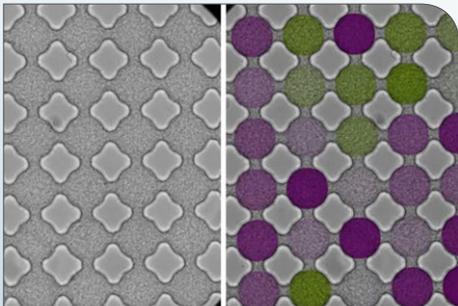


[Advanced manufacturing \(1\)](#)[Advanced materials \(4\)](#)[Autonomous systems & robotics \(4\)](#)[Communications technology \(1\)](#)[Cyber security \(3\)](#)[Energy \(3\)](#)[Materials science \(1\)](#)[Medical sciences \(1\)](#)[Microelectronics \(2\)](#)[Photonics \(1\)](#)[Quantum science \(1\)](#)[S&T policy \(1\)](#)[Science without borders \(6\)](#)[Sensors \(3\)](#)

## FEATURE ARTICLES

### [Study reveals shared behavior of microbes and electrons](#)

Nanowerk, 05JAN2016



This image shows a microfluidic 6x6 lattice. The left-hand side shows the original data and the overlaid color coding on the right-hand side shows the relative strength of clockwise (purple) or anti-clockwise (green) circulation. (Image courtesy of the researchers)

An international team of researchers (UK, France, Australia, USA - MIT) has identified an unexpected shared pattern in the collective movement of bacteria and electrons: As millions of bacteria stream through a microfluidic lattice, they synchronize and

swim in patterns similar to those of electrons orbiting around atomic nuclei in a magnetic material. By tuning certain dimensions of the microfluidic lattice, they were able to direct millions of microbes to align and swim in the same direction, much the way electrons circulate in the same direction when they create a magnetic field. With slight changes to the lattice, groups of bacteria flowed in opposite directions, resembling electrons in a nonmagnetic material. They identified a mathematical model that applies to the motions of both bacteria and electrons.

[TECHNICAL ARTICLE](#)

Tags: [Science without borders](#), [Featured Article](#)

### [Ultra-thin, tunable, broadband microwave absorber may advance radar cloaking](#)

AIP Publishing, 10NOV2015

Researchers in China have fabricated an absorber with a stretching transformation pattern, which is both thin and can absorb a wide range of frequencies for near-meter microwave application. Its absorption range covers a broad band from 0.7 to 1.9 gigahertz below -10 decibel, and the total thickness of the absorber is only 7.8

millimeters, which is one of the thinnest microwave absorbers reported. The stretching transformation pattern used in the active frequency-selective surface absorber to expand the bandwidth is an effective technique for producing broadband tunability. [TECHNICAL ARTICLE](#)

Tags: [Sensors](#), [S&T China](#), [Featured Article](#)

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [Program Seeks Ability to Assemble Atom-sized Pieces Into Practical Products](#)

DARPA News, 29DEC2015

DARPA recently launched its Atoms to Product (A2P) program, with the goal of developing technologies and processes to assemble nanometer-scale pieces into systems, components, or materials that are at least millimeter-scale in size. The program calls for closing the assembly gap in two steps: From atoms to microns and from microns to millimeters. Performers are tasked with addressing one or both of these steps and have been assigned to one of three working groups, each with a distinct focus area.

Tags: [Advanced manufacturing](#), [Government S&T](#)

### ADVANCED MATERIALS

#### [Antireflective Coating: Sugar-based carbon hollow spheres that mimic moth eyes](#)

Science Daily, 05JAN2016

The new material, developed by an international team of researchers (Belarus, France, UK, Germany), is a monolayer of hollow carbon spheres packed in two dimensions and has been demonstrated to be able to achieve almost perfect microwave absorption, i.e. near 100 percent absorption of microwaves in the Ka-band (26-37 gigahertz) frequency range. The coating may be used as a radar absorbing material in stealth technology.

[TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#), [Materials science](#)

[continued...](#)

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## **Graphene-like boron made for the first time, claim researchers**

Physics World, 05JAN2016

An international team of researchers (USA - Argonne National Laboratory, Northwestern University, Stony Brook University, UT San Antonio, China, Russia) has produced boron films that are just one atom thick. A preliminary study of the ultrathin material called “borophene” suggests that it displays a variety of fascinating and potentially useful properties including direction-dependent conductivity. However, unlike graphene, the boron films are not free-standing and are instead fixed to a metal substrate. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## **New bimetallic alloy nanoparticles for printed electronic circuits**

Nanowerk, 05JAN2016

An international team of researchers (USA - Duke University, Japan, China, South Korea) found that copper nanoparticles alloyed with 1% Sn, 5% Ag, 5% Ni, or 30% Ni had electrical conductivities similar to that of copper; however, unlike copper, the nanoparticles remained conductive after 24 hours at 85 °C and 85% relative humidity. They expect that it can be used as the main component of affordable conductive inks with high oxidation resistance. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## **Unconventional phase transition in photonic structures discovered**

Science Daily, 25DEC2015

An international team of researchers (Russia, Australia) has researched the phenomenon of phase transition between photonic crystals and metamaterials—two types of periodic structures capable of manipulating light in intricate ways. The study helps to gain an insight into the fundamental properties of periodic structures and opens new possibilities for the design and creation of new electromagnetic materials. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## **AUTONOMOUS SYSTEMS & ROBOTICS**

### **From Tools to Teammates: Integrating Robots on Human Teams**

MIT Lincoln Laboratory, 05JAN2016

Lincoln Laboratory’s Autonomous Systems Laboratory is part of a basic research program in collaborative robotics, a new trend in the robotics industry that seeks to advance robot-human synergy. The Laboratory’s program focuses on developing (1) enabling technologies for autonomous systems and (2) algorithms and cognitive models that autonomously present warfighters with mission-relevant data acquired by autonomous systems.

*Tags: Autonomous systems & robotics*

## **Artificial Intelligence Finally Entered Our Everyday World**

Wired, 01JAN2016

Artificial intelligence is changing not only the way we use our computers and smartphones but the way we interact with the real world. 2015 is the year artificial intelligence technology took off in a big way in the real world. DuLight and the Google chatbot may be experiments, but Facebook’s face recognition, Microsoft’s Skype translation, and Google’s Android voice recognition are very real—and available to all. And thanks to some big moves at the end of the year, advances in deep learning will only accelerate.

*Tags: Autonomous systems & robotics, Artificial intelligence*

## **Best of 2015: Deep Learning Machine Beats Humans in IQ Test**

MIT Technology Review, 31DEC2015

Computers have never been good at answering the type of verbal reasoning questions found in IQ tests. Now a deep learning machine unveiled in China is changing that.

*Tags: Autonomous systems & robotics, Artificial intelligence*

## **Practical artificial intelligence tools you can use today**

KurzweilAI, 30DEC2015

Most AI solutions today are fielded by the big players in IT. For example, Apple’s Siri or the capabilities Apple embedded directly in iOS9, Google’s many savvy search solutions, Amazon’s very smart recommendation engine, and IBM’s Watson. Here is a short list of capabilities we recommend all futurists, technologists and business executives to track.

*Tags: Autonomous systems & robotics, Artificial intelligence*

## **COMMUNICATIONS TECHNOLOGY**

### **Researchers advance software-defined radio technology**

PhysOrg.com, 29DEC2015

Researchers in Japan have developed the Appliance Defined Ubiquitous Network (ADUN), a mechanism that delivers unlimited broadband radio-wave information to clients via a distribution server. To build such networks, virtualized wireless transceivers are implemented using cloud computing and broadband Internet. Their findings hold implications for building global networks of distribution servers that can deliver unlimited radio data to multiple clients simultaneously, because limitations lie within hardware rather than software.

*Tags: Communications technology, S&T Japan*

## **CYBER SECURITY**

### **Why too much evidence can be a bad thing**

PhysOrg.com, 04JAN2016

An international team of researchers (Australia, France) discuss the importance of the paradox of unanimity in

“The most significant event of the nineteenth century will be judged as Maxwell’s discovery of the laws of electrodynamics.” RICHARD FEYNMAN

cryptography. Data is often encrypted by verifying that some gigantic number provided by an adversary is prime or composite. One way to do this is to repeat a probabilistic test called the Rabin-Miller test until the probability that it mistakes a composite as prime is extremely low. The systemic failure that occurs in this situation is computer failure. Consequently, the cryptographic protocol may appear to be more secure than it really is, since test results that appear to indicate a high level of security are actually much more likely to be indicative of computer failure. The paradox of unanimity may be counterintuitive, but the researchers explain that it makes sense once we have complete information at our disposal.

*Tags: Cyber security, Cryptology*

### **Microsoft to warn users about ‘nation-state’ intrusion**

[PhysOrg.com, 01JAN2016](#)

Microsoft said it already notifies users if accounts have been targeted or compromised by a third party but is taking the additional step of letting people know if it is likely that the attacker may be “state-sponsored” because it is likely that the attack could be more sophisticated or more sustained than attacks from cyber criminals and others.

*Tags: Cyber security*

### **Images, codes could provide secure alternative to multiple device password systems**

[Science Daily, 23DEC2015](#)

Researchers in the UK believe their new multi-level authentication system GOTPass could be effective in protecting personal online information from hackers. It could also be easier for users to remember, and be less expensive for providers to implement since it would not require the deployment of potentially costly hardware systems. The system would be applicable for online banking and other such services. [TECHNICAL ARTICLE](#)

*Tags: Cyber security, S&T UK*

## ENERGY

### **Melting, coating, and all-solid-state lithium batteries**

[PhysOrg.com, 01JAN2016](#)

An international team of researchers (South Korea, USA - Brookhaven National Laboratory, Lawrence Berkeley National Laboratory) has developed a way to coat the active materials with the solid electrolyte. This process, called the solution-process, works by diffusing the powder type of active material in the liquid from melted solid electrolyte and vaporizing the solvent. After the solution-process, it

became more possible to coat the layers of solid electrolyte on the active materials. [TECHNICAL ARTICLE](#)

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

### **Understanding the mechanism for generating electric current without energy consumption at room temperature**

[Nanowerk, 28DEC2015](#)

At extremely low temperatures and under no external magnetic field, an electric current flows around the edge of the film without energy loss. An international team of researchers (China, Japan) has revealed the mechanism by which this occurs and identified the requirements for the development of new types of extremely low power consumption electric devices by studying Cr-doped (Sb,Bi)<sub>2</sub>Te<sub>3</sub> thin films. [TECHNICAL ARTICLE](#)

*Tags: Energy, Materials science*

### **The Ideal Fuel**

[MIT Technology Review, 22DEC2015](#)

Researchers at UC Berkeley have shown that genetically engineered bacteria nestled amid the nanowires function as “living catalysts.” They take up the hydrogen split from the water and combine it with carbon dioxide to make methane and other hydrocarbons that are needed for fuels or plastics. The system currently matches the efficiency of photosynthesis, storing less than 1% of the energy captured from sunlight in the form of chemical bonds. That’s not bad for a proof-of-concept demonstration, but making it more efficient and thus cost-effective will be essential.

[TECHNICAL ARTICLE](#)

*Tags: Energy*

## MATERIALS SCIENCE

### **Transition metal catalyst prompts ‘conjunctive’ cross-coupling reaction**

[Science Daily, 04JAN2016](#)

Cross-coupling, known as Suzuki-Miyaura coupling, connects two types of reactants, including one electron donor and one electron acceptor. Researchers at Boston College report using transition metals to develop an alternative cross-coupling process that merges two electron donors while they react with the electron acceptor. The resulting ‘conjunctive’ reaction takes place efficiently and offers a high degree of selectivity, the team reports. The research may open up a broad new collection of chemical reactions that will be useful in chemical manufacture.

[TECHNICAL ARTICLE](#)

*Tags: Materials science*

## MEDICAL SCIENCES

### [Traveling salesman uncorks synthetic biology bottleneck](#)

EurekAlert, 05JAN2016

Researchers at Duke University have developed a freely available computer program based on the “traveling salesman” mathematics problem. Synthetic biologists can now find the least-repetitive genetic code to build the molecule they want to study. The program will allow those with limited resources or expertise to easily explore synthetic biomaterials that were once available to only a small fraction of the field. [TECHNICAL ARTICLE](#)

Tags: *Medical Sciences, Biology, Synthetic biology*

## FEATURED RESOURCE

### [EurekAlert](#)

EurekAlert! is an online, global news service operated by AAAS, featuring news and resources focused on all areas of science, medicine and technology. [RSS](#)

## MICROELECTRONICS

### [Process variation threatens to slow down and even pause chip miniaturization](#)

PhysOrg.com, 05JAN2016

Above the nearly 350nm technology node, Process variation (PV) had negligible effect on processors, since the magnitude of variation was insignificant compared to the device size. However, with ongoing process scaling, the effect of PV can be seen on all metrics of interest, such as performance, energy and yield. Researchers at Oak Ridge National Laboratory investigate the impact of PV along with strategies for mitigating it in a wide range of system architectures, e.g. in CPUs, GPUs, in processor components (cache, main memory, processor core), in memory technologies (SRAM, DRAM, eDRAM, non-volatile memories e.g. PCM, resistive RAM) and in both 2D and 3D processors. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics, Advanced manufacturing, Government S&T*

### [Sub-1 volt three-terminal nanoelectromechanical switch](#)

Nanotechweb, 04JAN2016

Researchers in Saudi Arabia used amorphous metal tungsten nitride to demonstrate NEM switches which are capable of sub-1 volt operation. Low-cost amorphous metal is integration friendly and its material property can also be tailored to make it suitable for high volume

manufacturing. The demonstrated 3-terminal NEM switches show 0.8 volt switching voltage which is the lowest ever in the genre of NEM switches. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics*

## PHOTONICS

### [Ringing in new way to measure, modulate trapped light](#)

Science Daily, 23DEC2015

A team of researchers in the US (NIST, University of Maryland) has developed a novel way to noninvasively measure and map how and where trapped light vibrates within microscale optical resonators. The new technique not only makes for more accurate measurements but also allows scientists to fine-tune the trapped light's frequency by subtly altering the shape of the resonator itself. Visualizing the vibration patterns will help scientists to perfect ultrasensitive optical sensors for detecting biomolecules and even single atoms. [TECHNICAL ARTICLE](#)

Tags: *Photonics, Government S&T*

## QUANTUM SCIENCE

### [Pure quantum-mechanical mixture of electrons and photons demonstrated in bismuth selenide](#)

PhysOrg.com, 05JAN2016

In 2013, MIT physicists showed for the first time that shining powerful mid-infrared laser light on solid bismuth selenide produces Floquet-Bloch states, which are characterized by replicas of electronic energy states inside a solid with gaps opening up at crossing points of replica states. Now, researchers have shown that changing the light's polarization yields pure Floquet-Bloch states. The new work yields higher resolution for experimental demonstrations of replica electronic levels, which are also called sidebands, and also offers a theoretical explanation for distinguishing Floquet states from Volkov states. [TECHNICAL ARTICLE](#)

Tags: *Quantum science, Particle physics*

## S&T POLICY

### [Russian Military to Test Combat Robots in 2016](#)

Defense Update, 30DEC2015

Ten years from now, about 30 percent of the Russian combat power will consist of remotely-controlled and robotic platforms – this is the goal of an ambitious research and development program pursued by the military and approved by the Russian Military Industrial Committee (MIC). The new robotic lab was established in 2014. Although some of its projects are futuristic and theoretical at this stage, others are closer to maturity and those addressing specific functions. The first robotic guards unit are likely to become operational in 2017-2018.

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

## SCIENCE WITHOUT BORDERS

**Open journals that piggyback on arXiv gather momentum**

Nature News, 04JAN2016

An astrophysicist has launched a low-cost community peer-review platform that circumvents traditional scientific publishing. The Open Journal of Astrophysics works in tandem with manuscripts posted on the pre-print server arXiv. Researchers submit their papers from arXiv directly to the journal, which evaluates them by conventional peer review. Accepted versions of the papers are then re-posted to arXiv and assigned a DOI, and the journal publishes links to them. Because the software is open-source and available at GitHub researchers in other fields will adopt the same platform to create their own open journals.

Tags: Science without borders

**Human-machine superintelligence can solve the world's most dire problems**

MIT Technology Review, 31DEC2015

Researchers in the US (Cornell University, industry partner) present a new vision of human computation which pushes beyond traditional limits, and takes on hard problems that until recently have remained out of reach. Humans surpass machines at many things, ranging from simple pattern recognition to creative abstraction. With the help of computers, these cognitive abilities can be effectively combined into multidimensional collaborative networks that achieve what traditional problem-solving cannot. TECHNICAL ARTICLE

Tags: Science without borders, Information technology

**The 6 Biggest Technology Failures of 2015**

MIT Technology Review, 31DEC2015

Welcome to MIT Technology Review's second annual list of top tech flops. Without further preamble, here are the technologies we thought did the least for humanity in 2015.

Tags: Science without borders

**A look ahead at 2016: What research trends will be hot—and what will not?**

Science Magazine, 30DEC2015

From the rise of reusable rockets to sequencing entire ancient genomes to the rapidly spreading Zika virus to the hunt for a sidekick to the Higgs boson, Science Magazine offers their best guesses—in no particular order—of the new themes that they think will take hold in 2016.

Tags: Science without borders, Forecasting

**The top A.I. breakthroughs of 2015**

KurzweilAI, 29DEC2015

The biggest developments of 2015 fall into five categories of intelligence: abstracting across

environments, intuitive concept understanding, creative abstract thought, dreaming up visions, and dexterous fine motor skills. A small number of important threads within each that have brought the field forward this year are highlighted.

Tags: Science without borders, Artificial intelligence

## SENSORS

**New material for detecting photons captures more quantum information**

EurekAlert, 05JAN2016

An international team of researchers (USA - NIST, Jet Propulsion Laboratory, Switzerland) used an electron beam to pattern nanowires into a thin film made of a heat-tolerant ceramic superconductor, molybdenum silicide. The new design can operate at higher (though still cryogenic) temperatures and at a higher electrical current. The higher temperature simplifies refrigeration; the higher current cuts jitter in half, from about 150 picoseconds to 76 picoseconds. NIST researchers enhanced the detector's light absorption and efficiency by embedding the chip in a cavity made of gold mirrors and layers of other unreactive materials. TECHNICAL ARTICLE

Tags: Sensors, Government S&amp;T, Photonics

**Single molecule detection of contaminants, explosives or diseases now possible**

Nanowerk, 29DEC2015

Researchers at Pennsylvania State University have developed a technique to detect single molecules of a number of chemical and biological species from gaseous, liquid or solid samples by combining the ultrasensitivity of surface enhanced Raman scattering (SERS) with a slippery surface. The invention could open new applications in analytical chemistry, molecular diagnostics, environmental monitoring and national security. TECHNICAL ARTICLE

Tags: Sensors ■

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