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S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

Feature Articles

New optical biosensor can diagnose infections in few seconds

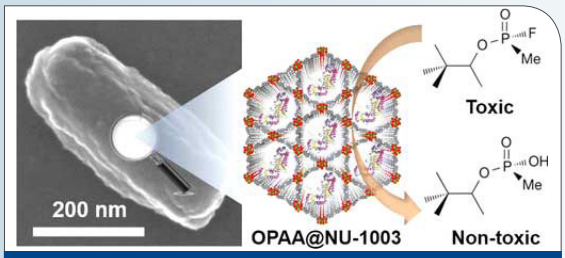
PhysOrg.com, 06OCT2016

The biosensor, developed by researchers in Russia, is made of a regularly micro-perforated silver nanofilm deposited on a transparent substrate made of natural mineral fluorite. A sample of biomaterial is placed on the film and exposed to infrared light. By acquiring light spectra passing through the sample, researchers can infer the presence of specific bacteria or viruses. They demonstrated that the biosensor can detect a single bacteria. The high sensitivity of the sensor is due to the grating-like structure of the silver film. TECHNICAL ARTICLE

Tags: Sensors, S&T Russia, Featured Article

A nerve agent antidote that could be taken before an attack

Nanowerk, 05OCT2016



Synthesis and characterization of a water-stable zirconium metal–organic framework (MOF), NU-1003. This material has been used to immobilize the nerve agent hydrolyzing enzyme, organophosphorus acid anhydrolase (OPAA)

An enzyme called organophosphorus acid anhydrolase has attracted attention recently for its ability to break down nerve agents. But the body's immune system gets rid of it quickly. Packaging the enzyme in liposome nanocarriers gives the antidote greater staying power, but handling and storing the liposomes is complicated. An international team of researchers (USA - Northwestern University, US Army Edgewood Chemical Biological Center, China, Saudi Arabia) used a zirconium-based MOF and loaded it with the antidote. Testing showed that the MOF-encapsulated enzyme was even more effective at breaking down the nerve agent simulant diisopropyl fluorophosphate and the nerve agent soman than the antidote by itself. OPEN ACCESS TECHNICAL ARTICLE

Tags: Counter WMD, Featured Article

S&T News Articles

ADVANCED MATERIALS

Three ways organic electronics is changing technology as we know it

PhysOrg.com, 10OCT2016

One day, your latest gadget won't be in your pocket like a phone or even wrapped around your wrist like a smartwatch, but stuck to your skin like a transparent plaster. Researchers in Japan attempt to make "optoelectronic skin". The chemistry of organic semiconductors can be modified in ways that are impossible with materials such as silicon. Organic semiconductors can be made to be soluble, and can be turned into an ink. This means it's possible to print electronic circuits, with the potential to manufacture components as fast as printing newspapers. And because they're based on plastic materials, these circuits can also be made flexible and so no longer need to sit inside rigid boxes. TECHNICAL ARTICLE

Tags: Advanced materials, Flexible electronics, S&T Japan

Complex materials can self-organize into circuits, may form basis for multifunction chips

EurekAlert, 04OCT2016

In a proof-of-principle experiment, researchers at Oak Ridge National Laboratory showed that when the complex oxide material Lanthanum Praseodymium Calcium Manganese Oxide is confined to micro- and nanoscales it can act like a multi-component electrical circuit. This behavior stems from phase separation, in

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which tiny regions in the material exhibit vastly different electronic and magnetic properties. The experiment shows that phase separated materials could be a way beyond the "one-chip-fits-all" approach.

Tags: Advanced materials, Materials science, Metamaterials

New multiferroic materials from building blocks

Science Daily, 03OCT2016

Researchers in Japan utilized a new chemical design for artificial multiferroic thin films using two-dimensional oxide nanosheets as building blocks. This approach enables engineering the interlayer coupling between the ferromagnetic and ferroelectric orders, as demonstrated by artificial superlattices composed of ferromagnetic Ti0.8Co0.2O2 nanosheets and dielectric perovskite-structured Ca2Nb3O10 nanosheets. The (Ti0.8Co0.2O2/Ca2Nb3O10/Ti0.8Co0.2O2) superlattices exhibit the multiferroic effects at room temperature, which can be modulated by tuning the interlayer coupling. This study opens a pathway to create new artificial materials with tailored multiferroic properties. In addition, the successful development of room temperature multiferroic nanofilms may lead to their application to new memory devices, taking advantage of their multifunctionality and low-voltage operation. TECHNICAL ARTICLE

Tags: Advanced materials, S&T Japan

BIOTECHNOLOGY

Solving the problem of glare

Nanowerk, 05OCT2016

Instead of changing the light's coherence, researchers in Israel reduced glare by using wavefront shaping to change the field of the light illuminating the object. They minimized the amount of blinding light scattered into the camera by using an optical device called a spatial light modulator and an optimization algorithm to control the shape of the impinging light field. The method can be used to detect quickly moving objects such as blood cells by reducing the light coming from the static background. This could be useful for microfluidic applications and flow cytometry, a technique used in many diagnostic and biomedical research applications. OPEN ACCESS TECHNICAL ARTICLE

Tags: Biotechnology, Photonics

Launched: A Synthetic Biology Factory for Making Weird New Organisms

IEEE Spectrum, 04OCT2016

Building an organism to spec is no easy task. Genetics still isn't well understood; there's no universal catalog listing of genes that details what they all do. Even if researchers know what a particular gene does in an orange tree, for example, when they add it to a yeast cell, it might interact with the native DNA in unexpected ways. If they're adding several genes from different species to that yeast cell, things get even more complicated. That is why a company in Massachusetts takes an engineering approach to biology - designing, building, and testing living organisms.

Tags: Biotechnology, Synthetic biology

ENERGY

New kind of supercapacitor made without carbon

Nanowerk, 11OCT2016

MOFs are extremely porous, sponge-like structures which conduct ions very well. A team of researchers in the US (MIT, Argonne National Laboratory) used Ni_3 to make supercapacitors which can be made under much less harsh conditions than those needed for the carbon-based materials. The new device, even without any optimization of their characteristics, already match or exceed the performance of existing carbon-based versions in key parameters. They lost less than 10 percent of their performance after 10,000 cycles. The supercapacitors could play an important role in making renewable energy sources practical for widespread deployment, provide grid-scale storage, and be used in electric vehicles and other applications. TECHNICAL ARTICLE

Tags: Energy, Materials science

Future Information Technologies: New combinations of materials for producing magnetic monopoles

Nanowerk, 10OCT2016

Magnetic patterns such as monopoles or skyrmions are promising options for fast and energy efficient data storage. However obtaining and manipulating such magnetic structures is not easy. An international team of researchers (Germany, Spain, USA - Oak Ridge National Laboratory) covered microstructures of superconducting YBaCuO-dots with an extremely thin film of ferromagnetic iron-nickel-alloy, a permalloy. They applied an external magnetic field to change the magnetic domains inside the permalloy to create supercurrent which persist even after the removal of the external magnetic field. OPEN ACCESS TECHNICAL ARTICLE

Tags: Energy, Advanced materials

World Energy Scenarios to 2060

Next Big Future, 10OCT2016

According to the World Energy Council report, underlying drivers - including lower population growth, new technologies, greater environmental challenges, and a shift in economic and geopolitical power - will re-shape the economics of energy. New technologies to 2060 will keep energy demand growth moderate relative to historical trends, and will help to enable industrialised economies to transition more quickly into service and sustainability-led growth. Advanced manufacturing, automation, telecommuting, and other technologies also will disrupt traditional energy systems. TECHNICAL ARTICLE

Tags: Energy

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"Nothing has such power to broaden the mind as the ability to investigate systematically and truly all that comes under thy observation in life." MARCUS AURELIUS

ENVIRONMENTAL SCIENCE

Research resolves a debate over 'killer electrons' in space

EurekAlert, 04OCT2016

The particles that are most dangerous to spacecraft are known as relativistic and ultra-relativistic electrons. The ultra-relativistic, or "killer electrons," are especially hazardous and can penetrate the most protected and valuable satellites in space. An international team of researchers (USA - UCLA, Stanford University, University of Colorado, UC Berkeley, University of New Hampshire, Germany, Finland) found that the most intense relativistic and ultra-relativistic electrons were discovered in different locations in the Van Allen belts and the ultra-relativistic particles were located deep inside the magnetosphere. Their detailed measurements showed that the waves were indeed scattering particles into the atmosphere but affected only ultra-relativistic electrons, not relativistic particles. The findings may help develop methods of cleaning up the radiation belts from harmful radiation and make the environment around the Earth friendlier for satellites.

Tags: Environmental science, Space technology

INFORMATION TECHNOLOGY

Computer experts identify fourteen themes of creativity

Science Daily, 06OCT2016

Computational creativity is a relatively new field of research into computer systems that exhibit creative behaviours. Using language-analysis software, researchers in the UK identified the creative words and grouped them into clusters. These are considered to be 14 components of creativity. These clusters have been used to evaluate the creativity of computational systems, and are expected to be a useful resource for other researchers in computational creativity, as well as forming a basis for the automated evaluation of creative systems. OPEN ACCESS TECHNICAL ARTICLE

Tags: Information technology, S&T UK

Low energy electric field found suitable for quick magnetic recording

Science Daily, 04OCT2016

An international team of researchers (Germany, Russia, the Netherlands) generated a terahertz electric field so strong that it can induce a voltage of a million of volts in a magnet. Thereby it perturbs the orbital motion of the electrons and deflects the direction of the magnetic anisotropy axis. Importantly, this process happens so fast that the magnetization starts to wobble around. The amplitude of the magnetization oscillations scales nonlinearly with the driving electric field. They believe that the finding will be applicable in recording devices in the foreseeable future. TECHNICAL ARTICLE

Tags: Information technology

MATERIALS SCIENCE

Exotic property confirmed in natural material could lead to fundamental studies

PhysOrg.com, 07OCT2016

Through applying uniaxial strain along armchair direction, an international team of researchers (USA - Purdue University, Canada) has succeeded in demonstrating a cross-plane interlayer negative Poisson's ratio on black phosphorus for the first time. Their results support the existence of a cross-plane intralayer negative Poisson's ratio in the constituent phosphorene layers under uniaxial deformation along the zigzag axis. The phenomenon originates from the puckered structure of its in-plane lattice, together with coupled hinge-like bonding configurations. TECHNICAL ARTICLE

Tags: Materials science

Method enables material to carry more electrical current without resistance at a higher temperature

PhysOrg.com, 06OCT2016

The amount of current iron-based superconductors can carry has been low in comparison to other superconductors. Introducing defects in the crystal structure of the materials increases the amount of current they can carry. An international team of researchers (USA - Brookhaven National Laboratory, Florida State University, Japan) ran simulations and figured out the right combinations of defect and ion species combinations that should hold down the magnetic vortices without negatively impacting the material's superconducting properties. They believe that the critical current and temperature can be further enhanced by fine tuning the structure of the defects and the arrangement of the lattice strains. OPEN ACCESS TECHNICAL ARTICLE

Tags: Materials science

Nanoscale confinement leads to new all-inorganic perovskite with exceptional solar cell properties

Nanowerk, 06OCT2016

An international team of researchers (USA - NERL, University of Colorado, University of Washington, Colorado School of Mines, India) synthesized and purified

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nanocrystals of $CsPbI_3$. Contrary to the bulk version of $CsPbI_3$, the nanocrystals were found to be stable not only at temperatures exceeding 600 degrees Fahrenheit but also at room temperatures and at hundreds of degrees below zero. They transformed the nanocrystals into a thin film. Used in a solar cell, the $CsPbI_3$ nanocrystal film proved efficient at converting 10.77 percent of sunlight into electricity. The efficiency is similar to record quantum dot solar cells of other materials and surpasses other reported all-inorganic perovskite solar cells. TECHNICAL ARTICLE

Tags: Materials science, Advanced materials, Government S&T, Solar energy

Physicists 'dissolve' water in an emerald

Nanowerk, 05OCT2016

Liquid water does not demonstrate ferroelectric behavior due to the molecules being located so closely that their interactions are dominated by the short-range hydrogen bonds, which suppress the long-range dipole-dipole forces. An international team of researchers (Russia, Germany, Czech Republic) devised a subtle and unexpected way of creating conditions when the dipole-dipole interactions between water molecules would be stronger than hydrogen bonding. They managed to confine individual H_2O molecules in a network of nanosized cavities within the crystal structure of beryl. The electric fields, which are generated by nanoconfined water, could play a vital role in various phenomena studied in biology, chemistry, geology, and meteorology, or even in the formation of the planets of our Solar System. OPEN ACCESS TECHNICAL ARTICLE

Tags: Materials science

Featured Resource

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MICROELECTRONICS

Smallest. Transistor. Ever.

Nanowerk, 06OCT2016

A team of researchers in the US (UC Berkeley, Lawrence Berkeley National Laboratory, UT Dallas, Stanford University) used carbon nanotubes and molybdenum disulfide (MoS_2) in their invention. Both silicon and MoS_2 have a crystalline lattice structure, but electrons flowing through silicon are lighter and encounter less resistance compared with MoS_2 hence their flow can be controlled with smaller gate lengths. MoS_2 can also be scaled down to atomically thin sheets, about 0.65 nanometers thick, with a lower dielectric constant. Both of these properties, in addition to the mass of the electron, help improve the control of the flow of current inside the transistor when the gate length is reduced to 1 nanometer. TECHNICAL ARTICLE

Tags: Microelectronics

PHOTONICS

Noise-canceling optics

PhysOrg.com, 11OCT2016

Researchers at Caltech have created a device that selectively cancels the scattered light, leaving only the light that reflected or bounced off the objects and slipped back through the murk unmolested. The new system relies on destructive interference to do the canceling. The new technology, termed "coherence gated negation" (CGN) splits a laser into twin parallel beams, using one to illuminate a target and the other to cancel out the glare. Superimposing the light from each results in a cleaned-up image on a camera sensor. Potential uses of CGN include satellite exploration of cloud-obscured planets, biomedical applications and navigating foggy roads. OPEN ACCESS TECHNICAL ARTICLE

Tags: Photonics

Metamaterial uses light to control its motion

PhysOrg.com, 10OCT2016

A team of researchers in the US (University of Pennsylvania, UC San Diego) designed a device in which the top plate is a bilayer gold/silicon nitride with nanoantennas etched into the gold layer and the bottom plate is a metal reflector. When light is shined upon the device, the nanoantennas absorb all of the incoming radiation from light and convert into heat. The bilayer materials and the gap between the top and bottom layer enables the bilayer to again absorb all of the incoming light and the cycle repeats over and over again. Potential use of the device includes using it as a frequency reference to accurately keep time in GPS, computers, wristwatches and other devices. The platform may be used in high precision sensors and quantum transducers. TECHNICAL ARTICLE

Tags: Photonics

Physicists control the polarization of the light, lowering its speed up to 10 times

PhysOrg.com, 04OCT2016

An international team of researchers (Russia, Japan) ensured that the plane of polarization of the "slow" light is turned so quickly that it is significantly different even between the beginning and the "tail" of a 200-femtosecond laser pulse. The magnitude of the observed effect is still insufficient for practical use. They have shown clearly that ultrafast modulation of light in magnetophotonic crystals is possible and has good prospects. Spatial light modulators can be used when creating holographic memory,

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three-dimensional displays, as well as the accurate refractive index sensors and magnetic field sensors. TECHNICAL ARTICLE

Tags: Photonics, Sensors

Scientists develop new method of high-precision optical measurement

PhysOrg.com, 04OCT2016

To demonstrate that one pulse can be formed which propagates around in a resonator, an international team of researchers (Switzerland, Russia) introduced laser into two optical resonators, one made out of magnesium fluoride and the second made out of silicon nitride. They observed solitons in real-time by the addition of weak phase modulation to the input signal. Using two identical optical solitons and overlapping their optical frequency combs, scientists could measure optical frequencies, which could not be measured directly because of their size. They measured frequencies in radio waves beyond the optical range. TECHNICAL ARTICLE

Tags: Photonics

QUANTUM SCIENCE

Electron spins talk to each other via a 'quantum mediator'

Nanowerk, 10OCT2016

Information exchange between the bits in quantum computers is difficult, especially over larger distances. An international team of researchers (the Netherlands, Switzerland) positioned the electrons in quantum dots, where they were held in position by an electrical field. Between the two occupied quantum dots, they positioned an empty quantum dot as a "mediator" that could form an energy barrier between the two spins. By adjusting the electrical field around the empty quantum dot and lowering the energy barrier, the spin information is exchanged. Interaction can be switched on and off at will. The work forms an important step in the construction of larger quantum computers in which the communication between quantum bits over large distances is essential. TECHNICAL ARTICLE

Tags: Quantum science, Information technology

Researchers prevent quantum errors from occurring by continuously watching a quantum system

PhysOrg.com, 07OCT2016

Quantum systems are naturally fragile and they constantly evolve in uncontrolled ways due to unwanted interactions with the environment, leading to errors in the computation. An international team of researchers (the Netherlands, UK) experimentally generated quantum Zeno subspaces in up to three nuclear spins in diamond. Joint observables on these nuclear spins are projected via a nearby electronic spin, generating protected quantum states in Zeno subspaces. They show an enhancement in the time that quantum information is protected with increasing number of projections and derive a scaling law that is independent of the number of spins. Their work allows for the investigation of the interplay of frequent observations and various noise environments. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science

Physicists Create World's First Time Crystal

MIT Technology Review, 04OCT2016

The laws of physics are not only symmetrical in space but also in time. And that raises the interesting question of whether it is possible to break temporal symmetry in the same way. A team of researchers in the US (NIST, UC Berkeley, UT Austin, Harvard University) studied ytterbium ions with spins that interact with each other and discovered that after allowing the system to evolve, the interactions occurred at a rate that was twice the original period. Since there is no driving force with that period, the only explanation is that the time symmetry must have been broken, thereby allowing these longer periods. As for applications, they say for example, that time crystals could be used for quantum information tasks, such as implementing a robust quantum memory. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science, Materials science

S&T POLICY

Renewables need a grand-challenge strategy

Nature News, 05OCT2016

Public spending on research into renewable energy is too low to meet even the modest targets set at the Paris climate talks last December, let alone decarbonize the world economy. It stands at about US$6.5 billion a year. An international team of researchers (Canada, USA - Harvard University, UC Berkeley, UK, the Netherlands, Mexico) argue that to ensure the strategic and most effective use of these funds, stakeholders must work together across countries, sectors and disciplines. They propose that this is done through a 'grand challenges' strategy for renewable energy. They argue that agreeing on a global set of priorities would be an efficient and effective way for countries and funders to make decisions about which technologies to back.

Tags: S&T policy

SCIENCE WITHOUT BORDERS

20 physicists who revolutionized our understanding of the world

Science Alert, 11OCT2016

Every now and then a physicist comes along who forever changes our perception of the Universe and everything in it. Here are 20 physicists whose theories, ideas, and discoveries revolutionized the way we see the world.

Tags: Science without borders

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Google's Neural Machine Translation System: Bridging the Gap between Human and Machine Translation

arXiv, 26SEP2016

Researchers at Google present a model for Google's Neural Machine Translation system which consists of a deep long short-term memory network with 8 encoder and 8 decoder layers using attention and residual connections. To accelerate the final translation speed they employ low-precision arithmetic during inference computations. They divide words into a limited set of common sub-word units for both input and output. This method provides a good balance between the flexibility of "character"-delimited models and the efficiency of "word"-delimited models and ultimately improves the overall accuracy of the system. Open Access TECHNICAL ARTICLE

Tags: Science without borders, Artificial intelligence

SENSORS

New sensor material could enable more sensitive readings of biological signals

PhysOrg.com, 07OCT2016

Researchers in the UK overcame the inherent instability of n-type materials in water by designing new structures that prevent electrons from engaging in side-reactions which would degrade the device. The devices can detect positively charged sodium and potassium ions which are important for neuron activities in the body. In the future, the team hopes to be able to create materials tuned to detect particular ions allowing ion-specific signals to be detected. TECHNICAL ARTICLE

Tags: Sensors

New, carbon-nanotube tool for ultra-sensitive virus detection and identification

PhysOrg.com, 07OCT2016

Researchers at Pennsylvania State University have developed and demonstrated a device that selectively traps and concentrates viruses by their size—smaller than human cells and bacteria, but larger than most proteins and other macromolecules—in incredibly dilute samples. Viruses get trapped and build up to usable concentrations within the forest of nanotubes. They can be put through a panel of tests to identify it. As the device isolates and concentrates viruses purely by size there is no need for any antibody or other molecular label. Open Access TECHNICAL ARTICLE

Tags: Sensors, Biotechnology

Quantum sensor targets gravity and magnetism

Physics World, 06OCT2016

Researchers in Australia have made a high-precision sensor that can measure gravitational and magnetic fields at the same time. The device uses an atom interferometer to track the motion of a Bose–Einstein condensate in free fall and the researchers say it could improve the search for iron ore, hydrocarbons, diamonds and other minerals. TECHNICAL ARTICLE

Tags: Sensors, S&T Australia

New nanosensor system can detect cocaine at low concentrations

Nanowerk, 03OCT2016

The method, developed by researchers in Spain, combines the use of gated mesoporous silica nanoparticles and SERS spectroscopy that uses gold nanoparticles to detect very low concentrations of the substances being analysed. It is based on the release of a dye that is easily identifiable by SERS spectroscopy from inside the silica nanoparticles, provided the substance being detected is present. In the lab, it allowed them to reach nanomolar detection levels for cocaine and 30 copies of genomic DNA/µL in the case of mycoplasma. Open Access TECHNICAL ARTICLE

Tags: Sensors ■

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