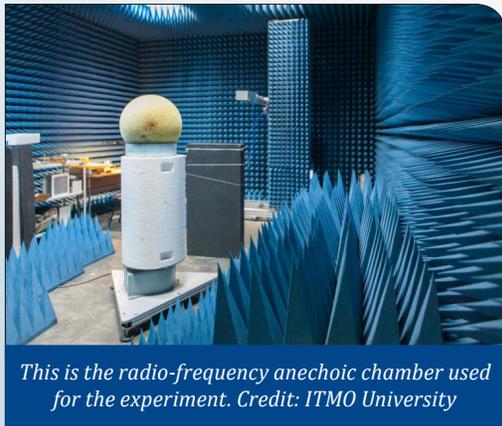


[Advanced materials \(6\)](#)[Autonomous systems
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FEATURE ARTICLES

[Scientists create invisible objects in the microwave range without metamaterial cloaking](#)

[Science Daily, 13APR2015](#)

This is the radio-frequency anechoic chamber used for the experiment. Credit: ITMO University

Contrary to the now prevailing notion of invisibility that relies on metamaterial coatings, an international team of researchers (Russia, Australia) achieved the result using a homogenous object without any additional coating layers. The method is based on a new understanding of electromagnetic wave scattering. [TECHNICAL ARTICLE](#)

Tags: [Breakthrough technology](#), [Sensors](#), [Featured Article](#)

[Team tightens bounds on quantum information 'speed limit'](#)

[PhysOrg.com, 13APR2015](#)

The work by a team of researchers in the US (NIST, University of Maryland) offers a better description of how quickly information can travel within a system built of quantum particles such as a group of individual atoms. Engineers will need to know this to build quantum computers, which will have vastly different designs and be able to solve certain problems much more easily than the computers of today. While the new finding does not give an exact speed for how fast information will be able to travel in these as-yet-unbuilt computers, it does place a far tighter constraint on where this speed limit could be. [TECHNICAL ARTICLE](#)

Tags: [Quantum science](#), [Government S&T](#), [Featured Article](#)

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Achieving continuous metal film with broadband optical transparency](#)

[Nanotechweb, 13APR2015](#)

Researchers in China combined plasmonic resonances and optical modes to form a broadband optically transparent metal film. These are provided by the plasmonic crystals and the Fabry-Perot cavity respectively. The PC and the FP cavity respectively act as the optical field input and output couplers. [TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#), [Photonics](#), [S&T China](#)

[Long-sought magnetic mechanism observed in exotic hybrid materials](#)

[Science Daily, 13APR2015](#)

A team of researchers in the US (MIT, Brookhaven National Laboratory, Pennsylvania State University) has shown conclusive evidence of van Vleck magnetism, which mediates the magnetic properties of topological insulators. The discovery could lead to quantum computers, spintronics, and superior semiconductors. [TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#)

[Team develops elastic-composite nanogenerator \(w/video\)](#)

[Nanowerk, 13APR2015](#)

Researchers in South Korea demonstrated a facile methodology to obtain a high-performance and hyper-stretchable elastic-composite generator (SEG) using very long silver nanowire-based stretchable electrodes. Their stretchable piezoelectric generator can harvest mechanical energy to produce high power output (~4 V) with large elasticity (~250%) and excellent durability (over 104 cycles). The results were achieved by the non-destructive stress-relaxation ability of the unique electrodes as well as the good piezoelectricity of the device components. The new SEG can be applied to a wide-variety of wearable energy-harvesters to transduce biomechanical-stretching energy from the body (or machines) to electrical energy. [TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#), [Flexible electronics](#)

[continued...](#)

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[New insights into graphene and organic composites in electronics](#)

Science Daily, 10APR2015

An international team of researchers (Italy, Germany, France), working under the auspices of the EU funded Graphene flagship, show how organic semiconductors can be used to better process graphene, and to tune its properties for particular applications. [TECHNICAL ARTICLE 1, 2](#)

Tags: *Advanced materials, S&T EU*

[Researchers develop flame and water resistant cotton coating that is also self-cleaning](#)

PhysOrg.com, 10APR2015

Researchers in China fabricated flame-retardant and self-healing superhydrophobic coatings on cotton fabric by a solution-dipping method, which involves the sequential deposition of a trilayer of branched poly (ethylenimine) (bPEI), ammonium polyphosphate (APP), and fluorinated-decyl polyhedral oligomeric silsesquioxane (F-POSS). When directly exposed to flame, such a trilayer coating generates a porous char layer because of its intumescent effect, successfully giving the coated fabric a self-extinguishing property. The F-POSS embedded in cotton fabric and APP/bPEI coating produces a superhydrophobic surface with a self-healing function. [TECHNICAL ARTICLE](#)

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

[Engineers now understand how complex carbon nanostructures form](#)

PhysOrg.com, 09APR2015

The forces that create the CNT structures known as “forests” often are unpredictable and are mostly left to chance. Researchers at the University of Missouri have developed a method which can map how different synthesis parameters, such as temperature and catalyst particle size, influence how nanotubes form while simultaneously testing the resulting CNT forests for how they will behave in one comprehensive simulation. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

AUTONOMOUS SYSTEMS & ROBOTICS

[Video Friday: Robot Sword Fights, MIT Basement Racing, and RoboGames](#)

IEEE Spectrum, 10APR2015

NSF checks out the UCLA Biomechatronics Lab to see how they're incorporating a sense of touch into prosthetics.

Tags: *Autonomous systems & robotics*

BIG DATA

[Machine Learning Algorithm Mines 16 Billion E-Mails](#)

MIT Technology Review, 09APR2015

A team of researchers in the US (Yahoo Labs, University of Southern California) studied patterns of behavior in a

database of 16 billion e-mails exchanged between two million people over several months. E-mail patterns are so reliable that a machine learning algorithm can predict in advance how long a reply is likely to be and when an e-mail conversation is likely to end. That's information that could play an important role in the next generation of e-mail systems. [TECHNICAL ARTICLE](#)

Tags: *Big data*

BIOTECHNOLOGY

[Spontaneous formation of biomimetic, nanoporous membrane channels](#)

PhysOrg.com, 10APR2015

An international team of researchers (USA, Spain) found that CNTs functionalized with lipid molecules spontaneously insert into cell membranes, both natural and synthetic. Importantly, insertion of the small CNTs into live cell walls allowed them to interface directly with a real biological system. The results point to the hybrid materials having useful membrane applications which include providing a platform for nanofluidic studies, building bioelectronic interfaces and artificial cells, and serving as key components for energy-efficient membrane separation systems. [TECHNICAL ARTICLE](#)

Tags: *Biotechnology, Biomimetics*

ENERGY

[Cheap carbon foam makes good battery catalyst](#)

Nanotechweb, 13APR2015

The new carbon nanostructure made by a team of researchers in the US (Case Western Reserve University, University of North Texas) is cheap, easy to make and environmentally friendly. It works efficiently for both oxygen reduction reaction (ORR) and oxygen evolution reaction (OER), two key chemical reactions in metal-air batteries. It might be used to replace expensive platinum and other metal-based ORR and OER catalysts in a wide range of applications, including fuel cells, metal-air batteries, solar cells and even water-splitting systems. [TECHNICAL ARTICLE](#)

Tags: *Energy, Battery*

[Making battery charges last a lot longer: New ways to see light and store information](#)

Science Daily, 13APR2015

An international team of researchers (China, the Netherlands, UK, Germany) designed an organic electronic device in which charge generated by light lived approximately 10,000 times longer than was previously thought possible. They did this by designing a small device based on organic molecules in which the built-in electric field creates a well which traps and protects charge carriers. [TECHNICAL ARTICLE](#)

Tags: *Energy, Battery*

continued...

“That which can be asserted without evidence, can be dismissed without evidence.”

CHRISTOPHER HITCHENS

Plant cell structure discovery could lead to improved renewable materials

Science Daily, 10APR2015

Researchers in the UK found that the xylan polymer, which comprises about a third of wood, has an unexpected shape inside the plant cell walls. Plant cell walls provide mechanical strength to plants. This major step forward in understanding the molecular architecture of plant cell walls will impact the use of plants for renewable materials, energy and for building construction.

TECHNICAL ARTICLE

Tags: Energy

Quantum Dots Could Harvest Waste Energy From Nanoscale Electronics

IEEE Spectrum, 10APR2015

At the heart of a rectifier, invented by an international team of researchers (Germany, UK), are two coupled quantum dots made of gallium arsenide and aluminum gallium arsenide. One dot is connected to an electronic circuit, which provides AC in the form of voltage fluctuations, while the other quantum dot is where the direct current flows out to picowatts of power. TECHNICAL

ARTICLE

Tags: Energy, Quantum science

Research could usher in next generation of batteries, fuel cells

Science Daily, 10APR2015

A team of researchers in the US (University of South Carolina, Brookhaven National Laboratory, Clemson University) studied gadolinium doped ceria (GDC), which transports oxygen ions and is currently in use as a solid oxide fuel cell electrolyte. Through the use of additives and a “smart” chemical reaction, they demonstrated a greatly enhanced conductivity in GDC. The result is a faster and more efficient conversion into electricity.

TECHNICAL ARTICLE

Tags: Energy, Materials science

Scientists a step closer to developing renewable propane

Science Daily, 10APR2015

Natural metabolic pathways for the renewable biosynthesis of propane do not exist, but an international team of researchers (UK, Finland) has developed an alternative microbial biosynthetic pathway to produce renewable propane. The team modified existing fermentative butanol pathways using an engineered enzyme variant to redirect the microbial pathway to produce propane as opposed to butanol. TECHNICAL ARTICLE

Tags: Energy

Voltage Fluctuations Converted to Electricity

American Physical Society Spotlight, 10APR2015

Four years ago, researchers in Switzerland proposed that energy might be harvested more effectively with a three terminal device. Their design aimed to extract energy from a temperature difference while avoiding any direct connection from hot to cold along which heat might flow. An international team of researchers (Germany, UK) demonstrated this basic idea in a real device. They didn't actually measure energy extraction from a temperature difference, because experiments cannot maintain and measure such differences accurately at the nanoscale dimensions of the device. Instead, they applied voltage fluctuations from a controlled voltage source to mimic the effects of a temperature difference and showed that the device works as envisioned. TECHNICAL ARTICLE

Tags: Energy, Quantum science

Erupting electrodes: how recharging leaves behind microscopic debris inside batteries (w/video)

Nanowerk, 09APR2015

A team of researchers in the US (PNNL, Florida State University, Tallahassee, UC Davis, Penn State University) provides the first visual evidence of what leads to the formation of lithium dendrites, nanoparticles and fibers commonly found in rechargeable lithium batteries that build up over time and lead to battery failure. The work will help researchers design cheaper and more powerful rechargeable batteries with metals more common and safer than lithium. TECHNICAL ARTICLE

Tags: Energy, Battery

EXPLOSIVES

What happens underground when a missile or meteor hits

Science Daily, 10APR2015

Researchers at Duke University report that materials like soil and sand actually get stronger when they are struck harder. The findings help explain why attempts to make ground-penetrating missiles go deeper by simply shooting them harder and faster have had limited success. Projectiles actually experience more resistance and stop sooner as their strike speed increases. TECHNICAL ARTICLE

Tags: Explosives, Military technology

continued...

IMAGING TECHNOLOGY

Engineering team invents a camera that powers itself

PhysOrg.com, 15APR2015

Researchers at Columbia University have designed a prototype video camera that is fully self-powered, and produces an image of a well-lit indoor scene every second for an indefinite length of time. They designed a pixel that can not only measure incident light but also convert the incident light into electric power. The team is presenting its work at an up-coming conference.

Tags: Imaging technology

A novel liquid-immersible micro-electromechanical systems scanning mirror

PhysOrg.com, 10APR2015

A team researchers in the US (Washington University, Texas A&M University, College Station) has developed a high speed liquid-immersible MEMS scanning mirror with capability of fast and simultaneous scanning of both focused optical and high-frequency ultrasound beams in a liquid environment, which is necessary for high-frequency ultrasound propagation. This work provides a new approach to study the complex neurological functions of the brain. [TECHNICAL ARTICLE](#)

Tags: Imaging technology

FEATURED RESOURCE

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MATERIALS SCIENCE

Multifunctional materials able to respond to thermal stimuli and change colour

Nanowerk, 10APR2015

An international team of researchers (Spain, USA) synthesised hybrid materials based on layered double hydroxides intercalated with thermochromic molecules that change colour with temperature. The system resembles a sandwich with layers of hydroxides, which are magnetic, and interlayers of photoactive molecules. [TECHNICAL ARTICLE](#)

Tags: Materials science

Optimizing atomic neighborhoods for speedier chemical reactions

Science Daily, 09APR2015

An international team of researchers (USA, China) discovered that for palladium-nickel catalysts, certain

surface characteristics, measured at the atomic level, sped up the creation of carbon dioxide from carbon monoxide. The study enhances the discovery and design cycles necessary for engineering low-cost, highly active, and stable catalysts. [TECHNICAL ARTICLE](#)

Tags: Materials science

MICROELECTRONICS

Fujitsu develops thin cooling device for compact electronics

PhysOrg.com, 14APR2015

Using technologies for stacking metal sheets, researchers at Fujitsu Corporation have developed a thin loop heat pipe, less than one millimeter thick. It is capable of transferring approximately five times more heat than current thin heat pipes. This technology will make it possible for CPUs and other heat-generating components to run cooler and to avoid concentrated hot-spots inside devices.

Tags: Microelectronics

Graphene Could Be Great for Spintronics

IEEE Spectrum, 10APR2015

Researchers in Sweden report that they have been able to preserve electron spin for an extended distance using large area graphene. They were able to demonstrate precise pure spin transport over lengths of 16 micrometers with a spin lifetime of 1.2 nanoseconds. They used graphene produced through CVD techniques which promise a way of producing graphene in bulk and consequently more cheaply. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, Advanced materials, S&T Sweden

Performance and durability combine in liquid crystal transistors

PhysOrg.com, 10APR2015

Researchers in Japan have designed a liquid crystal molecule that produces high-performance organic field effect transistors with good temperature resilience and relatively low device variability in addition to high mobility. The discovery may lead to the possibility of designing new materials for the burgeoning field of printed electronics. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, S&T Japan

PHOTONICS

Solution-grown nanowires make the best lasers

PhysOrg.com, 13APR2015

A team of researchers in the US (Columbia University, University of Wisconsin-Madison) has developed a simple method to grow organic-inorganic hybrid perovskites into elongated crystals that make promising lasers. The lasers were nearly 100 percent efficient. Essentially every photon absorbed produced a photon of laser light. [TECHNICAL ARTICLE](#)

Tags: Photonics, Advanced materials

continued...

QUANTUM SCIENCE

[Quantum cryptography at the speed of light: Researchers design first all-photonic repeaters](#)

PhysOrg.com, 15APR2015

All-photonic repeaters proposed by researchers in Canada boast higher quantum-communication rates, use optical elements whose proof-of-principle demonstrations have already been made, and function at room temperature. They make essential use of highly entangled quantum states (called ‘cluster states’) and their useful property of fault-tolerance to losses. [TECHNICAL ARTICLE](#)

Tags: *Quantum science, S&T Canada*

[On the road to spin-orbitronics](#)

Nanowerk, 14APR2015

An international team of researchers (USA, South Korea, China) led by Lawrence Berkeley National Laboratory, discovered a technique by which “spin textures” of magnetic domain walls in ultrathin magnets can be switched between left-handed, right-handed, cycloidal, helical and mixed structures. Given that the “handedness” or chirality of spin texture determines the movement of a magnetic domain wall in response to an electric current, this technique should lend itself to the creation of domains walls designed for desired electronic memory and logic functions. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

[Electrical control of quantum bits in silicon paves the way to large quantum computers](#)

Science Daily, 10APR2015

An international team of researchers (Australia, USA, Japan) demonstrated that a highly coherent qubit, like the spin of a single phosphorus atom in isotopically enriched silicon, can be controlled using electric fields, instead of using pulses of oscillating magnetic fields. The method works by distorting the shape of the electron cloud attached to the atom, using a very localized electric field. This distortion at the atomic level has the effect of modifying the frequency at which the electron responds. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

[Quantum physics: Hot and cold at the same time](#)

Science Daily, 09APR2015

Temperature is a statistical concept. Very small systems, consisting of a small number of particles, are not usually described statistically. An international team of researchers (Austria, Germany, Russia) has now measured how quantum systems reach a state with well-defined statistical properties. They found out that quantum systems can have several temperatures at once.

These findings are relevant for many different quantum systems, maybe even for technological applications.

[TECHNICAL ARTICLE](#)

Tags: *Quantum science*

SCIENCE WITHOUT BORDERS

[Scientists building next-generation dark energy probe](#)

PhysOrg.com, 09APR2015

University of Michigan scientists will build components of a giant camera called Dark Energy Spectroscopic Instrument (DESI) that will map 30 million galaxies’ worth of the universe in three dimensions. The camera will sit at the prime focus of the Mayall 4-meter telescope at Kitt Peak National Observatory in Arizona. It will contain 5,000 optical fibers, each of which can be pointed at an individual galaxy, with the unique positioning system U-M will build. It is designed to help answer one of the most puzzling scientific questions of our time: Why is the expansion of the universe accelerating? [DESI website](#)

Tags: *Science without borders*

SENSORS

[Cost-effective production of magnetic sensors](#)

Science Daily, 10APR2015

Even a one-dimensional sensor needs two microelectronic half-bridges, whose applied magnetic fields point in opposite directions. Joining the two pieces is an elaborate and expensive procedure. Researchers in Germany are able to produce not only the full bridges, but also the two-dimensional sensors monolithically from one piece. For this purpose, the researchers separate a layer of material off a wafer and etch the desired structure out. Subsequent laser treatment enables the scientists to adjust the preferred magnetic directions at will.

Tags: *Sensors, S&T Germany* ■

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