



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Researchers combine logic, memory to build a 'high-rise' chip](#)

[Nanowerk, 15DEC2014](#)

Researchers at Stanford University are building layers of logic atop layers of memory to

create a tightly interconnected high-rise chip. Many thousands of nanoscale electronic "elevators" would move data between the layers much faster, using less electricity, than the bottle-neck prone wires connecting single-story logic and memory chips today. The paper will be presented at the IEEE International Electron Devices Meeting on Dec. 15-17.

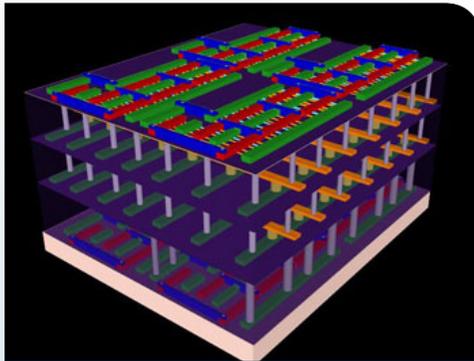
*Tags: Microelectronics, Featured Article*

### [Comet landing named Physics World 2014 Breakthrough of the Year](#)

[Physics World, 12DEC2014](#)

The Physics World 2014 Breakthrough of the Year goes to ESA's Rosetta mission for being the first to land a spacecraft on a comet. Nine other achievements are highly commended and cover topics ranging from nuclear physics to acoustics.

*Tags: Science without borders, Featured Article*



*This illustration represents the four-layer prototype high-rise chip built by Stanford engineers. Image: Max Shulaker, Stanford*

## ADVANCED MATERIALS

### [New form of ice could help explore exciting avenues for energy production and storage](#)

[Science Daily, 10DEC2014](#)

An international team of researchers (Germany, France) discovered Ice XVI, the least dense of all known forms of ice. It has a highly symmetric cage-like structure that can trap gaseous molecules to form compounds known as clathrates or gas hydrates. The discovery could help ease the flow of gas and oil through pipelines in low temperature environments, and open up untapped reservoirs of natural gas on the ocean floor. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

### [New 'high-entropy' alloy is as light as aluminum, as strong as titanium alloys](#)

[Science Daily, 10DEC2014](#)

An international team of researchers (USA, Qatar) combined lithium, magnesium, titanium, aluminum and scandium to make a nanocrystalline high-entropy alloy that has low density, but very high strength. Its density is comparable to aluminum, but it is stronger than titanium alloys. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## AUTONOMOUS SYSTEMS & ROBOTICS

### [RoboBrain: The World's First Knowledge Engine For Robots](#)

[MIT Technology Review, 12DEC2014](#)

Researchers at Stanford University are creating a knowledge engine called RoboBrain. It is a kind of Google for robots that can be freely accessed by any device wishing to carry out a task. At the same time, the database gathers new information about these tasks as robots perform them, thereby learning as it goes. [TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, Artificial intelligence*

## **Video Friday: Giant Hexapod, Laser Snakes, and a Levitating Lamp**

IEEE Spectrum, 12DEC2014

From the Harvard Biodesign Lab, a soft robot that uses different wraps of fibers to control the direction in which it pneumatically expands, allowing different segments to either serve as anchors or actuators.

*Tags: Autonomous systems & robotics*

## **We've Put a Worm's Mind in a Lego Robot's Body**

Smithsonian , 19NOV2014

The OpenWorm project put their software program in a simple Lego robot. It is claimed that the robot behaved in ways that are similar to those observed in *C. elegans*. Stimulation of the nose stopped forward motion. Touching the anterior and posterior touch sensors made the robot move forward and back accordingly.

*Tags: Autonomous systems & robotics*

## **BIOTECHNOLOGY**

### **A Step Toward Artificial Cells, Built from Silicon**

MIT Technology Review, 12DEC2014

An international team of researchers (Israel, US) used patterns of light to create spots where DNA binds and assembles into toothbrush-like bundles. Each DNA brush was confined to a small, round compartment. These compartments were joined by a narrow capillary 20 micrometers wide to a larger channel, which carried a flow of liquid extracts from bacterial cells—all the ingredients needed to synthesize proteins from the DNA brushes.

*Tags: Biotechnology, Medical technology*

## **COMMUNICATIONS TECHNOLOGY**

### **New theory could yield more-reliable communication protocols**

PhysOrg.com, 12DEC2014

Communication protocols for digital devices are very efficient but also very brittle; they require information to be specified in a precise order with a precise number of bits. Humans are much more flexible. In a series of recent papers, a team of researchers in the US (MIT, Columbia University, Carnegie Mellon, Microsoft) has begun to describe theoretical limits on the degree of imprecision that communicating computers can tolerate, with very real implications for the design of communication protocols. **TECHNICAL**

**ARTICLE**

*Tags: Communications Technology, Information technology*

## **Communication App Works Without a Cellular Network**

MIT Technology Review, 10DEC2014

MeshMe uses what's known as mesh networking: it treats each smartphone running the app as a router, passing data from one handset to the next to get messages to recipients via the most efficient pathway. Even if you're acting as a node in this network, you can't read data sent over MeshMe unless it is routed to you.

*Tags: Communications Technology, Information technology*

## **ENERGY**

### **This plane will be able to fly anywhere in the world within 4 hours**

Science Alert (Australia), 13DEC2014

Researchers in the UK are developing an engine system called SABRE that relies on a device called the precooler—technology that cools down the air entering the engine system by more than 1,000 degrees Celsius in .01 seconds. That corresponds to an unheard-of cooling rate of 400 megawatts, and will allow the plane to “breathe” oxygen.

*Tags: Energy, Space technology*

## **ENVIRONMENTAL SCIENCE**

### **Early warning signals of abrupt climate change**

Science Daily, 08DEC2014

Researchers in the UK used simulation from a highly complex model to analyse the Atlantic Meridional Overturning Circulation. It showed that early warning signals are present up to 250 years before it collapses, suggesting that scientists could monitor the real world overturning circulation for the same signals. **TECHNICAL**

**ARTICLE**

*Tags: Environmental science, Climatology, S&T UK*

## **FORECASTING**

### **Research Fronts 2014: 100 top ranked specialties in the sciences and social sciences.**

Thomson Reuters, 16DEC2014

Research Fronts 2014 presents a total of 144 research fronts, including 100 hot and 44 emerging ones. The research fronts are classified into 10 broad research areas in the sciences and social sciences, as they were in the 2013 report. The objective was to discover which research fronts were most active or developing most rapidly. The specific methodology used for identifying the research fronts is described.

*Tags: Forecasting, Emerging technology*

“The greatest enemy of knowledge is not ignorance, it is the illusion of knowledge.”

STEPHEN HAWKING

## MATERIALS SCIENCE

### [New Discovery Opens Door For Radical Reduction in Energy Consumed by Digital Devices](#)

UC Berkeley News, 17DEC2014

Researchers at UC Berkeley provide a possible way to overcome the Boltzmann Tyranny. It relies on the ability of certain materials to store energy intrinsically and then exploit it to amplify the input voltage. This could, in effect, potentially “trick” a transistor into thinking that it has received the minimum amount of voltage necessary to operate. [TECHNICAL ARTICLE](#)

Tags: *Materials science, Energy*

### [Lead islands in a sea of graphene magnetise the material of the future](#)

Nanowerk, 15DEC2014

Researchers in Spain have discovered that if lead atoms are intercalated on a graphene sheet, a powerful magnetic field is generated by the interaction of the electrons' spin with their orbital movement. This property could have implications in spintronics.

Tags: *Materials science*

### [Superconductivity record breaks under pressure](#)

Nature News, 12DEC2014

Researchers in Germany placed a sample of hydrogen sulphide between the tips of two diamond anvils and then used electrodes to measure how the material's electrical resistance changed as they cooled the system towards absolute zero. They found that under a pressure of 1.8 million atmospheres, the resistance dropped suddenly at about 190 K (-83 °C), suggesting that a transition to superconductivity had occurred. [TECHNICAL ARTICLE](#)

Tags: *Materials science, S&T Germany*

### [Stacking two-dimensional materials may lower cost of semiconductor devices](#)

Science Daily, 11DEC2014

Researchers at North Carolina State University used molybdenum sulfide and tungsten sulfide to show that stacking materials that are only one atom thick can create semiconductor junctions that transfer charge efficiently, regardless of whether the crystalline structure of the materials is mismatched. The discovery lowers manufacturing costs of semiconductors. [TECHNICAL ARTICLE](#)

Tags: *Materials science*

## MICROELECTRONICS

### [Silicon nanonets: promising electrically active materials](#)

Nanotechweb, 16DEC2014

Researchers in France show that silicon nanonets exhibit percolating, highly reproducible and controllable electrical properties for precisely controlled SiNW densities. Compared with standard semiconducting thin films, semiconducting nanonets have many advantages: high surface area, electrical conductance, optical transparency, mechanical robustness and flexibility. They could have application in new devices. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics, S&T France*

### [New findings could point the way to “valleytronics”](#)

MIT News, 15DEC2014

New findings by a team of researchers (MIT, Harvard, Taiwan) could provide a pathway toward a kind of two-dimensional microchip that would make use of a characteristic of electrons other than their electrical charge, as in conventional electronics. The new approach is dubbed “valleytronics,” because it makes use of properties of an electron that can be depicted as a pair of deep valleys on a graph of their traits. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics*

### [Transistor memory devices with large memory windows](#)

Nanotechweb, 15DEC2014

Researchers in South Korea have fabricated a high-capacity Nano-floating gate memory (NFGM) device based on multi-stacking of densely packed hydrophobic Au nanoparticle layers instead of the more conventional NFGM with a single charge trapping layer. This approach has significant effect on memory. They showed that the charge trap densities in lateral and vertical dimensions can be easily modulated by adsorption isotherm behaviour and layer number. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics*

### [Researchers using germanium instead of silicon for CMOS devices](#)

PhysOrg.com, 09DEC2014

Researchers at Purdue University show how to use germanium to produce “P-type” and “N-type” transistors. Because both types of transistors are needed for CMOS circuits, the findings point to possible applications for germanium in computers and electronics.

Tags: *Microelectronics, Semiconductors*

*continued...*

## PHOTONICS

**New way to plug 'leaky' light cavities demonstrated**

Science Daily, 10DEC2014

Researchers at UC San Diego sought a way around the leak problem by designing a BIC (bound states in the continuum) metamaterials device consisting of a rectangular metal waveguide and ceramic light scatterer. Instead of limiting the size and number of passages where light can escape the cavity, the cavity's design produces destructive interferences for the light waves. The study directly addresses one of the major challenges currently facing nanophotonics. [TECHNICAL ARTICLE](#)

Tags: Photonics, Advanced materials

## FEATURED RESOURCE

**IEEE Spectrum magazine**

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

## QUANTUM SCIENCE

**Control on shape of light particles opens the way to the quantum internet**

Nanowerk, 15DEC2014

An international team of researchers (the Netherlands, Germany) has succeeded in getting the required degree of control by embedding a quantum dot into a 'photonic crystal', thereby creating an optical cavity. The researchers applied a very short electrical pulse to the cavity, which influences how the quantum dot interacts with it, and how the photon is emitted. By varying the strength of this pulse, they were able to control the shape of the transmitted photons. [TECHNICAL ARTICLE](#)

Tags: Quantum science

**'Fibonacci quasiparticle' could form basis of future quantum computers**

PhysOrg.com, 15DEC2014

Topological quantum computing (TQC) is a newer type of quantum computing that uses "braids" of particle tracks, rather than actual particles such as ions and electrons, as qubits to implement computations. A team of researchers in the US (Cornell University, Microsoft) have theoretically shown that anyons tunneling in a double-layer system can transition to an exotic non-Abelian state that contains "Fibonacci" anyons that are powerful enough for universal TQC. [TECHNICAL ARTICLE](#)

Tags: Quantum science

**Scientists resolve spin puzzle**

Science Daily, 10DEC2014

An international team of researchers (UK, Japan) used theoretical modelling to predict the structure of the defects in magnetite through a series of first principles calculations based on quantum mechanics. Through experiments they found that antiphase boundary defects are unusually stable and cause antiferromagnetic coupling leading to reduced spin polarization in magnetite. The discovery potentially opens the way for its use in producing more powerful electronic devices. [TECHNICAL ARTICLE](#)

Tags: Quantum science, Materials science

**Nanoscale resistors for quantum devices**

Science Daily, 09DEC2014

Researchers in the UK created thin films of chromium oxide using sputter deposition. They were able to tune the resistance of the chromium oxide films by controlling the oxygen content of the films: the higher the oxygen content, the higher the resistance. The resistors could speed the development of quantum devices for computing and fundamental physics research. [TECHNICAL ARTICLE](#)

Tags: Quantum science, S&amp;T UK

**Laser blast makes pure quantum dots**

Physics World, 08DEC2014

A team of researchers in the US (UT San Antonio, Northeastern University) developed a process to make quantum dots made of pure selenium by simply firing a laser beam at selenium powder mixed into a glass of water. Unlike other techniques, this does not involve potentially toxic chemicals. The high-quality nanostructures could be used in two very different applications: as antibacterial agents and as light harvesters in solar cells.

Tags: Quantum science, Advanced materials, Quantum dots

## SCIENCE WITHOUT BORDERS

**"ResearchLandscaping" brings together science and industry experts**

Fraunhofer IAO, 16DEC2014

Fraunhofer IAO developed "ResearchLandscaping", a structured method that fleshes out a map of experts that identifies potential partners and partner networks, analyzes their skills profile and visualizes the findings.

Tags: Science without borders, S&amp;T Germany

**Assessing scientific research by 'citation wake' detects Nobel laureates' papers**

PhysOrg.com, 12DEC2014

Researchers in Germany have proposed a new measure of assessment that is based on the "citation wake" of a paper, which encompasses the direct citations and weighted indirect citations received by the paper. The new method attempts to focus on the propagation of ideas rather than

credit distribution, and succeeds by at least one significant measure: a large fraction (72%) of its top-ranked papers are coauthored by Nobel Prize laureates.

**TECHNICAL ARTICLE**

*Tags: Science without borders, Bibliometrics*

**Object Recognition Using Deep Neural Networks: A Survey**

[arXiv, 10DEC2014](#)

An international team of researchers (India, USA) describes the history of research in Neural Networks and several of the recent advances in this field. The performances of recently developed Neural Network Algorithm over benchmark datasets have been tabulated. Finally, some the applications of this field have been provided. **TECHNICAL ARTICLE**

*Tags: Science without borders, Mathematics*

**Physicists explain puzzling particle collisions**  
[Science Daily, 10DEC2014](#)

An anomaly spotted at the Large Hadron Collider has prompted researchers at UC San Diego to reconsider a mathematical description of the underlying physics. By considering two forces that are distinct in everyday life but unified under extreme conditions, they have simplified one description of the interactions of elementary particles. Their new version makes specific predictions about events that future experiments should observe and could help to reveal 'new physics,' particles or processes that have yet to be discovered.

*Tags: Science without borders, Materials science, Particle physics*

## SENSORS

**Researchers develop ultrasensitive vibration monitors based on spider organs**

[PhysOrg.com, 11DEC2014](#)

Researchers in South Korea built their sensor by applying a 20 nanometer layer of platinum on top of a soft polymer and then introduced a series of parallel cracks. Because the layer is on top of a somewhat elastic base, the device can be stretched slightly, which happens when vibration is introduced. Sending electricity across the top layer allows for the device to be used as a vibration sensor. The monitor could have applications in music, speech recognition and health monitoring. **TECHNICAL ARTICLE**

*Tags: Sensors, Biomimetics* ■

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