Volume 5, Issue 17 ■ 24APR2015

S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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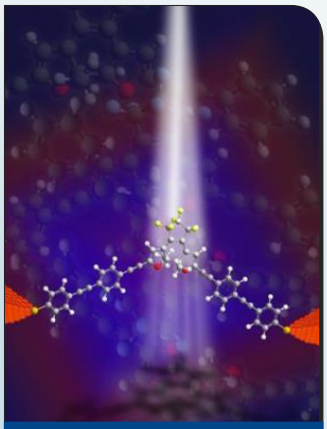
FEATURE ARTICLES

Tiniest circuits: Light-controlled molecule switching

Science Daily, 20APR2015



Molecular switch. Credit: Image courtesy of University of Konstanz

Through complex experiments, researchers in Germany have discovered a particular diarylethene compound which can conduct an electrical current. The current can be selectively turned on and off like an electrical switch. The molecule is approximately three nanometres in size, it rotates very little when a point in its structure opens and it possesses two nanowires that can be used as contacts. It is an insulator when open and becomes a conductor when closed. TECHNICAL ARTICLE

Tags: Microelectronics, Photonics, S&T Germany, Featured Article

Light in a spin

Nanowerk, 15APR2015

An international team of researchers (Germany, South Africa, Kenya) has demonstrated that laser light traveling along a helical path through space can accelerate and decelerate as it spins into the distance. This is the first time that angular acceleration has been observed with light, and is therefore likely to lead to new applications using these structured light fields. TECHNICAL ARTICLE

Tags: Photonics, Featured Article

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

Efficient method of producing metallic nanoparticles

Science Daily, 20APR2015

Developed by researchers in Finland, the aerosol technology reactor for nanoparticle production can generate a variety of pure metal particles, particles of various alloys and carbon-coated particles. They demonstrated it's practical functionality by testing the production of various nanometals, metallic compounds and carbon-coated materials. The reactor can efficiently produce hundreds of grammes or even kilogrammes of nanoparticles per day.

Tags: Advanced manufacturing, S&T Finland

ADVANCED MATERIALS

Engineers introduce design that mimics nature's camouflage

PhysOrg.com, 20APR2015

Researchers at the University of Nebraska have created a structure consisting of three layers: a base that insulates against heat, a middle that readily absorbs light, and a top made of either a liquid or solid. Paper, glass, foil, silicon and other materials have all proven suitable for the middle layer, so long as it includes a distribution of colored pixels. The middle and top layers also contain colloids: microscopic particles of soda lime, glass or copper. It can begin replicating color and texture within seconds of exposure to pulses of light. The new design responds to much lower-intensity light and at faster rates than its few predecessors. TECHNICAL ARTICLE

Tags: Advanced materials

Theoretical framework for graphene physics established

Science Daily, 20APR2015

The theoretical framework, developed by an international team of researchers (Singapore, USA), can be generally applied to various two dimensional materials. They showed that when one 2D material is placed on

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top of another, their electronic coupling induces significant mechanical strain, stretching and shrinking bonds in three dimensions, and that these distortions change the electronic properties. They found that the band gap depends on several factors including the angle between the two sheets and their mechanical stiffness. TECHNICAL ARTICLE

Tags: Advanced materials

Boron-based atomic clusters mimic rare-earth metals

PhysOrg.com, 17APR2015

Researchers at Pennsylvania State University have shown that boron-doped lanthanide superatom clusters mimic the valence electron configuration of certain rare earth elements, and may serve as rare earth analogs. Cluster chemistry involves combining atoms or molecules in such a way that they are considered something in between an isolated atomic or molecular species and bulk material. TECHNICAL ARTICLE

Tags: Advanced materials

How to maximize the superconducting critical temperature in a molecular superconductor

PhysOrg.com, 17APR2015

An international team of researchers (UK, Hungary, Slovenia, Japan, France) led by Japan, unveiled a new state of matter—the Jahn-Teller metal—and showed that when the balance between molecular and extended lattice characteristics of the electrons at the Fermi level is optimized, the highest achievable temperature for the onset of superconductivity is attained. TECHNICAL ARTICLE

Tags: Advanced materials

New paper opens the door to the study of a new class of materials

PhysOrg.com, 17APR2015

Researchers at the University of Notre Dame describe how an accurate statistical description of heterogeneous particulate materials, which is used within statistical micromechanics theories, governs the overall thermo-mechanical properties. They predicted the properties of granular Platonic solids (crystalline) packs and discovered a significant shape effect in their overall thermo-mechanical behavior. Based on their work, a large class of materials with arbitrary inclusions can now be easily studied. TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

A 'pin ball machine' for atoms and photons

PhysOrg.com, 16APR2015

An international team of researchers (Germany, US, Spain) proposes a combination of nano-photonics with ultracold atoms for simulating quantum many-body systems and creating new states of matter. TECHNICAL ARTICLE

Tags: Advanced materials

Nanotubes with two walls have singular qualities

Science Daily, 16APR2015

An international team of researchers (USA, Mexico) found that in double walled CNTs both the distance between the walls and the individual chirality of the tubes impact the double-walls' electrical properties. In addition, the researchers found the diameter of the tube, especially the inner tube with its more pronounced curvature, has a small but significant impact on the structure's semiconducting properties. TECHNICAL ARTICLE

Tags: Advanced materials

New materials repel oil underwater, could better clean up oil spills

PhysOrg.com, 16APR2015

Researchers at the University of Wisconsin-Madison used a unique, layer-by-layer approach for fabricating thin, multi-layer polymer films which allowed them to manipulate both the chemistry and the topography of the material yielding three-dimensional structures that are porous at the micrometer and nanometer scale. The coatings are extremely superoleophobic in underwater environments.

Tags: Advanced materials, Materials science

Nature-inspired nanotechnology mesh captures oil but lets water through

Nanowerk, 15APR2015

Researches at Ohio State University sprayed a fine dusting of silica nanoparticles onto the stainless steel mesh to create a randomly bumpy surface and layered the polymer and surfactant on top. In tests, water filtered through the mesh to land in a beaker below. The oil collected on top of the mesh, and rolled off easily into a separate beaker when the mesh was tilted. TECHNICAL ARTICLE, 2

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS

Video Friday: Robotic Kitchen, Swarming Drones, and Robots Want Your Blood

IEEE Spectrum, 17APR2015

The ONR program, LOw-Cost Unmanned aerial vehicle Swarming Technology (LOCUST), is a prototype for a UAV that can be launched through a tube using compressed air, and the idea is that you can launch a whole bunch of them "to autonomously overwhelm an adversary." In 2016, 30 of them will swarm in a ship-based demonstration.

Tags: Autonomous systems & robotics

COMMUNICATIONS TECHNOLOGY

Innovation boosts Wi-Fi bandwidth tenfold

PhysOrg.com, 20APR2015

The prototype, called WiFO, developed by researchers at Oregon State University, uses LEDs that are beyond the

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"Science is merely an extremely powerful method of winnowing what's true from what feels good." CARL SAGAN

visual spectrum for humans and creates an invisible cone of light about one meter square in which the data can be received. To address the issue of a small area of usability, the researchers created a hybrid system that can switch between several LED transmitters installed on a ceiling, and the existing WiFi system.

Tags: Communications Technology

CYBER SECURITY

University group reveals geo-inference attack threat that uses browser cache to reveal user location

PhysOrg.com, 20APR2015

Researchers in Singapore describe geo-inference attacks—where hackers can set up a website and then use cache information in a user's browser to reveal their geographical location. TECHNICAL ARTICLE

Tags: Cyber security

Fighting the next generation of cyberattacks

PhysOrg.com, 16APR2015

A team of researchers in the US (University of Utah, UC Irvine) is creating an analyzer that can thwart algorithmic attacks that target the set of rules or calculations that a computer must follow to solve a problem. Algorithmic attacks can secretly monitor how an algorithm is running or track how much energy a computer is using and use that information to glean secret data that the computer is processing. They can also disable a computer by forcing it to use too much memory or driving its central processing unit to overwork.

Tags: Cyber security

Human and technical ingenuity will be required to defeat shape-shifting malware

PhysOrg.com, 16APR2015

There is more to defence now than antivirus scanners alone, and perimeter defences and other forms of intrusion detection systems are able to detect suspicious network traffic rather than just suspicious files. Nevertheless with imaginative and ingenious criminal and programming minds at work, it's really only skilled and experienced human talent that provide the awareness required—technology alone cannot offer a total solution.

Tags: Cyber security

ELECTRONIC WARFARE

A blueprint for clearing the skies of space debris

Science Daily, 17APR2015

The blueprint put forward by an international team of researchers (Japan, France, Italy, USA) combines a super-wide field-of-view telescope, developed by RIKEN's EUSO team and a recently developed high-efficiency laser system that will be used to track space debris and remove it from orbit. The new method will be capable of tracking down and deorbiting the most dangerous space debris, around the size of one centimeter. The intense laser beam focused on the debris will produce high-velocity plasma ablation, and the reaction force will reduce its orbital velocity, leading to its reentry into Earth's atmosphere. TECHNICAL ARTICLE

Tags: Electronic Warfare, Satellite technology, Space technology

ENERGY

Beyond the lithium ion - a significant step toward a better performing battery

Nanowerk, 17APR2015

Researchers at the University of Illinois at Chicago have shown they can replace the lithium ions, each of which carries a single positive charge, with magnesium ions, which have a plus-two charge. Because magnesium is an ion that carries two positive charges, every time we introduce a magnesium ion in the structure of the battery material we can move twice as many electrons. TECHNICAL ARTICLE

Tags: Energy, Battery

Engineer improves rechargeable batteries with nano 'sandwich'

Science Daily, 17APR2015

To reduce the dissolution of sulfur-based products into the electrolyte, researchers at Kansas State University wrapped molybdenum disulfide sheets with a few layers of silicon carbonitride. They showed that when silicon carbonitride and boron nitride nanosheets are combined, they have high temperature stability and improved electrical conductivity. TECHNICAL ARTICLE

Tags: Energy, Battery

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How a crying baby might soon power your phone

TechRadar, 15APR2015

Researchers at the Georgia Institute of Technology used a laser to burn miniscule holes in a sheet of paper the size of a postage stamp, then coated one side in copper and the other with polytetrafluoroethylene. The two sides were joined on one edge, but left free on the others. As sound waves hit the sheet of paper, they cause the copper and Teflon sides to come into and out of contact, generating a small amount of static electricity like rubbing a balloon on your head. TECHNICAL ARTICLE

Tags: Energy

Featured Resource

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ENVIRONMENTAL SCIENCE

Major advance in artificial photosynthesis poses win/win for the environment

Science Daily, 16APR2015

A team of researchers in the US (DOE's Lawrence Berkeley National Laboratory, UC Berkeley) has created a hybrid system of semiconducting nanowires and bacteria that mimics the natural photosynthetic process by which plants use the energy in sunlight to synthesize carbohydrates from carbon dioxide and water. However, this new artificial photosynthetic system synthesizes the combination of carbon dioxide and water into acetate, the most common building block today for biosynthesis. TECHNICAL ARTICLE

Tags: Environmental science, Government S&T

FORECASTING

New method uses patent data to estimate a technology's future rate of improvement

PhysOrg.com, 15APR2015

Researchers at MIT devised an equation incorporating a patent set's average forward citation and average publication date, and calculated the rate of improvement for each technology domain. Their results matched closely with the rates determined through the more labor-intensive approach of finding numerous historical performance data points for each technology. They determined the improvement rates of 28 different technologies, including solar photovoltaics, 3-D printing, fuel-cell technology, and genome sequencing. Their method can help reduce the uncertainty of the capabilities of a technology in the future, not to zero, but to a more manageable number.

Tags: Forecasting

IMAGING TECHNOLOGY

Scientists develop a new algorithm which will speed up the process to obtain HDR images

PhysOrg.com, 15APR2015

Researchers in Spain have developed a new algorithm for the capture of high dynamic range images which reduces the time of capture or the level of noise in the resulting image. Beyond the field of photography, this new development can also be applied to artificial vision systems, medical imaging, control quality systems in assembly lines, and satellite images. TECHNICAL ARTICLE

Tags: Imaging technology

INFORMATION TECHNOLOGY

Wearable device turns user's thumbnail into a miniature wireless track pad

Science Daily, 16APR2015

Researchers at MIT describe a prototype of the device, called NailO, in a paper they're presenting at an upcoming conference. The thumbnail is a hard surface with no nerve endings, so a device affixed to it wouldn't impair movement or cause discomfort. And it's easily accessed by other fingers, it is unobtrusive. The prototype sensors were built by printing copper electrodes on sheets of flexible polyester which allowed them to experiment with a range of different electrode layouts. Commercial version of their device would have a detachable membrane on its surface. VIDEO

Tags: Information Technology, Flexible electronics

MATERIALS SCIENCE

Giant magnetic effects induced in hybrid materials

Science Daily, 20APR2015

A team of researchers in the US (UC San Diego, University of Colorado) investigated a hybrid material consisting of a thin nickel film on a vanadium oxide substrate. They report that the magnetic coercivity (defined as the resistance to a change in the direction of the magnetic fields for a ferromagnetic material) of nickel reveals insights concerning the transition of vanadium oxide from being an electrical conductor to becoming an insulator, called the metal-insulator transition (MIT). Potential applications are in disparate energy related fields: energy driven magnetic recording and self-healing current fault limiters. TECHNICAL ARTICLE

Tags: Materials science

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New path to loss-free electricity

Science Daily, 20APR2015

An international team of researchers (USA, China) has mapped out the redistribution of orbital electrons in barium iron arsenide, with and without cobalt substitution. The results reveal a remarkable increase in charge distribution around the iron and arsenic atoms as cobalt is incorporated into the material. The induced charge redistribution around the iron and arsenic atoms after cobalt substitution suggests that the strongly coupled bond-electron fluctuation and charge separation may provide a new mechanism for high-temperature superconductivity. TECHNICAL ARTICLE

Tags: Materials science, Government S&T

Superconductors Under Pressure

American Physical Society Spotlight, 16APR2015

Researchers in Spain have shown that pressurized H_2S superconducts at 190K. They studied the decomposition pathways of H_2S when it is pressurized to 200 gigapascals. They found that H_2S could form two stable metallic structures, H_3S or HS_2. They also found that electron-phonon interactions explain high temperature superconductivity in H_3S if the anharmonic vibrational motion of the hydrogen atoms is considered. TECHNICAL ARTICLE

Tags: Materials science

MEDICAL SCIENCES

Novel nanoparticles could save soldiers' lives after explosions

Medical Express, 16APR2015

Building on past research in this area, a team of researchers in the US (Virginia Tech University, Case Western Reserve University, Veterans Administration) paired clot-promoting nanoparticles with a corticosteroid that stops inflammation. They injected the particles in rats within 10 minutes of traumatic injury and found the therapeutic compound increased oxygen levels, and reduced internal bleeding and cellular damage in the lungs. The researchers conclude that the nanoparticles could be a good candidate to develop further for emergency trauma care. TECHNICAL ARTICLE

Tags: Medical Sciences, Biotechnology

MICROELECTRONICS

Printing silicon on paper, with lasers

PhysOrg.com, 21APR2015

Researchers in the Netherlands have pioneered a method that allows silicon itself, in the polycrystalline form used in circuitry, to be produced directly on a substrate from liquid silicon ink with a single laser pulse. TECHNICAL ARTICLE

Tags: Microelectronics, Advanced materials

There's more to come from Moore

Nature, 17APR2015

Moore's law is approaching physical limits: truly novel physics will be needed to extend it. Where are we headed? Labs around the world are experimenting with approaches and materials that could drastically cut energy consumption. One avenue that could be exploited is the inherent stability of the collective 'topological' properties of atoms: a modern twist on the ancient practice of encoding information by tying knots. Some researchers are trying out radical 'neuromorphic' circuit architectures inspired by the plasticity of the brain's neuronal networks.

Tags: Microelectronics, Emerging technology

STEM

Science and engineering graduate school enrollment increases - Rise largely fueled by influx of foreign students

NSF News, 17APR2015

After remaining essentially flat for the past two years, the number of full-time graduate students enrolled in science and engineering programs rose by 2.4 percent in 2013, to nearly 425,000 students. NSF's National Center for Science and Engineering Statistics (NCSES) found the increase was largely due to a 7.9 percent rise in full-time enrollment of foreign graduate students on temporary visas.

Tags: STEM ■

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