



[Advanced materials \(7\)](#)

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

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

[Cyber security \(2\)](#)

[Energy \(2\)](#)

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

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

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

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

[Microelectronics \(2\)](#)

[Photonics \(1\)](#)

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

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

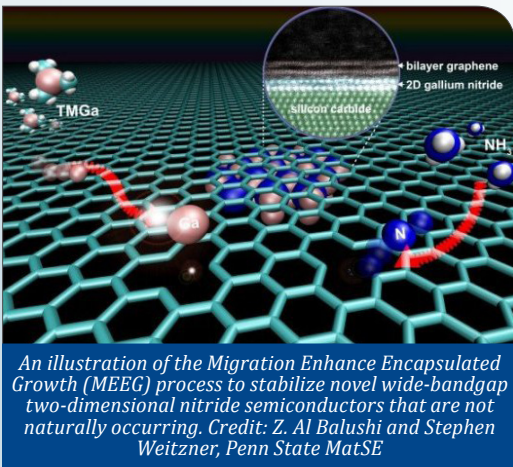
[Science without borders \(6\)](#)

[Sensors \(2\)](#)

FEATURE ARTICLES

Graphene key to growing two-dimensional semiconductor with extraordinary properties

Science Daily, 29AUG2016



An illustration of the Migration Enhance Encapsulated Growth (MEEG) process to stabilize novel wide-bandgap two-dimensional nitride semiconductors that are not naturally occurring. Credit: Z. Al Balushi and Stephen Weitzner, Penn State MatSE

When grown in its two-dimensional form, gallium nitride transforms from a wide-bandgap material to an ultrawide-bandgap material, effectively tripling the energy spec-

trum in which it can operate, including the whole ultraviolet, visible and infrared spectrum. A team of researchers in the US (Pennsylvania State University, University of Notre Dame, US Naval Research Laboratory, University of Texas at Dallas, industry partner) developed a growth method, Migration Enhanced Encapsulated Growth, which uses a layer of graphene to assist the growth and stabilize a robust structure of 2D gallium nitride. The process also changes the crystal structure of the material, which may lead to entirely new applications in electronics and optoelectronics. [TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#), [Featured Article](#)

A nanoscale wireless communication system via plasmonic antennas

PhysOrg.com, 25AUG2016

Researchers at Boston College developed a device with a three-step conversion process that changes a surface plasmon to a photon on transmission and then converts that elemental electromagnetic particle back to a surface plasmon as the receiver picks it up. Central to the

newfound control of the surface plasmons was the creation of a small gap of air between the waves and the silver surface of the device by removing a portion of the glass substrate. Expanding and narrowing that gap proved crucial to tuning the device. Without dispersion, the new device capitalizes on the capability of surface plasmons to travel at 90 to 95 percent of the speed of light on a silver surface and photons traveling between the antennas at their inherent speed of light. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: [Communications technology](#), [Featured Article](#)

S&T NEWS ARTICLES

ADVANCED MATERIALS

3-D-printed structures 'remember' their shapes

Science Daily, 26AUG2016

An international team of researchers (Singapore, USA - MIT, Georgia Institute of Technology) used microstereolithography, a 3-D printing process they have pioneered where they use light from a projector to print patterns on successive layers of resin. They picked two polymers, one composed of long-chain polymers and the other resembling more of a stiff scaffold. When mixed together and cured, the material can be stretched and twisted dramatically without breaking. It can bounce back to its original printed form, within a specific temperature range. Applications range from soft actuators to tiny drug capsules that open upon early signs of infection. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#)

Admitting visible light, rejecting infrared heat

Science Daily, 25AUG2016

The transparency of glass to visible light makes it the most common way to let light into a building. But because glass is also transparent to near-infrared

continued...

[BACK TO TOP](#)

radiation -- windows also let in heat, giving rise to the well-known greenhouse effect. Researchers in Singapore have developed a coating with tin oxide nanoparticles doped with small amounts of the element antimony. By varying the nanoparticles' antimony concentration, they could optimize their ability to absorb near-infrared radiation. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

[Defect-engineered graphene improves supercapacitors](#)

[Nanowerk, 25AUG2016](#)

Due to nanocarbon's inherently low quantum capacitance, the net energy that could be drawn from supercapacitors is reduced. By doping graphene layers with nitrogen atoms, an international team of researchers (USA - Clemson University, University of South Carolina, India) has produced graphene with three different flavors: graphitic, pyridinic, and pyrrolic. Pyridinic and pyrrolic graphene add nitrogen atoms in the right configuration to change the microscopic distribution of electrons and thereby increase the quantum capacitance of graphene. They were able to extract as much energy as a Li-ion thin-film battery but with two orders of magnitude higher power. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

[Defects, electrons, and a long-standing controversy](#)

[PhysOrg.com, 25AUG2016](#)

A team of researchers in the US (Johns Hopkins University, Argonne National Laboratory, Oak Ridge National Laboratory) reconciled a long-standing controversy on the diverse results on topological insulators' low-temperature electrical properties and established a systematic relationship between the bulk chemistry and surface topological properties. They showed that electron dopants enhance the topological behavior of bulk samarium hexaboride while aluminum defects and samarium vacancies suppress it. Understanding of the mechanism paves a way to control the properties of topological insulators. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials

[Graphene under pressure](#)

[Nanowerk, 25AUG2016](#)

Graphene balloons routinely form when graphene is placed on flat substrates. Researchers in the UK found that the shape and dimensions of the nano-bubbles provide straightforward information about both graphene's elastic strength and its interaction with the underlying substrate. Such balloons can also be created with other two-dimensional crystals such as single layers of molybdenum disulfide or boron nitride. Graphene enclosing bubbles of a micron size creates pressures as high as 200 megapascals,

or 2,000 atmospheres. The technology helps study the properties of atomically thin membranes under high strain and pressure. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

[Nanofur for oil spill cleanup](#)

[Nanowerk, 23AUG2016](#)

Researchers in Germany have found that the oil-binding capacity of the water plant is determined by the shape of the hair ends. Based on this, the researchers improved the plastic nanofur material developed at their institute. It is now used as a model to further develop the new Nanofur material for the environmentally friendly cleanup of oil spills. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, Biomimetics, S&T Germany

AUTONOMOUS SYSTEMS & ROBOTICS

[What Robots Can Learn from Babies](#)

[MIT Technology Review, 30AUG2016](#)

Children quickly learn to predict what will happen if they turn a cup filled with juice upside down. Robots, on the other hand, don't have a clue. Researchers at the [Allen Institute for Artificial Intelligence](#) in Seattle have developed a computer program that shows how machines determine how the objects captured by a camera will most likely behave. This could help make robots and other machines less prone to error, and might help self-driving cars navigate unfamiliar scenes more safely.

Tags: Autonomous systems & robotics, Artificial intelligence

[The first autonomous, entirely soft robot](#)

[Science Daily, 25AUG2016](#)

A team of researchers in the US (Harvard University, partner hospitals) has 3D-printed an autonomous, untethered, and entirely soft robot nicknamed the octobot, which is pneumatic-based. It transforms hydrogen peroxide into a large amount of gas replacing rigid power sources. A soft analog of a simple electronic oscillator controls when hydrogen peroxide decomposes to gas in the octobot. The simplicity of the assembly process paves the way for more complex designs. [TECHNICAL ARTICLE](#)

Tags: Autonomous systems & robotics

COMMUNICATIONS TECHNOLOGY

[Programmable network routers](#)

[MIT News, 23AUG2016](#)

Because the routers that direct traffic in a server farm need to be superfast, the control algorithms are hardwired into the routers' circuitry. That means that if someone develops a better algorithm, network operators have to wait for a new generation of hardware before they can take advantage of it. A team of researchers in the US (MIT, Washington University, Stanford University, industry partners) are working to change that with routers that are programmable

“Our job in physics is to see things simply, to understand a great many complicated phenomena, in terms of a few simple principles.” STEVEN WEINBERG

but can still keep up with the blazing speeds of modern data networks. [OPEN ACCESS TECHNICAL ARTICLE 1](#), [OPEN ACCESS 2](#).

Tags: *Communications technology*

CYBER SECURITY

[Secure networks for the Internet of the future](#)
PhysOrg.com, 25AUG2016

A research consortium working on an EU project SENDATE (SEcure Networking for a DATa center cloud in Europe) is seeking to develop a network architecture and technologies for secure and flexible distributed data centres. Innovative technologies and approaches such as the virtualization of network functions combined with software-defined networking establish the basis for their effort.

Tags: *Cyber security, Information technology*

[Cybersecurity researchers design a chip that checks for sabotage](#)
EurekAlert, 23AUG2016

Researchers at New York University designed a chip with both an embedded module that proves that its calculations are correct and an external module that validates the first module's proofs. The verifying processor can be fabricated separately from the chip. This arrangement provides a safety net for the chip maker and the end user.

Tags: *Cyber security*

ENERGY

[A silicon-metal nanocomposite for high capacity lithium-ion batteries](#)
Nanowerk, 23AUG2016

An international team of researchers (Japan, USA - Arizona State University, Georgia Institute of Technology) developed an anode material for lithium-ion rechargeable batteries by forming nanoparticles made of silicon-metal composites on metal substrates. The resulting anode material had high capacity—almost twice as high as conventional materials—and a long cycle life. These results will lead to the development of higher-capacity and longer-life anode materials for Li-ion rechargeable batteries.

TECHNICAL ARTICLE

Tags: *Energy, Battery*

[Bubble-wrapped sponge creates steam using sunlight](#)
Science Daily, 22AUG2016

An international team of researchers (MIT, United Arab Emirates) has invented a bubble-wrapped, sponge-like device that soaks up natural sunlight and heats water to

boiling temperatures, generating steam through its pores. The design, which the researchers call a 'solar vapor generator,' requires no expensive mirrors or lenses to concentrate the sunlight, but instead relies on a combination of relatively low-tech materials to capture ambient sunlight and concentrate it as heat. TECHNICAL ARTICLE

Tags: *Energy, Solar energy*

ENVIRONMENTAL SCIENCE

[Seismic shield: Large-scale metamaterials combat earthquakes in 3-D model'](#)
PhysOrg.com, 24AUG2016

An international team of researchers (France, Italy, UK) propose a novel approach to the problem and discuss the feasibility of a passive isolation strategy for seismic waves based on large-scale mechanical metamaterials, including numerical analysis of both surface and guided waves, soil dissipation effects and adopting full 3D simulations. OPEN ACCESS TECHNICAL ARTICLE

Tags: *Environmental science*

IMAGING TECHNOLOGY

[Amazon and the CIA Want to Teach AI to Watch from Space](#)
MIT Technology Review, 25AUG2016

A joint project by a group of companies in the US wants to train machine-learning algorithms to interpret high-resolution satellite photos by themselves. According to the team it should be possible to train software to do things like map the roads and buildings of shanty towns, track changes to urban infrastructure such as park benches and stop signs, and measure the materials used in roofs and other structures. That kind of information could be commercially valuable, and help inform health and aid programs.

Tags: *Imaging technology, Artificial intelligence, Autonomous systems & robotics, Satellite technology*

INFORMATION TECHNOLOGY

[Post-disaster optimization technique capable of analyzing entire cities](#)
Science Daily, 24AUG2016

Researchers at Lehigh University created Algorithm with Multiple-Input Genetic Operators (AMIGO) designed to consider very complex objectives, keeping computational costs down and makes the search process more efficient. It does this by taking advantage of the additional data in the genetic operators which are used to guide the algorithm toward a solution. It takes the topology of a network and

continued...

then develops optimal recovery strategies. [TECHNICAL ARTICLE](#)

Tags: Information technology

MATERIALS SCIENCE

[Physicists discovered new peculiarities of a material with a giant magnetocaloric effect](#)

[Science Daily, 25AUG2016](#)

Magnetocaloric materials have been successfully used to produce ultra-low temperatures, and also have good prospects in the heat engines' and refrigeration units' production. An international team of researchers (Russia, Japan, UK) studied an alloy of iron and rhodium to study the magnetocaloric effect (MCE) and showed that the smallest structural change in the iron-rhodium alloys may result in a significant change in its magnetocaloric properties. MCE is used as a method of study of the magnetic phase transitions in different materials and refine the phase diagrams of magnetic materials.

[TECHNICAL ARTICLE](#)

Tags: Materials science

FEATURED RESOURCE

[SciTech Daily](#)

Selected analysis, opinion, features, background and book reviews from international news sources.

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MICROELECTRONICS

[Electrons at the speed limit](#)

[Science Daily, 26AUG2016](#)

Electronic components have become faster and faster over the years, thus making powerful computers and other technologies possible. An international team of researchers (Switzerland, Japan) has investigated how fast electrons can ultimately be controlled with electric fields. Their insights are of importance for the petahertz electronics of the future. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, Information technology, Integrated circuits

[Finding patterns in 'electron puddles'](#)

[PhysOrg.com, 23AUG2016](#)

An international team of researchers (France, Switzerland, USA - Yale University) created an "electron puddle" within a semiconductor in order to study the particle-wave duality in the nature of electrons. Application of an electric potential led to the puddle's charge increasing in steps. The stronger the quantum and thermal fluctuations were, the more smeared these

single-electron steps became. This smearing provided the quantitative measure for the fluctuations. According to the researchers, understanding the quantum laws of electricity is crucial in the development of future nanoelectronic devices. [TECHNICAL ARTICLE](#)

Tags: Microelectronics

PHOTONICS

[Scientists experimentally realize optomechanically induced non-reciprocity](#)

[PhysOrg.com, 29AUG2016](#)

Normal non-reciprocal devices are based on magnetic-optical material. An international team of researchers (China, USA - Yale University) has experimentally demonstrated non-magnetic non-reciprocity using optomechanical interactions in a whispering gallery microresonator. The underlying mechanism demonstrated in this study is universal and can be generalized to any traveling wave resonators. Non-reciprocal phase shift is of fundamental interest for exploring exotic topological photonics.

[TECHNICAL ARTICLE](#)

Tags: Photonics

QUANTUM SCIENCE

[New single-photon microwave source developed](#)

[PhysOrg.com, 25AUG2016](#)

An international team of researchers (UK, Japan, Russia) used a super-cooled qubit that bridges two open ends of a broken transmission line to create a new device which is tunable and is able to produce single photons over a wide range of frequencies on demand. After being excited, the qubit immediately relaxes, producing a single photon. The qubit energy can be tuned, thus altering the frequency of the output photons. The technology has great potential for applications in quantum computing, quantum information technology and studying the fundamental reactions between light and matter in quantum circuits. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

Tags: Quantum science, Photonics, Qbits

[Spin polarization by strong field ionization](#)

[PhysOrg.com, 16AUG2016](#)

Using the gas of Xe atoms, researchers in Germany present the first experimental detection of electron spin polarization created by strong-field ionization. The measured spin-polarization was found to be as high as 30%, changing its sign with the electron energy. This work opens the new dimension of spin to strong-field physics. It paves the way to the production of sub-femtosecond spin-polarized electron pulses with applications ranging from probing the magnetic properties of matter at ultrafast timescales to testing chiral molecular systems with sub-femtosecond temporal and sub-ångström spatial resolutions. [TECHNICAL ARTICLE](#)

Tags: Quantum science, S&T Germany

S&T POLICY

[Businesses spent \\$341 billion on R&D performed in US in 2014](#)

NSF News, 25AUG2016

Development accounted for the greatest share, 78 percent, of 2014 R&D spending. Applied research accounted for 16 percent, while basic research accounted for 6 percent. Funding from companies' own sources rose by 6.7 percent from 2013 to 2014, totaling \$283 billion. Funding from other sources totaled \$58 billion. The federal government was the largest of those other sources, accounting for \$27 billion, \$19 billion of which came from the Department of Defense.

Tags: S&T policy

SCIENCE WITHOUT BORDERS

[These are the world's 10 worst problems, according to millennials](#)

Science Alert, 30AUG2016

These insights come from the World Economic Forum's annual 2016 Global Shapers Survey which surveyed more than 26,000 millennials from 181 countries to gauge the priorities, concerns, and attitudes of millennials around the globe. According to the respondents the three most serious issues affecting the world today are climate change, followed by large-scale wars and religious conflicts. They trusted the responsibility to fix the issues plaguing the world belongs to international organisations and themselves.

Tags: Science without borders

[Global Grand Challenge #gsummit](#)

Next Big Future, 28AUG2016

Singularity University believes that leveraging the convergence of exponential technologies will set us on the path to solve [Global Grand Challenges](#) and shift from an era of scarcity to abundance. There are twelve global grand challenges (GGCs). Each GGC includes three perspectives: ensuring basic needs are met for all people, sustaining and improving quality of life, and mitigating future risks.

Tags: Science without borders

[Measuring tiny forces with light](#)

PhysOrg.com, 25AUG2016

A team of researchers in the US (NIST, University of Maryland) is developing two types of force-measurement devices that use laser light to reliably create small forces. The first is a chip-sized sensor that can use micro- to milliwatt-power light. The second is a tabletop contraption designed for laser light of about 1 watt to tens of kilowatts of power. Uses could include sensors that use laser light as a built-in reference and cheap field-portable balances for near-instant

measurement of masses of a milligram or less. [TECHNICAL ARTICLE](#)

Tags: Science without borders

[Positioning exact to the millimeter: Geodetic reference system enables highly accurate positioning](#)

Science Daily, 25AUG2016

Everyday positioning wouldn't be possible without a highly complex reference system that requires constant updating. Researchers in Germany have released the International Terrestrial Reference System DTRF2014, which includes minute seasonal variations in the coordinates on the order of millimeters. The results are of interest to precisely model the movement of the earth's crust, measure the rising sea level, and position satellites and thus improve the precision of all satellite-guided navigation systems.

[TECHNICAL ARTICLE](#)

Tags: Science without borders, S&T Germany

[35 Innovators Under 35 2016](#)

MIT Technology Review, 23AUG2016

The people in Technology Review's 16th annual celebration of young innovators are disrupters and dreamers. No matter whether they're pursuing medical breakthroughs, refashioning energy technologies, making computers more useful, or engineering cooler electronic devices—and regardless of whether they are heading startups, working in big companies, or doing research in academic labs—they all are poised to be leaders in their fields.

Tags: Science without borders

[Seven over 70](#)

MIT Technology Review, 23AUG2016

Yet more proof that innovation isn't only for the young. The article highlights seven innovators over the age of 70, still working.

Tags: Science without borders

SENSORS

[Fast switching all-solid-state wavelength-dependent bipolar photodetector](#)

Nanowerk, 29AUG2016

Researchers in Japan have developed a solid-state wavelength-dependent bipolar photodetector which has faster response times and tunable switching wavelengths. The device exploits the wavelength-dependent penetration of photons in semiconductors. Optoelectronic sensors that can switch their photocurrent direction based on the wavelength of incident light are an important building block in novel optical logic gates, color sensors, and photocatalysts. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors, S&T Japan

Carbon Nanotube-Based Sensor Detects Toxins With a Mobile Phone

IEEE Spectrum, 25AUG2016

An international team of researchers (MIT, Japan) found that when they wrapped the supramolecular polymers around the CNTs, the polymer acted as an insulator that limited the natural high conductivity of the CNTs. Detection occurs when the polymer wrapping comes in contact with a toxic gas, chemicals cause the disassembly and the wires touch and completes the circuit. There is no need to move many electrons to measure this and we can inductively power and read the sensor with near-field communication devices, such as a smartphone. TECHNICAL ARTICLE

Tags: *Sensors* ■

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