femtogauss

An international team of researchers (USA - California State University-East Bay, Boston University, UC Berkeley, Lawrence Berkeley National Laboratory, Germany) has shown theoretically that a compass needle actually does wobble in a sufficiently weak field

and that this effect could be exploited to make a supersensitive magnetometer. Their calculations show that such a device could be 1,000 times more sensitive than today's best magnetometers. Researchers say that this connection between macroscopic and quantum-scale magnets could lead to new magnetometry techniques.

TECHNICAL ARTICLE

Tags: Sensors, Featured Article

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

[Printing metal in midair](#)

[Science Daily, 17MAY2016](#)

Researchers at Harvard University used an ink composed of silver nanoparticles, sending it through a printing nozzle and then annealing it using a precisely programmed laser that applies just the right amount of energy to drive the ink's solidification. The printing nozzle moves along x, y, and z axes and is combined with a rotary print stage to enable freeform curvature. In this way, tiny hemispherical shapes, spiral motifs, even a butterfly made of silver wires less than the width of a hair can be printed in free space within seconds. The printed wires exhibit excellent electrical conductivity, almost matching that of bulk silver.

TECHNICAL ARTICLE

Tags: Advanced manufacturing

ADVANCED MATERIALS

[Shape-shifting modular interactive device unveiled](#)

[Science Daily, 17MAY2016](#)

An international team of researchers (UK, USA - Purdue University) has developed a prototype for an interactive mobile device, called Cubimorph that can change shape on-demand. The device, made out of a chain of cubes, contributes towards the vision of programmable matter, where interactive devices change their shape to fit functionalities required by end-users.

Tags: Advanced materials, Flexible electronics

[Self-healing, flexible electronic material restores functions after many breaks](#)

[Science Daily, 16MAY2016](#)

Pennsylvania State University added boron nitride nanosheets to a base material of plastic polymer to create a material that has all properties needed for use as a dielectric in wearable electronics—mechanical strength, breakdown strength to protect against surges, electrical resistivity, thermal conductivity and dielectric,

continued...

[BACK TO TOP](#)

or insulating, properties. The material is able to self-heal because boron nitride nanosheets connect to one another with hydrogen bonding groups functionalized onto their surface. Boron nitride nanosheets are impermeable to moisture. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Flexible electronics

[Researchers unleash graphene ‘tiger’ for more efficient optoelectronics](#)

[Nanowerk](#), 13MAY2016

An international team of researchers (USA - University of Washington, Columbia University, Carnegie Mellon University, National High Magnetic Field Laboratory, Japan) discovered that when the graphene layer’s lattice is aligned with the layers of boron-nitride, a type of “superlattice” is created with properties allowing efficient optoelectronics. When they directed energetic photons toward the superlattice, they discovered that in Van Hove singularities regions one energized photon could transfer its energy to as many as five electrons that are subsequently collected by electrodes. The research could lead to the development of highly efficient devices that could harvest light with a large energy profit. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

[Precisely flawed nanodiamonds could produce next-generation tools for imaging and communications](#)

[PhysOrg.com](#), 12MAY2016

Diamondoids are interlocking carbon cages found in petroleum fluids. They weigh less than a billionth of a carat; the smallest ones contain just 10 atoms. A team of researchers in the US (Stanford University, SLAC National Accelerator Laboratory) used diamondoids to seed the growth of flawless, nano-sized diamonds. By introducing other elements, such as silicon or nickel, during the growing process, they hope to make nanodiamonds with precisely tailored flaws that can produce single photons of light for next-generation optical communications and biological imaging.

Tags: Advanced materials, Materials science

[A different type of defect in 2D materials](#)

[Nanowerk](#), 11MAY2016

Researchers at Caltech show that 2D halide perovskite can be classified into three types based on their functions: (i) generating charge carriers (ii) trapping/scattering/recombining charge carriers (iii) being inactive. The defects function can be tuned by varying the chemical potential of environment. In contrast, most defects in 2D metal chalcogenides belong to type (ii) and are hence harmful to many applications. The material can be used for next-generation solar cells, with the efficiency quickly approaching that of commercial silicon cell but at a much lower price.

[TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

AUTONOMOUS SYSTEMS & ROBOTICS

[Watch This Drone Land on Walls and Ceilings Like an Insect](#)

[Gizmodo](#), 14MAY2016

Utilizing several “microspines,” and a tail spine, the drone positions itself against a wall or ceiling. The microspines drag against the bumps in the wall and hang on using friction, allowing the drone to perch securely on materials like stucco or cinder block. This can help drones use their batteries more efficiently, allowing a pilot drone to find a suitable location and hang out to shoot footage or to take pictures, conserving its energy. It also makes it possible for drones to continue operating in weather conditions that it might be unable to fly in.

Tags: Autonomous systems & robotics

[Google to Developers: Here’s How to Stop Making Dumb Chatbots](#)

[MIT Technology Review](#), 12MAY2016

One of the tools released by Google to outside developers is called SyntaxNet, which can learn to understand the meaning of words and phrases given their context and common usage. This works with the deep-learning framework previously released by Google, called TensorFlow. Google has also released a pre-trained parser for English, called Parsey McParseface. Text fed into the parser will be automatically broken into syntactic components that makes it easier for a computer to parse ambiguous queries or commands correctly.

Tags: Autonomous systems & robotics, Artificial intelligence

CYBER SECURITY

[A password of another kind: User identification through the skull](#)

[Science Daily](#), 12MAY2016

Researchers in Germany used components of the Google Glass to develop a new biometric identifier. Besides the miniature microphone, they use the bone conduction speaker, which is barely visible and is embedded in the frame near the right ear. It directs sound vibrations through the surrounding skull bone directly to the inner ear. Because the skull is individual, the sound signal is changed in a way which is unique for every person. Hence, we can use it as a biometric identifier. [TECHNICAL ARTICLE](#)

Tags: Cyber security, S&T Germany

ENERGY

[New analysis method to boost lithium-ion battery capacity](#)

[PhysOrg.com](#), 16MAY2016

Researchers in Japan analyzed the structure of amorphous silicon monoxide and found that its structure allows the storage of a larger number of Li ions, in turn leading to better battery performance. The new analysis method is

continued...

“Two things are infinite: the universe and human stupidity; and I’m not sure about the universe.” ALBERT EINSTEIN

essential to further develop the next generation of high-capacity lithium-ion batteries. [TECHNICAL ARTICLE](#)

Tags: Energy, Battery, S&T Japan

[Researchers advance groundbreaking ‘water-in-salt’ lithium ion battery technology](#)

[PhysOrg.com](#), 12MAY2016

An international team of researchers (USA - University of Maryland, U.S. Army Research Laboratory, Arizona State University, Spain) proposed introducing a second lithium salt to form a new super-concentrated aqueous electrolyte. The resultant ultra-high concentration of 28 m led to more effective formation of a protective interphase on the anode along with further suppression of water activities at both anode and cathode surfaces. They demonstrated that the introduction of a second salt further pushed the energy densities of aqueous Li-ion cells closer to those of the state-of-the-art Li-ion batteries. [TECHNICAL ARTICLE](#)

Tags: Energy, Battery

ENVIRONMENTAL SCIENCE

[How nanoparticles flow through the environment](#)

[Nanowerk](#), 12MAY2016

In order to assess the amounts of man-made nanoparticles that make their way into the air, earth or water, researchers in Switzerland have developed a computer model. The dynamic model does not just take into account the significant growth in the production and use of nanomaterials, but also makes provision for the fact that different nanomaterials are used in different applications. They report that their estimates offer the best available data at present about the environmental accumulation of nanosilver, nanozinc, nano-titanium dioxide and carbon nanotubes.

[TECHNICAL ARTICLE](#)

Tags: Environmental science, Advanced materials, S&T Switzerland

GOVERNMENT S&T

[DARPA Demo Day 2016 Aims to Speed Transition of Game-Changing Technologies to Military Services](#)

[DARPA News](#), 11MAY2016

On May 11, DARPA hosted DARPA Demo Day 2016 at the Pentagon, providing the Defense Department (DoD) community an up-close look at DARPA’s diverse portfolio of innovative technologies and military systems. DARPA program managers and numerous academic and private-sector project leaders demonstrated their ongoing work on more than 60 current DARPA programs. [A full list of DARPA Demo Day 2016 programs with summaries.](#)

Tags: Government S&T, DARPA

INFORMATION TECHNOLOGY

[Spin-currents at metal-oxide interfaces for magnetic memories](#)

[Nanowerk](#), 13MAY2016

Researchers in Japan have demonstrated spin-to-charge current conversion by spin pumping from a ferromagnetic permalloy to a Cu/Bi₂O₃ interface. Cu/Bi₂O₃ is a metal/insulator interface, making it easier to control the spin-charge current conversion with an external electric field in the future. The research could pave a way for controlling the conversion between spin and charge current by an electric field effect, which could be beneficial for domain wall motion and the magnetization switching. [TECHNICAL ARTICLE](#)

Tags: Information Technology, Materials science, S&T Japan

MATERIALS SCIENCE

[Attosecond physics: Using laser pulses to direct protons](#)

[Nanowerk](#), 13MAY2016

Using ultrashort laser pulses, an international team of researchers (Germany, USA - Kansas State University, United Arab Emirates, Saudi Arabia) removed an outer hydrogen atom from one side of a hydrocarbon molecule and directed it to the opposite side, where it reattached. The method could be used in the future to synthesize new substances by controlling chemical reactions. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Crafting complex materials to solve the mystery of magnetism](#)

[PhysOrg.com](#), 12MAY2016

Researchers at Pacific Northwest National Laboratory developed a multidimensional analysis approach to measure ordering in the material at the atomic scale. Through investigations of the double perovskite La₂MnNiO₆ they showed that combining multiscale synthesis, characterization, and modeling techniques could lead to a predictive understanding of complex materials systems. In turn, this understanding could help scientists precisely engineer these systems. [TECHNICAL ARTICLE](#)

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

MICROELECTRONICS

[Moore’s Law Is Dead. Now What?](#)

[MIT Technology Review](#), 13MAY2016

The world’s most powerful calculating machines appear to be already feeling the effects of Moore’s Law’s end times.

continued...

The world's top supercomputers aren't getting better at the rate they used to. That's bad news for research programs reliant on supercomputers, such as efforts to understand climate change, develop new materials for batteries and superconductors, and improve drug design. The coming plateau in transistor density will stir more interest in redrawing the basic architecture of computers among supercomputer and data-center designers.

Tags: Microelectronics

FEATURED RESOURCE

Armed with Science

Armed with Science is a daily blog site for the Department of Defense that incorporates print, video, and social media assets over 50 scientific organizations across the Federal government. [RSS](#)

PHOTONICS

Photons with half-integer angular momentum are the latest twist on light

[Physics World, 16MAY2016](#)

An international team of researchers (Ireland, UK) report that photons can have half-integer values of angular momentum when they are confined to fewer than three dimensions. The discovery could have applications in quantum computing and could also boost the capacity of optical-fibre data transmission. [TECHNICAL ARTICLE](#)

Tags: Photonics

Two-beam super-resolution lithography used to create 3D photonic 'gyroid' nanostructures

[PhysOrg.com, 16MAY2016](#)

Rather than rely on traditional methods, such as two-photon polymerization, researchers in Australia found a way to use two-beam super-resolution lithography to create 3D photonic "gyroid" nanostructures. The technique has two major advantages over other techniques used in the past, it offers much better resolution and the resulting structure has more mechanical strength. The structures they created should make them ideal for use in photonics, optic technologies and optoelectronics devices. [TECHNICAL ARTICLE](#)

Tags: Photonics, S&T Australia

Experiment suggests it might be possible to control atoms entangled with the light they emit by manipulating detection

[PhysOrg.com, 12MAY2016](#)

Researchers at Washington University looked at spontaneous emission with an instrument sensitive to the wave rather than the particle nature of light. They found

that different detectors see spontaneous emission very differently - in the wave nature of light we see diffusive evolution between the states. The fact that an atom's average excitation can increase even when it decays is a sign that how we look at light might give us some control over the atoms that emitted the light. [TECHNICAL ARTICLE](#)

Tags: Photonics

Plans for a laser-driven gamma-ray beam are unveiled by physicists

[Physics World, 11MAY2016](#)

According to researchers at UT Austin a collimated beam of gamma-ray photons could be created by firing intense laser pulses into a specially designed plastic target. The electrons liberated when the pulse hits the target are accelerated in zigzag trajectories along magnetic-field lines. The electrons would therefore emit synchrotron radiation in the direction of the laser beam—an effect that could be used to make a pulsed gamma-ray source tens of terawatts in power. [TECHNICAL ARTICLE](#)

Tags: Photonics, Particle physics

QUANTUM SCIENCE

Theorists smooth the way to modeling quantum friction

[Science Daily, 16MAY2016](#)

A team of researchers in the US (Princeton University, UC Irvine) used operational dynamic modeling to develop a model focused on the two ultimate requirements—that it should obey the Heisenberg principle and produce real observations—and worked backwards. This distinct approach creates a new rigorous and practical formulation for quantum friction. The model opens a way forward to understand not only quantum friction but other dissipative phenomena as well. [TECHNICAL ARTICLE](#)

Tags: Quantum science

Novel gate may enhance power of Majorana-based quantum computers

[Nanowerk, 13MAY2016](#)

In topological quantum computing, braiding is used to circumvent the relentless and noisy background that constantly bombard the computer's data. To overcome the difficulties associated with braiding, researchers at the University of Maryland added an extra process beyond ordinary braiding, and discovered a way to give a certain breed of topological particles all the tools needed to run any quantum calculation, all the while circumventing the need for actual braiding. [TECHNICAL ARTICLE](#)

Tags: Quantum science

Quantum physics inside a drop of paint

[PhysOrg.com, 12MAY2016](#)

Researchers in the Netherlands proved that two photons falling on a drop of paint can just leave through two possible exits. According to the so-called 'Hong-Ou-Mandel effect', the

continued...

photons come out through one of the two exits at the same time. Which one that will be cannot be predicted beforehand. They achieved this by programming the light in a very smart way. Controlling quantum light effects like in the new experiments, opens new possibilities in quantum computing and advanced security techniques like a 'quantum credit card'. [TECHNICAL ARTICLE](#)

Tags: Quantum science, Materials science

[New device steps toward isolating single electrons for quantum computing](#)

[Science Daily, 11MAY2016](#)

Electrons represent an ideal quantum bit. However, exploiting electrons as qubits also poses a challenge in that they must be trapped and manipulated. A team of researchers in the US (University of Chicago, Yale University, Argonne National Laboratory) captured the electrons by coaxing them to float above the surface of liquid helium at extremely low temperatures. Attraction and repulsion balance out at about 10 nanometers above the surface of the helium. Thus the electrons can be held for as long as needed. Spin states of the trapped electrons can be the basic building blocks of a scalable quantum computer. [TECHNICAL ARTICLE](#)

Tags: Quantum science

S&T POLICY

[Russia plans to deploy 24 hypersonic Yu-71 missiles by 2025](#)

[Next Big Future, 12MAY2016](#)

According to Jane's Intelligence Review, Project 4202 could turn out a limited number of glide vehicles armed with nuclear warheads by 2020, and up to 24 with new hypersonic payloads could be deployed between 2020 and 2025. Reports indicate that by then, Russia could potentially deploy a new ICBM that could carry the Yu-71. The advantage of the U-71 is about its speed and maneuverability. The vehicle is said to develop the speed ten times the speed of sound; it carries nuclear warheads.

Tags: S&T policy, Military technology, S&T Russia

SCIENCE WITHOUT BORDERS

[Ultrafast light pulses drive quasiparticle collider](#)

[Physics World, 12MAY2016](#)

An international team of researchers (Germany, USA - UC Santa Barbara) created "excitons" by firing a laser pulse at a semiconductor. This new experimental technique could resolve the dynamics of the collision to about two femtoseconds. The researchers say that, apart from improving our understanding of the fundamental physics of excitons, the technique opens the door to studying the fast dynamics of quasiparticle interactions

in solids. It could even be used to design semiconductor devices in the future. [TECHNICAL ARTICLE](#)

Tags: Science without borders, Particle physics

SENSORS

[New C-IED Jammer for the French Army Defense Update, 16MAY2016](#)

ECLIPSE, a new counter-IED system developed by Thales, is built around a new-generation jammer that prevents improvised explosive devices from being detonated by remote control. The moment an IED is detected, ECLIPSE jams radio signals across a wide range of frequencies, without interfering with the radio communication systems used by friendly forces.

Tags: Sensors, Military technology

[Launching a swarm with rockets to find the cause of GPS chaos](#)

[PhysOrg.com, 12MAY2016](#)

Solar storms are detrimental not only to air traffic; they can also cause damage to space stations, satellites and astronauts, electrical installations on the ground, subsea telecommunications cables and communication with shipping and oil rigs in the North. To develop better space weather forecasts, researchers in Sweden are working on a project to measure the temperature, ion velocity and electron density of the plasma. A rocket will be launched which will spew out other measuring devices once it is in the ionosphere.

Tags: Sensors, S&T Sweden

[World's first wireless satellite](#)

[Science Daily, 12MAY2016](#)

Previously, all single components of a satellite had to be interconnected using electric cables. Researchers in Germany have developed a technology that uses miniaturised high-speed real-time radio modules with short ranges instead. This reduces design effort and costs while boosting the satellite's technical reliability and flexibility. The technology is scheduled to be tested in 2018.

Tags: Sensors, S&T Germany, Satellite technology

[Paper gets 'smart' with drawn-on, stenciled sensor tags](#)

[Science Daily, 11MAY2016](#)

A team of researchers in the US (Disney Research, University of Washington, Carnegie Mellon University) has developed PaperID technology which leverages inexpensive, off-the-shelf RFID tags that function without batteries but can be detected through a reader device placed in the same room as the tags. Each tag has a unique identification, so a reader's antenna can pick out an individual among many. The lightweight interfaces can do anything from controlling music using a paper baton, to live polling in a classroom. [TECHNICAL ARTICLE](#)

Tags: Sensors

Spontaneous emission and the operation of invisibility cloaks: Can the invisibility cloaks render objects invisible in quantum mechanic domain?

arXiv, 04MAY2016

Researchers in Iran studied the spontaneous emission rate of an excited two-level atom in the vicinity of an ideal invisibility cloaking. They compared the results in the presence and the absence of the invisibility cloak and found that the cloak works very well far from its resonance frequency to conceal a macroscopic object, whereas at near the resonance frequency the object is more visible than the situation that the object is not covered by the cloak. TECHNICAL ARTICLE

Tags: *Sensors* ■

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 asdrest-bulletin-reply@sainc.com. This publication is authored and distributed by:

The Office of Technical Intelligence
OSD AT&L/OASD(R&E)

Ms. Hema Viswanath
OTI Corporate Librarian