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## FEATURE ARTICLES

### [On quantum scales, there are many second laws of thermodynamics](#)

[PhysOrg.com, 09FEB2015](#)

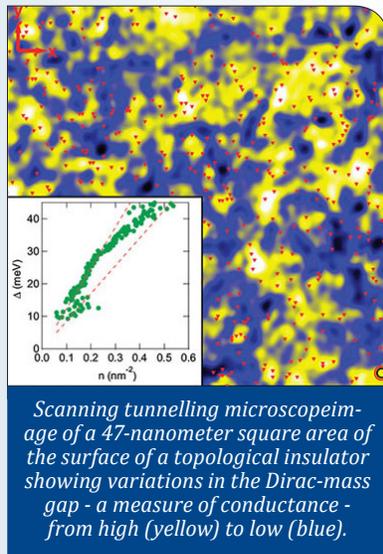
An international team of researchers (UK, Poland, Singapore) has uncovered additional second laws of thermodynamics which complement the ordinary second law of thermodynamics. These new second laws are generally not noticeable except on very small scales, at which point, they become increasingly important. The results of the study give an improved understanding of how heat and energy is transformed on very small scales. This is expected to have wide applications in the design of small systems, including nanoscale devices, biological motors, and quantum technologies such as quantum computers. **TECHNICAL ARTICLE**

*Tags: Quantum science, Featured Article*

### [Physics breakthrough stalled by magnetic disorder](#)

[Nanowerk, 06FEB2015](#)

Ferromagnetic topological insulators were supposed to be the next big thing, offering potential breakthroughs in electronics and new insights into the physics of solids—but it hasn't happened. Researchers at Cornell and Brookhaven National Laboratory have found out that tinkering with the materials to make the insulators work has actually introduced a disorder that spoils the desired effects. **TECHNICAL ARTICLE**

*Tags: Materials science, Featured Article*

## ADVANCED MANUFACTURING

### [Bionic leaf: Researchers use bacteria to convert solar energy into liquid fuel](#)

[Science Daily, 09FEB2015](#)

Researchers at Harvard University have developed a system in which the artificial leaf produces oxygen and hydrogen which is fed to a bacterium called *Ralstonia eutropha*. An enzyme takes the hydrogen back to protons and electrons, and then combines them with carbon dioxide to replicate—making more cells. **TECHNICAL ARTICLE**

*Tags: Advanced manufacturing, Energy*

### [Additive Manufacturing Is Reshaping Aviation](#)

[MIT Technology Review, 06FEB2015](#)

Additive manufacturing processes can reduce waste, speed up production, and enable designs that might not be feasible with conventional production processes. The novel shapes and unusual material properties the technology makes possible—such as propeller blades optimized for strength at one end and flexibility at the other—could change the way airplanes are designed. **TECHNICAL ARTICLE**

*Tags: Advanced manufacturing*

## ADVANCED MATERIALS

### [Hybrid perovskite nanoparticles with 80% luminescence yield obtained](#)

[Science Daily, 10FEB2015](#)

Researchers in Spain have developed a method for preparing methylammonium-lead bromide hybrid nanoparticles with luminescence up to 80%. They have also proven their high stability under ultraviolet visible light. **TECHNICAL ARTICLE**

*Tags: Advanced materials*

### [New design tool for metamaterials](#)

[EurekaAlert, 09FEB2015](#)

A team of researchers in the US (Lawrence Berkeley National Laboratory, University of California) report that the relative nonlinear susceptibility of large classes

*continued...*[BACK TO TOP](#)

of metamaterials can be predicted using a comprehensive nonlinear scattering theory. This will allow the team to efficiently design metamaterials with strong nonlinearity for important applications such as coherent Raman sensing, entangled photon generation and frequency conversion.

**TECHNICAL ARTICLE**

*Tags: Advanced materials*

### **Precision growth of light-emitting nanowires**

**Science Daily, 06FEB2015**

Researchers at Lawrence Berkeley National Laboratory found that the gallium-nitride nanowire growth orientation strongly depended on the relative concentration of nickel and gold within the catalyst. By altering the concentrations in the alloy, the researchers could precisely manipulate the orientation of the nanowires, even on the same substrate in the same batch. The catalysts have given scientists more options than ever in turning the color of light-emitting nanowires. **TECHNICAL ARTICLE**

*Tags: Advanced materials, Materials science*

### **Cheap and abundant chemical outperforms precious metals as a catalyst**

**Science Daily, 04FEB2015**

Researchers at Caltech have discovered a new technique which uses a cheap and abundant chemical potassium tert-butoxide as a catalyst to help create a host of products ranging from new medicines to advanced materials. The potassium salt is more effective than state-of-the-art precious metal complexes at running very challenging chemical reactions. **TECHNICAL ARTICLE**

*Tags: Advanced materials*

### **Five synthetic materials with the power to change the world**

**The Conversation, 04FEB2015**

Since the dawn of this new era of fully synthetic materials, the advances have been unparalleled in the history of materials. Here are five types of polymers that will shape the future—Bioplastics, Plastic composites/nanocomposites, Self-healing polymers, Plastic electronics, and Smart and reactive polymers.

*Tags: Advanced materials*

## **AUTONOMOUS SYSTEMS & ROBOTICS**

### **Video Friday: Teleoperated Balloon Animals, Zipperbots, and Indiana Darwin**

**IEEE Spectrum, 06FEB2015**

Robots are getting much better at sensing and manipulation. Still, asking them to do anything autonomously, especially in unfamiliar or unstructured environments where things need to happen in real time, is usually only going to lead to disappointment.

*Tags: Autonomous systems & robotics*

### **New algorithms allow autonomous systems to deal with uncertainty**

**PhysOrg.com, 05FEB2015**

Out of the 13 or so tasks involved in the laundry problem, the robotic system, developed by researchers at UC Berkeley, completed more than half of them autonomously and nearly completed the rest. The framework they developed combines several popular planning paradigms and optimizes them to run efficiently on modern hardware. It also incorporates an effective approach for computing plans by learning from examples, rather than through rigid instructions or programs.

*Tags: Autonomous systems & robotics, Artificial intelligence*

## **ENERGY**

### **Defeating dendrites and capturing battery capacity**

**Nanowerk, 04FEB2015**

Dendrites, deposits that form on electrode surfaces during the charging process, cause the batteries to short circuit, leading to serious safety hazards. For the first time, a team including experts at DOE's Pacific Northwest National Laboratory grew protective films around the anodes that prevented dendrites from forming. **TECHNICAL ARTICLE**

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

## **ENVIRONMENTAL SCIENCE**

### **Scientists identify the 13 most important research challenges to face global change in the Mediterranean region**

**Alphagalileo, 10FEB2015**

A multidisciplinary team of researchers in Spain has evaluated scientific progress of the last 16 years in the study of global change in terrestrial Mediterranean ecosystems and has identified which should be immediate research priorities to make our ecosystems more resistant to the negative effects of this phenomenon. They report that science is faced with thirteen challenges and three fundamental considerations which need to be taken into account.

*Tags: Environmental science*

### **Scientists Suggest Testing Climate Engineering**

**MIT Technology Review, 10FEB2015**

A study by the National Academy of Sciences calls for experiments that would test technologies designed to counteract the global warming caused by greenhouse-gas emissions. The **REPORT** doesn't recommend specific experiments, but it notes that studies might shed light on the chemistry and physics of cloud formation and the interaction of sulfur-based particles with the ozone layer.

*Tags: Environmental science*

“Science can only ascertain what is, but not what should be.”

ALBERT EINSTEIN

## INFORMATION TECHNOLOGY

### [Long-term storage of digital information in DNA is possible](#)

Nanowerk, 09FEB2015

To demonstrate the perfect recovery of the information, researchers in Switzerland encapsulate the DNA in an inorganic matrix and employ error-correcting codes to correct storage-related errors. Accelerated aging experiments were performed to measure DNA decay kinetics, which show that data can be archived on DNA for millennia under a wide range of conditions. The original information could be recovered error free, even after treating the DNA in silica at 70°C for one week.

TECHNICAL ARTICLE

Tags: Information Technology, Biotechnology, S&T Switzerland

## MATERIALS SCIENCE

### [Study shows benefits of silicon carbide for sensors in harsh environments](#)

PhysOrg.com, 09FEB2015

Researchers in Australia report on the effect of mechanical strain on the electrical conductivity of silicon carbide deposited on silicon wafer. Silicon carbide is already used in power electronics and these results are very encouraging for sensor technology, particularly in harsh working environments. TECHNICAL ARTICLE

Tags: Materials science, S&T Australia

### [Turing also present at the nanoscale](#)

Science Daily, 05FEB2015

An international team of researchers (Poland, France, Denmark) reports that in their study, clear and permanent patterns formed spontaneously in the simulated systems of nanometer dimensions which remained stable despite the destructive influence of fluctuations. It turned out that one cycle of concentration changes within the Turing pattern could appear on a length of just 20 molecules. The possibility of forming Turing patterns on nanometer distances opens the door to interesting applications, particularly in the field of surface modification of materials. TECHNICAL ARTICLE

Tags: Materials science

## MICROELECTRONICS

### [Extreme-temperature electronics](#)

EurekAlert, 10FEB2015

A team of researchers from the US (UC Riverside, Rensselaer Polytechnic Institute) has fabricated molybdenum disulfide thin-film transistors which remain

functional at high temperatures of at least 500 Kelvin [220 Celsius]. The transistors also demonstrate stable operation after two months of aging, which suggests new applications for molybdenum disulfide thin-film transistors in extreme-temperature electronics and sensors. TECHNICAL ARTICLE

Tags: Microelectronics, Advanced materials

### [Nanoscale solution to big problem of overheating in microelectronic devices](#)

Science Daily, 06FEB2015

Researchers at the University of Southern California used a technique called Plasmon Energy Expansion Thermometry to effectively measure the temperatures within a transistor by measuring the expansion of materials already contained in the device. Measurements of temperatures hidden inside a device will enable better thermal management, which means faster transistors and lower power consumption. TECHNICAL ARTICLE

Tags: Microelectronics

## NEUROSCIENCE

### [New findings on how the brain ignores distractions](#)

Medical Express, 03FEB2015

When we concentrate on something, we also engage in the unsung, parallel act of purposefully ignoring other things. A new study describes how the brain may achieve such “optimal inattention”. With this knowledge, researchers at Brown University hope they can harness our power to ignore—for instance, to reduce pain.

Tags: Neuroscience

## PHOTONICS

### [The power of light-matter coupling at the nanoscale](#)

Nanowerk, 05FEB2015

Researchers in France have explained why polaritons can remain for an unusually long time at the lowest energy levels, in a way that alters the microscopic and macroscopic characteristics of their constituting matter. These findings pave the way for optical, electronic and chemical applications. TECHNICAL ARTICLE

Tags: Photonics, S&T France

### [New optical fibre shortens laser pulses the easy way](#)

Physics World, 04FEB2015

An international team of researchers (France, UK, Russia, Germany) has developed a simple and efficient way of

*continued...*

creating ultrashort infrared laser pulses. The technique reduces the length of a pulse by simply passing it through a specially structured, hollow glass fibre filled with a noble gas. The researchers say that the new method should make it easier for laboratories to produce pulses for studying chemical reactions on very short timescales.

[TECHNICAL ARTICLE](#)

*Tags: Photonics*

### [Rediscovering spontaneous light emission with a nano-antenna](#)

[Nanowerk, 03FEB2015](#)

Researchers at UC Berkeley have developed a nano-sized optical antenna that can greatly enhance the spontaneous emission of light from atoms, molecules and semiconductor quantum dots. This advance opens the door to light-emitting diodes that can replace lasers for short-range optical communications, including optical interconnects for microchips, plus a host of other potential applications. [TECHNICAL ARTICLE](#)

*Tags: Photonics*

## FEATURED RESOURCE

### [IEEE Spectrum magazine](#)

Flagship publication of the IEEE is a monthly magazine which explores future technology trends and the impact of those trends on society and business. [RSS](#)

## QUANTUM SCIENCE

### [In the quantum world, the future affects the past: Hindsight and foresight together more accurately 'predict' a quantum system's state](#)

[Science Daily, 09FEB2015](#)

By combining information about a quantum system's evolution after a target time with information about its evolution up to that time, an international team of researchers (USA, Denmark) was able to narrow the odds of correctly guessing the state of the two-state system from 50-50 to 90-10. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Quantum Light Beam Solves Mazes, with a Little Help from Classical Noise](#)

[MIT Technology Review, 06FEB2015](#)

The transfer of energy across giant protein matrices appears to occur extremely rapidly with close to 100 percent efficiency. Recent thinking is that the transfer of energy through this maze must rely on both classical

and quantum processes. Researchers in Italy have demonstrated this effect using light passing through an artificial maze. Their work provides the first experimental evidence that a hybrid system, involving both quantum and classical states, significantly outperforms a quantum system alone.

[TECHNICAL ARTICLE](#)

*Tags: Quantum science, S&T Italy*

### [Probing qualities at the tips of nanocones](#)

[Nanowerk, 05FEB2015](#)

One of the ways of improving electrons manipulation is through better control over one of their spin. An international team of researchers (Slovak Republic, Russia, Czech Republic) has shown that the tip area offers the greatest curvature to an enhanced manifestation of a phenomenon called spin-orbit interaction. This, in turn, affects its electronic characteristics. These nanocones could thus become candidates for a new type of scanning probe in atomic force microscopy. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

## S&T POLICY

### [British defence in 2030: 3D printing and graphene armour](#)

[Wired \(UK\), 09FEB2015](#)

A research organization in the UK is carrying out a study on technology for land warfare in the 2030-2040 timescale with a two-pronged approach: a wide-ranging survey of current developments, and an open call for submissions from anyone who wants their research to be considered. They are looking at 12 technology areas including 3D printing, advanced materials, big data, human augmentation, robotics, power and navigation. The first phase will last 18 months, but it already seems that the most obvious technologies are not necessarily the winners.

*Tags: S&T policy, Emerging technology, Military technology, S&T UK*

## SCIENCE WITHOUT BORDERS

### [Breakthrough technologies could pave the way for cheaper, faster small-satellite launches](#)

[DARPA News, 05FEB2015](#)

Through its [Airborne Launch Assist Space Access \(ALASA\)](#) program, DARPA has been developing new concepts and architectures to get small satellites into orbit more economically on short notice. ALASA also aims to reduce infrastructure costs by using runways instead of fixed vertical launch sites, automating operations and avoiding unnecessary services. Phase 1 of the program advanced toward that goal.

*Tags: Science without borders, Emerging technology, Satellite technology, Space technology*

## **Photons simulate time travel in the lab**

Physics World, 05FEB2015

Researchers in Australia claim to have simulated time travel using fairly standard optical equipment on a lab bench. They have prepared photons that behave as if they are travelling along short cuts in space-time known as “closed time-like curves”. Their work might help in the long-sought-after unification of quantum mechanics and gravity. **TECHNICAL ARTICLE**

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

## **SENSORS**

### **Technique enables energy-harvesting sensors to be miniaturized**

PhysOrg.com, 05FEB2015

Self-powered sensors developed by researchers at Michigan State University may be attached to or embedded inside bridges, pavements, vehicles, rotating parts and biomedical implants. They can autonomously sense, compute and store cumulative statistics of strain rates, without the aid of batteries. The researchers discovered a unique synchrony between the physics of flash memory and the physics of devices that convert mechanical stress into energy.

*Tags: Sensors* ■

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