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S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLES

Vaccine that does not need refrigeration could save 500,000 lives each year from fatal diarrhea

Next Big Future, 23MAR2017

A nurse administers a rotavirus vaccine to a baby in Port-au-Prince, Haiti. Photograph: Hector Retamal/AFP/ Getty Images

An international team of researchers (France, Niger, USA - Harvard University, Cincinnati Children's Hospital, Switzerland) has developed a vaccine that does not require refrigeration and can remain stable for up to one year at 37C or six months at 40C. It is particularly effective against the strains of rotavirus found in sub-Saharan Africa, as well as affordable at only $2.50 (£2), the vaccine could potentially be rolled out quickly in routine immunisation programmes. The vaccine has proven as effective as those currently used to treat severe gastroenteritis. Trials in Niger's Maradi region successfully treated 4,000 children under the age of two. OPEN ACCESS TECHNICAL ARTICLE

Tags: Biotechnology, Medical sciences, Featured Article

Molecular motor-powered biocomputers

Nanowerk, 20MAR2017

An international team of researchers (USA - UC Berkeley, UK, Sweden, Germany, the Netherlands, Canada) is working on an EU sponsored project, Bio4Comp, to develop a computer based on highly efficient molecular motors that will use a fraction of the energy of existing computers, and that can tackle problems where many solutions need to be explored simultaneously. The idea is that biomolecular machines, each only a few nanometers in size, can solve problems by moving through a nanofabricated network of channels designed to represent a mathematical algorithm; an approach the scientists in the project termed "network-based biocomputation". They have demonstrated that this works. OPEN ACCESS TECHNICAL ARTICLE

Tags: Biotechnology, Information technology, S&T EU, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

Researchers create artificial materials atom-by-atom

Physorg.com, 27MAR2017

Researchers in Finland used a scanning tunnelling microscope to arrange vacancies in a single layer of chlorine atoms supported on a copper crystal. The same method can be applied in many well-understood systems in surface and nanoscience and could even be adapted to mesoscopic systems, such as quantum dots, which are controlled through lithographic processes. By arranging atoms in a lattice, it becomes possible to engineer the electronic properties of the material through the atomic structure. TECHNICAL ARTICLE

Tags: Advanced materials, S&T Finland

3-D printing turns nanomachines into life-size workers

Nanotechweb, 24MAR2017

Mechanically interlocked molecules (MIMs) are already widely used as molecular shuttles, switches, muscles and pumps. Researchers at Dartmouth College designed and synthesized MIM-based gels with properties desirable for 3-D printing. Utilizing the hydrogen bonding interactions between nanorings, they successfully printed lattice-like 3-D structures. They found that the complex 3-D architecture of these structures have shape-changing and recovery behavior that can be repeated many times. The research has unlocked the key to transforming microscopic nanorings into smart materials that perform work at human-scale. TECHNICAL ARTICLE

Tags: Advanced materials

Electrodeposition and annealing used to allow for adjusting hardness in nanograined metals

Physorg.com, 24MAR2017

Unlike normal metals which become harder as grains pileup, certain nanograined metals grow softer as more grains are added as they migrate rather than pileup. Using nickel and molybdenum, an international team of

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researchers (China, France) has demonstrated a technique based on electrodeposition and annealing pushing the molybdenum into the boundaries between nickel grains, which prevented the nickel grains from migrating under stress. The technique allows for the creation of metals with widely varying degrees of hardness by varying grain size and the degree to which electrodeposition is used versus annealing and whether it is synthesized at all. This gives manufactures more options when designing products. TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

Insights may lead to design and development of superior metallic alloys

Physorg.com, 24MAR2017

A long-standing issue in metallic glass research has been to resolve the packing of atoms in the material because the structure determines properties. An international team of researchers (China, USA - Argonne National Laboratory, Australia, Japan) has shown direct correlation between changes in the structure of the material and the energy required for that structure to change. Heat treatment, could be employed as a means to manipulate phase and microstructure of the metallic glass of interest. The research helps tune the properties of the material in larger sizes for specific applications. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials

Researchers grow a versatile diamond foil in a test reactor

Physorg.com, 24MAR2017

Researchers in Germany have developed a process of growing diamond coatings on silicon substrates which can be used on materials which are not suitable for direct coating. Using the technique, they produced diamond foil with a diameter of 28 centimetres. By varying manufacturing parameters it is possible to adjust the diamond grain size, electrical conductivity and thermal conductivity by many orders of magnitude. The research has opened a new range of other possible applications as virtually any substrate material can be coated with diamond film by means of a suitable joining technique. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials, Materials science, S&T Germany

A tough coat for silicon

Science Daily, 23MAR2017

Silicon forms an oxide layer on its surface when exposed to air or moisture, which can detract from its electronic properties. An international team of researchers (Singapore, Taiwan, Australia) coated silicon, germanium, and silicon nanowires with alkylthiols containing between seven and 18 carbon atoms using supercritical carbon dioxide ($scCO_2$) to deliver the coating. In tests the coated nanowires had significantly reduced cell growth compared with unprotected nanowires or a flat silicon surface. The $scCO_2$ technology can be adopted for many kinds of inorganic surface modification; it is scalable and enhances the quality and stability of the film. TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

Toward printable, sensor-laden "skin" for robots

MIT News, 23MAR2017

To demonstrate the feasibility of flexible, printable electronics that combine sensors and processing circuitry and can act on their environments, researchers at MIT have designed and built a device that responds to mechanical stresses by changing the color of a spot on its surface. Because a printed substrate could consist of many materials, interlocked in intricate but regular patterns, it broadens the range of functional materials that printable electronics can use. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials, Flexible electronics

Transparent ceramics make super-hard windows

Physorg.com, 17MAR2017

At ambient pressures, silicon nitride has a hexagonal crystal structure and is opaque. An international team of researchers (Germany, Japan) has succeeded in making a transparent piece of cubic silicon nitride with a diameter of about two millimetres. Although the material can be used under extreme conditions in engines, the possible window size is limited for practical reasons. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

BIOTECHNOLOGY

Inventing a new kind of matter

Physorg.com, 24MAR2017

In cells, microtubules grow, shrink, bend and stretch, altering the cell's underlying structure and adapt to their environment. A team of researchers in the US (Brandeis University, Georgia Institute of Technology) reproduced the processes in the laboratory with microtubules extracted from a cow's brain and placing them in a watery solution. The finding holds out the promise of developing an entirely new class of fluids that can flow without human or mechanical effort. TECHNICAL ARTICLE

Tags: Biotechnology

CYBER SECURITY

Quantum key system could make mobile transactions far more secure

Science Daily, 15MAR2017

An international team of researchers (UK, Finland) has developed and demonstrated a prototype device that can send unbreakable secret keys from a handheld device to a terminal. In the system the six resonant-cavity LEDs provide

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"Science does not know its debt to imagination."

RALPH WALDO EMERSON

overlapping spectra of light. Each of the six is filtered into a different polarization. The circularly polarized LEDs provide the bits for the key, while the other pairs are used to measure the security of the channel and provide error correction. Every four nanoseconds, one of the channels produces a one-nanosecond pulse in a random pattern. On the other end, six polarized receivers pick up the light from their matching LEDs and convert the photons into the key. The prototype's most important innovation is the steering system for photons. The team tested their idea with a handheld prototype made from off-the-shelf equipment.
Open Access TECHNICAL ARTICLE
Tags: Cyber security, Quantum science

ENERGY

The World's Largest Artificial Sun Could Help Generate Clean Fuel

MIT Technology Review, 23MAR2017

In large concentrated solar power plants, a field full of adjustable mirrors focus sunlight into a small incredibly hot area that melts salt which is then used to create steam and generate electricity. Researchers in Germany are working to develop a similar set up that could be used to power a high-energy reaction where hydrogen is extracted from water vapor and supply a constant and affordable source of liquid hydrogen fuel. In their facility, 140 Xenon short-arc lamps are spread across a surface. When all the lamps are switched on and focused on the same 20 by 20 centimeter spot, they create light that's 10,000 times more intense than solar radiation. At the center, temperature is over 3,000 °C.
Tags: Energy, S&T Germany

A new, gel-like coating beefs up the performance of lithium-sulfur batteries

Yale University, 20MAR2017

To improve the cycling stability of lithium-sulphur batteries, researchers at Yale University developed an ultrathin functionalized dendrimer–graphene oxide composite film which can be applied to virtually any sulfur cathode to alleviate capacity fading over battery cycling without compromising the energy or power density of the entire battery. The design provides a new strategy for confining lithium polysulfide intermediates and stabilizing lithium–sulfur batteries. TECHNICAL ARTICLE
Tags: Energy, Battery

Coming together, falling apart, and starting over, battery style

Nanowerk, 20MAR2017

In batteries, critical processes happen where the electrolyte and active material meet at the solid electrode. Researchers at Pacific Northwest National Laboratory have built a device that allows them to study key reactions in real time in controlled gaseous environments. It provides a way to understand the basic breakdown reactions, material build-up and other processes at the electrode surface during operation. Being able to gather this dynamic information is vital to building better batteries, fuel cells and improving the efficiency of industrial processes through electrocatalysis. TECHNICAL ARTICLE
Tags: Energy, Battery, Government S&T, Materials science

ENVIRONMENTAL SCIENCE

Harvard Scientists Moving Ahead on Plans for Atmospheric Geoengineering

MIT Technology Review, 24MAR2017

Sometime next year, researchers at Harvard University plan to launch, "StratoCruiser", a high-altitude balloon, tethered to a gondola equipped with propellers and sensors from a site in Tucson, Arizona. It will spray a fine mist of materials such as sulfur dioxide, alumina, or calcium carbonate into the stratosphere. The sensors would then measure the reflectivity of the particles and the way they interact with other compounds in the atmosphere. The basic idea is that spraying certain types of particles into the stratosphere could help reflect more heat back into space. Large volcanic eruptions have blasted tens of millions of tons of sulfur dioxide into the sky, which contributed to lower global temperatures in subsequent months.
Tags: Environmental science, Climatology

Chemists ID catalytic 'key' for converting CO2 to methanol

Science Daily, 23MAR2017

The catalyst made of copper, zinc oxide, and aluminum oxide used in industry to capture carbon dioxide and convert it to useful chemicals such as methanol, is not very efficient or selective. From experiments and computational modeling studies, an international team of researchers (USA - Brookhaven National Laboratory, Columbia University, SUNY Stony Brook, Venezuela) has identified the 'active site' of the catalyst. They found that copper zinc oxide gives the best results. There is synergy between copper and zinc oxide that accelerates the chemical transformation. Optimizing the copper/zinc oxide interface will become the driving principal for designing a new catalyst. TECHNICAL ARTICLE
Tags: Environmental science

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Eruptions on the sun trigger surprising phenomenon near Earth

Science Daily, 17MAR2017

Solar activity usually tends to increase the rate of ionization in the atmosphere and thus the density of free electrons in the ionosphere or move electrons to the polar caps. An international team of researches (Denmark, USA - Jet Propulsion Laboratory, Caltech, University of Illinois at Urbana-Champaign, Canada) shows a depletion of electrons in their measurements associated with a geomagnetic storm over the Arctic in 2014. They found that electrons in large quantities were almost vacuumed out from areas that extend over 500 to 1000 kilometres, just south of an area with strong increases in electron density, called patches. Polar patch formation was significantly decreased during the negative storm phase. They conclude that ionospheric heating due to the coronal mass ejection energy input caused changes in the polar atmosphere. The new findings increase the understanding of how geomagnetic storms affect Earth's atmosphere and could possibly lead to improved radio communication and navigation throughout the Arctic. TECHNICAL ARTICLE

Tags: Environmental science, Communications technology

Featured Resource

NASA Technical Reports Server (NTRS)

NTRS provides access to aerospace-related citations, full-text online documents, conference papers, journal articles, meeting papers, patents, research reports, images, movies, and technical videos created or funded by NASA. RSS

INFORMATION TECHNOLOGY

A Better Way to Organize the Internet: Content-Centric Networking

IEEE Spectrum, 23MAR2017

To provide more bandwidth and lower latency to many users at once, Xerox and their colleagues at the Palo Alto Research Center in California, have developed a better Internet architecture, they call content-centric networking (CCN). Their approach fundamentally changes the way information is organized and retrieved and improves network reliability, scalability, and security. CCN is based on how information is organized within the network, rather than the IP addresses of hosts. The new protocols can find and retrieve content from wherever it happens to be in the network at a given time and perform many additional tasks that could make networks faster, more resilient, and more secure.

Tags: Information technology, Communications technology

Making better decisions when outcomes are uncertain

MIT News, 21MAR2017

In Markov decision processes (MDP), a given decision doesn't always yield a predictable result; it could yield a range of possible results. A team of researchers in the US (MIT, Duke University) shows that, by adopting median of means it is possible to accurately characterize the value of a given decision while collecting much less empirical data than had previously seemed necessary. They describe an example in which the standard approach performed almost 4 million times to yield a reliable value estimate while their approach needs to be run 167,000 times. The new MDP analysis could help allocate computational resources. OPEN ACCESS TECHNICAL ARTICLE

Tags: Information technology

MATERIALS SCIENCE

Controlling ice formation

Physorg.com, 24MAR2017

No surface, including superhydrophobic surface is able to repel frost formation at very cold temperatures. Researchers in Taiwan have demonstrated the abilities of spatial control of ice formation and confinement of the ice-stacking direction by manipulating the local free energy barrier for frosting. The V-shaped microgroove patterned surface exhibited the best anti-icing and deicing performances. The research can pave the way towards the development of new engineered anti-icing surfaces. TECHNICAL ARTICLE

Tags: Materials science

Surprising twist in confined liquid crystals: A simple route to developing new sensors

Physorg.com, 24MAR2017

Historically, liquid crystals in tactoids conform to a bipolar and a bipolar configuration with a twist. Researchers at Georgia Institute of Technology found that at lower concentrations, liquid crystals arrange in a concentric fashion, but one that appears to be free of a singular defect. The crystals are water soluble and respond dramatically to being confined to certain patterns, concentrations and temperatures. The material's responsiveness to altering the environment could potentially be used to sense the chirality of molecules. OPEN ACCESS TECHNICAL ARTICLE

Tags: Materials science, Sensors

Research looks at friction properties of material

Physorg.com, 23MAR2017

A team of researchers in the US (Sandia National Laboratory, Virginia Polytechnic Institute and State University) established a correlation between the macro-scale friction regimes of metals and transition between two dominant atomistic mechanisms of deformation. Metals tend to exhibit bi-stable friction behavior—low and converging or high and diverging. They explained this behavior by using a simplified

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model based on grain size evolution as a function of contact stress and temperature and demonstrated it for self-mated pure copper and gold sliding contacts. This quantitative framework provides a shift from phenomenological to mechanistic and predictive fundamental understanding of friction for crystalline materials, including engineering alloys. TECHNICAL ARTICLE

Tags: Materials science, Government S&T

MICROELECTRONICS

Traditional semiconductor CMOS scaling at end of roadmap in 2024 then it is neuromorphic, quantum and other new systems

Next Big Future, 23MAR2017

According to the new semiconductor roadmap underway, there is no room for contact placement as well as worsening performance as a result of contacted poly pitch (CPP) scaling. It is projected that physical channel length would saturate around 12nm due to worsening electrostatics while CPP would saturate at 24nm to reserve sufficient CD (~11nm) for the device contact providing acceptable parasitics. Many organizations are proposing remedies [to the end of Moore's law] based on new device physics, such as neuromorphic circuits, quantum qubits, and spintronics. To enable such new architectures, the roadmap also includes a new section on applications benchmarks.

Tags: Microelectronics

QUANTUM SCIENCE

A robust, two-ion quantum logic gate that operates in a microsecond is designed

Physorg.com, 24MAR2017

An international team of researchers (Spain, USA - NIST) implemented faster-than-adiabatic two-qubit phase gates using smooth state-dependent forces. The forces are designed to leave no final motional excitation, independently of the initial motional state in the harmonic small-oscillations limit. They are simple, explicit functions of time and the desired logical phase of the gate, and are based on quadratic invariants of motion and Lewis-Riesenfeld phases of the normal modes. Two-qubit gates, such as the one examined in the study, may be useful for other applications of quantum technology, such as secure communications. TECHNICAL ARTICLE

Tags: Quantum science, Communications technology

Magnetic Fluctuations without a Magnet

American Physical Society Focus, 24MAR2017

Magnetic waves in a permanent magnet can survive even when the material is too hot for large-scale magnetism to exist. Inside a magnet is a highly ordered state of aligned spins. Small disturbances to this order can travel and persist as magnons. Using a thin film of a ferromagnetic material, which has a much lower critical temperature, researchers in Germany have found strong evidence for well-defined magnons traveling over distances of several nanometers well above critical temperature. The findings indicate that magnons exist in a wider range of conditions than previously known. Magnons might be used to transfer information quickly between such spins, and high-frequency magnons would be the most useful kind because they travel faster than lower frequency ones. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science, Communications technology

Quantum shortcuts cannot bypass the laws of thermodynamics

Physorg.com, 16MAR2017

Some recently proposed methods to control quantum systems, called shortcuts to adiabaticity (STA), appear to be energetically free. An international team of researchers (UK, Italy, USA - University of Maryland) applied the quantum speed limit which arises due to the Heisenberg uncertainty principle. Heisenberg uncertainty principle must apply to all STAs, and so it should prohibit them from operating in arbitrarily short times. By calculating the quantum speed limit, they showed that the faster you want to manipulate a system using an STA, the higher the thermodynamic cost. Instantaneous manipulation is impossible since it would require infinite energy to be put in. These limitations will help guide the design and implementation of these and other quantum systems in the future. TECHNICAL ARTICLE

Tags: Quantum science

S&T POLICY

The Importance of Killing Ideas, Not R&D

R&D Magazine, 22MAR2017

While spotting opportunity is the springboard for change, focusing on failure can be as much a part of finding the right answer for realizing that change. Being a disruptive innovator means staying ahead of the game by seeing things others simply don't see. How? By building an effective ecosystem with a team of lateral thinkers at its core. Without investment in R&D, it is impossible to be truly future focused. Tools for scouting technologies are only as good as the quality of the input.

Tags: S&T policy, Science without borders

SCIENCE WITHOUT BORDERS

Game-changing balloon technology enables near-global flight

Physorg.com, 24MAR2017

The pumpkin-shaped, football stadium-size super pressure balloon (SPB) is made from 22-acres of polyethylene film. It is capable of ascending to a nearly constant float altitude of about 35 km for flights lasting up to 100 days

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and endures the pressure changes that result from the heating and cooling of the day-night cycle. NASA expects the SPB to be capable of circumnavigating the globe once every one to three weeks, depending on wind speeds in the stratosphere. The long-duration flights enabled by SPB technology will allow extended observations of scientific phenomena, permit more sources to be surveyed, and provide more time to observe weak or subtle sources. Low cost of balloon missions, could permit the SPB to become a competitive platform for a number of scientific investigations.

Tags: Science without borders, NASA, Space technology

NASA selects CubeSat, SmallSat mission concept studies

Physorg.com, 23MAR2017

NASA has selected ten studies under the Planetary Science Deep Space SmallSat Studies (PSDS3) program, to develop mission concepts using small satellites to investigate Venus, Earth's moon, asteroids, Mars and the outer planets. For these studies, small satellites are defined as less than 180 kilograms in mass (about 400 pounds). CubeSats are built to standard specifications of 1 unit, which is equal to 10x10x10 centimeters (about 4x4x4 inches). They are launched into orbit as auxiliary payloads, significantly reducing costs. These satellites have the potential to enable transformational science. More on CubeSats.

Tags: Science without borders, NASA, Space technology

Molecular 'treasure maps' to help discover new materials

Physorg.com, 22MAR2017

Researches in the UK combined methods that predict how molecules will form crystal structures, with computer simulations that predict the properties of these structures. The result is relatively simple colour-coded maps which can be used by researchers without a computational background, to locate the best materials for specific applications. In simulations, the new approach led to the discovery and synthesis of materials with large methane storage capacities. The research could accelerate the discovery of materials for key applications in energy, pollution control, pharmaceuticals and a host of other fields. TECHNICAL ARTICLE

Tags: Science without borders, S&T UK

The science 'reproducibility crisis' - and what can be done about it

Cambridge University, 20MAR2017

Reproducibility is important to show that the claims of any experiment are true and for them to be useful for any further research. A survey by Nature revealed that 52% of researchers believed there was a "significant reproducibility crisis" and 38% said there was a "slight crisis". In this article three experts share their thoughts on how the situation could be improved.

Tags: Science without borders, S&T UK ■

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