



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLES

[Responsive material could be the 'golden ticket' of sensing](#)

[Nanowerk, 07JAN2015](#)

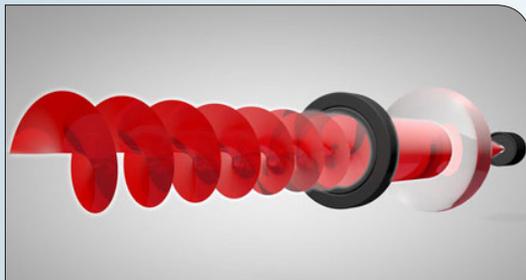
Researchers in the UK have developed a new self-assembled material, which, by changing its shape, can amplify small variations in temperature and concentration of biomolecules, making them easier to detect. The material, which consists of synthetic spheres 'glued' together with short strands of DNA, could be used to underpin a new class of biosensors, or form the basis for new drug delivery systems. In addition to its role as a carrier of genetic information, DNA is also useful for building advanced materials. **TECHNICAL ARTICLE**

Tags: Advanced materials, S&T UK, Featured Article

[New technology enables ultra-fast steering and shaping of light beams](#)

[Nanowerk, 06JAN2015](#)

Researchers in the UK have developed a new acousto-



*This image shows a new optical beam-forming device making 'twisted light.'
(Image: Universities of Bristol and Dundee)*

optical array which consists of 64 tiny piezo-electric elements which act as high frequency loud-speakers. The complex sound field generated deflects and sculpts any light passing through the new device. As the sound field changes, so does the shape of the light beam. The new technology will enable better optical devices to be made, such as holographs that can move rapidly in real time. **TECHNICAL ARTICLE**

Tags: Photonics, S&T UK, Featured Article

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

[How 3-D printing could revolutionize war and foreign policy](#)

[PhysOrg.com, 05JAN2015](#)

With key patents running out this year, new printers that use metal, wood and fabric are set to become much more widely available—putting the engineering world on the cusp of major historical change. But the real revolution of 3D printing is less about the things you can make and more about where you make them. Being able to take printers to a warzone promises a radical shake-up of combat and the defence industry. This could lead militaries to cut out private defence companies altogether. And by combining 3D printing with assembly line robotics, those that remain will be enormously streamlined.

Tags: Advanced manufacturing, Disruptive technology

[Researchers develop 3-D reconstruction software](#)

[PhysOrg.com, 05JAN2015](#)

The software developed by researchers in Mexico performs a 3D scan of the original mechanical parts or faces to obtain a virtual model of the real dimensions of objects or parts that are no longer manufactured so they can be reproduced. The reconstruction technique involves the projection and acquisition of binary patterns using a commercial projector and a digital camera. The software can serve as a tool for face recognition.

Tags: Advanced manufacturing

ADVANCED MATERIALS

[A risk-ranking tool for nanomaterials used by the military](#)

[Nanowerk, 06JAN2015](#)

Based on the research conducted by the U.S. Army Center for Environmental Health Research associated with the incorporation of various engineered nanomaterials into military applications and equipment, a new

continued...

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analysis develops and implements a risk ranking tool to rank engineered nanomaterials. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

[Focusing in on applications](#)

[Nature Nanotechnology, 06JAN2015](#)

The initial expectations of the field of plasmonics and nanomaterials, which were in part linked to potential practical applications in photovoltaics and optical computing have not yet been met. Scientists are coming to terms with certain fundamental limitations in the physics of plasmons. This issue of Nature Nanotechnology explores what can, and cannot, be realistically achieved in the field.

Tags: Advanced materials

[Thinner Stealth Coatings](#)

[American Physical Society Spotlight, 06JAN2015](#)

Researchers have known for some time that embedding a thin elastic layer with cylindrical, air-filled cavities makes an excellent sound absorber. An international team of researchers (Canada, France) modeled the cavities as spherical bubbles, each with a springy response to a pressure wave and a resonant frequency that depends on its size and the elasticity of the surrounding material. The simplification allowed them to derive an analytical equation that relates sound attenuation at a given frequency to the material properties and cavity size and spacing. It can absorb well over 99% of the acoustic-wave energy impinging on it. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

[New methods to control the size and chemical composition of nanoparticles](#)

[Nanowerk, 05JAN2015](#)

Researchers in Japan have developed methods to control the size and chemical composition of nanoparticles, and now they have found a way to control the degree of crystallinity, or the way that atoms align inside the nanoparticles. One of the most important features of this system is the possibility to interact with or modify freshly formed semiconductor nanoparticles in flight before reaching a substrate. A nanoparticle's crystallinity impacts its optical, magnetic, and electrical properties. [Patent application](#)

Tags: Advanced materials, S&T Japan

COMMUNICATIONS TECHNOLOGY

[Doing more with less: Steering a quantum path to improved internet security](#)

[EurekaAlert, 07JAN2015](#)

Despite being a weaker form of entanglement, quantum steering technique, developed by researchers in Australia, operates paradoxically to maintain communication security while tolerating greater real-world loss and removing the need for absolute trust in devices. They used special photon quantum states to program a measurement apparatus at each step of sending the code. [TECHNICAL ARTICLE](#)

Tags: Communications Technology, Quantum science, S&T Australia

[NRL Researchers Demo TREC Ship-to-Shore Data Link](#)

[NRL, 18DEC2014](#)

The full-duplex connection was set up between a node on top of a 760-foot-tall building near the harbor and another on board the vessel Norwegian Sky. As the cruise ship tracked out to sea, the data rate was ratcheted down to 100 Mbps and the link was operated out to ~16 nautical miles. The Tactical Reachback Extended Communications (TREC) system was tested as part of a Cooperative Research and Development Agreement.

Tags: Communications Technology, Government S&T

ENERGY

[A novel nanobowl optical concentrator for organic solar cell](#)

[Nanowerk, 07JAN2015](#)

Researchers in China have developed a nanobowl optical concentrator which can largely enhance the optical absorption in the active layer of organic solar cells and optical simulation. The improvement was contributed by the superior photon capturing capability of the nanobowl. [TECHNICAL ARTICLE](#)

Tags: Energy, S&T China

[New concept of fuel cell for efficiency and environment](#)

[Science Daily, 05JAN2015](#)

Researchers in South Korea applied the hexavalent chromium (Cr (VI)) as a type of "CO scavenger" to the direct methanol fuel cell. Their new method not only uses the redox process to clean the platinum electrode surface by transforming CO into CO₂, but also allows for the Cr (VI) to convert into Cr (III), which is a much less toxic oxidation state and even a micronutrient. As a result, the potential maintained a nearly constant value of up to 10 hours and the presence of Cr (VI) was completely absent. Moreover, it enhances the maximum power density by 20%. [TECHNICAL ARTICLE](#)

Tags: Energy

[Single-pot electrolytic synthesis of hydrogen and carbon fuels](#)

[Nanowerk, 05JAN2015](#)

Researchers at George Washington University have successfully attempted to simultaneously co-generate hydrogen and solid carbon fuels from a mixed hydroxide/carbonate electrolyte in a 'single-pot' electrolytic synthesis at temperatures below 650°C. The core advance of this work is the demonstration that both water and carbon dioxide can be absorbed and split in a single medium providing a single chamber. [TECHNICAL ARTICLE](#)

Tags: Energy

continued...

“Those who dislike entertaining contradictory thoughts are unlikely to enrich their science with new ideas.” MAX PLANCK

New technologies harvest energy from movements, sound and more

PhysOrg.com, 31DEC2014

Among the most basic forms of the technology is body power. When certain materials are squeezed or stretched, the movement of their atoms creates an electrical charge. Automatic watches have employed the concept for decades, for example, by winding themselves when their user moves their arm. Now, the concept is being considered for a multitude of other devices.

Tags: Energy

FORECASTING

THE WORLD IN 2025—10 PREDICTIONS OF INNOVATION

Thomson Reuters, 01JAN2014

How will science and technology affect our lives in the next decade? Thomson Reuters resources, including the Web of Science and Derwent World Patents Index, with their coverage of current concentration and accelerating trends in today's research and innovation, provide a look ahead with these 10 predictions.

Tags: Forecasting, Bibliometrics

MATERIALS SCIENCE

High-temperature superconductor 'fingerprint' found

PhysOrg.com, 07JAN2015

Researchers at Cornell University have isolated a “fingerprint” that identifies specific fluctuations in electrons that force them into pairs, causing their host material, lithium iron arsenic (LiFeAs), to make way for free-flowing, resistance-free electron pairs. About three decades ago, physicists started studying “unconventional” superconductors, which superconduct at 100 times higher temperatures. The mechanism of why this happens at such relatively high temperatures is a longstanding mystery, and one with deep implications for quantum physics. TECHNICAL ARTICLE

Tags: Materials science, Quantum science

Acoustic levitation made simple

PhysOrg.com, 05JAN2015

Researchers in Brazil have developed a device which can levitate polystyrene particles by reflecting sound waves from a source above off a concave reflector below. Changing the orientation of the reflector allow the hovering particle to be moved around. This breakthrough may be an important step toward building larger devices that could be used to handle hazardous materials, and

chemically-sensitive materials like pharmaceuticals.

TECHNICAL ARTICLE

Tags: Materials science

Colloidal quantum dots: solar applications

Nanotechweb, 05JAN2015

Researchers in China synthesized well-crystallized and nearly monodisperse tetragonal Cd₃P₂ CQDs. They demonstrated the quantum heterojunction solar cells employing the PbS CQDs/Cd₃P₂ CQDs architecture. Both p-type PbS and n-type Cd₃P₂ CQD layers are quantum-tunable.

TECHNICAL ARTICLE

Tags: Materials science, S&T China

A repulsive material: New hydrogel dominated by electrostatic repulsion

Science Daily, 30DEC2014

To create the new material, researchers in Japan arranged layers of titanate nano-sheets in a plane. Once the sheets were aligned in the plane, they fixed the magnetically induced structural order by transforming the dispersion into a hydrogel using a procedure called light-triggered in-situ vinyl polymerization. By doing this, they created a material whose properties are dominated by electrostatic repulsion rather than attractive interactions.

TECHNICAL ARTICLE

Tags: Materials science, S&T Japan

Silky substrate makes flexible solar cells biocompatible

Nanowerk, 30DEC2014

Researchers in China integrated a biocompatible silk fibroin with a mesh of silver nanowires to achieve a flexible, transparent, and biodegradable substrate for efficient plastic solar cells. The flexible substrate can achieve a conductivity of ~11.0 Ω/sq and transmittance of ~80% in the visible light range, which is much better than the commercialized flexible substrate such as indium tin oxide coated PET and indium tin oxide coated polyethylene naphthalate. The power conversion efficiency of 6.6% is relatively high on the silk fibroin substrate. TECHNICAL ARTICLE

Tags: Materials science, Flexible electronics, S&T China

MICROELECTRONICS

Thermal memory thrives at extremely high temperatures

PhysOrg.com, 07JAN2015

While the performance of electronic memory devices degrades at high temperatures, a newly proposed

memory actually requires temperatures in excess of 600 K to operate. Developed by researchers at the University of Nebraska-Lincoln, the new device called NanoThermoMechanical memory uses heat instead of electricity to record, store, and recover data. It could be used in space exploration missions, deep-well drilling, and in combustion engines, among other applications.

TECHNICAL ARTICLE

Tags: Microelectronics

New Form of Memory Could Advance Brain-Inspired Computers

MIT Technology Review, 30DEC2014

Using a prototype phase-change memory chip, researchers at IBM configured the system to act like a network of 913 neurons with 165,000 connections, or synapses, between them. The strength of those connections changes as the chip processes incoming data, altering how the virtual neurons influence one another. By exploiting that property, the researchers got the system to learn to recognize handwritten numbers.

Tags: Microelectronics, Information technology

FEATURED RESOURCE

Science Watch

Thomson Reuters ScienceWatch is an open Web resource for science metrics and research performance analyses that includes data and commentary on the people, places and topics at the forefront of science today.

PHOTONICS

Nanoscale neighbors: First use of transformation optics to accurately analyze nonlocality in 3D plasmonic systems

PhysOrg.com, 02JAN2015

Van der Waals interaction influences a range of phenomena including surface adhesion, friction and colloid stability. Calculating van der Waals forces between, for example, a pair of nanospheres less than five nanometers apart becomes quite difficult. Researchers in the UK report that they have found a workaround that greatly simplifies the calculations by replacing the nonlocal system with a local system that reproduces the results to a high degree of accuracy.

TECHNICAL ARTICLE

Tags: Photonics, S&T UK

QUANTUM SCIENCE

Fractional quantum Hall effect: Experimental progress and quantum computing applications

Nanowerk, 06JAN2015

Researchers in China outline previous research and recent discoveries and technical developments in fractional quantum Hall effect (FQHE) in a new paper. The paper covers the progress of the 5/2 state in terms of energy gap, spin polarization study, fractional charge and statistics. The relationship between the energy gap and other experimental parameters, such as electron density, mobility, and sample quality, are outlined. FQHE in graphene provides an interesting platform for experiments in many-body physics.

TECHNICAL ARTICLE

Tags: Quantum science, S&T China

Measuring the variances of Heisenberg's incompatible observables

PhysOrg.com, 05JAN2015

An international team of researchers (Italy, India, China) has proved two new uncertainty relations that bound the sum of variances of two incompatible observables. In contrast to the well-known Heisenberg-Robertson relation, which bounds the product of variances, these new relations always give non-trivial bounds for all incompatible observables. **TECHNICAL ARTICLE**

Tags: Quantum science

Quantum channel made of light

Science Daily, 02JAN2015

In experiments using ultracold atoms and laser light, researchers in Switzerland have measured a stepwise change in conductivity as the atoms pass through tiny structures. These findings might be of relevance for the design and construction of the next generation of electronic devices, as it enables the future study of effects that currently cannot be explored with electronic systems.

TECHNICAL ARTICLE

Tags: Quantum science, S&T Switzerland

Calling quantum dots to order

MIT News, 30DEC2014

Lead sulfide nanocrystals suitable for solar cells have a nearly one-to-one ratio of lead to sulfur atoms, but researchers at MIT discovered that to make uniformly sized quantum dots, a higher ratio of lead to sulfur precursors—24 to 1—is better. They found that they can change the ligand species on the surface of quantum dots, a great way of modifying the film properties, to more compact and functional species without disturbing the superlattice arrangement. **TECHNICAL ARTICLE**

Tags: Quantum science

SCIENCE WITHOUT BORDERS

First Direct Measurement of Gravity's Curvature

American Physical Society Spotlight, 05JAN2015

An international team of researchers (Italy, the Netherlands, UK) has measured the change in gravity gradient produced by a large mass, using measurements at three different heights. They say their technique could improve gravity-based mapping of variations in rock density in geology and prospecting, and it could also boost the precision of tests of general relativity and measurements of the gravitational constant. **TECHNICAL ARTICLE**

Tags: Science without borders

Imaginary Magnetic Fields in the Real World

American Physical Society Spotlight, 05JAN2015

Researchers in China have shown that imaginary magnetic fields associated with a spin bath—in this case, the molecule—approaching a phase transition can be related to the quantum coherence of a probe spin coupled to the bath. The demonstration that this connection exists in a physical system is important at a fundamental level, and could lead to new ways of studying phase transitions in complex, many-bodied materials. **TECHNICAL ARTICLE**

Tags: Science without borders, S&T China

The Top Technology Failures of 2014

MIT Technology Review, 31DEC2014

Success means a technology solves a problem, whether it's installed on a billion smartphones or used by a few scientists carrying out specialized work. But many—maybe most—technologies do not succeed, typically because they fail to reach the scale of adoption that would make them relevant. The reasons for failure aren't predictable.

Tags: Science without borders

SENSORS

Ultrasound technology made to measure

Fraunhofer Research News, 05JAN2015

The range of uses for ultrasound is gigantic; the applied technologies are just as diverse. Researchers are now covering a wide range of applications with a new modular system: From sonar systems to medical ultrasound technologies and all the way to the high frequency range—such as for materials testing.

Tags: Sensors, S&T Germany ■

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