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S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

FEATURE ARTICLES

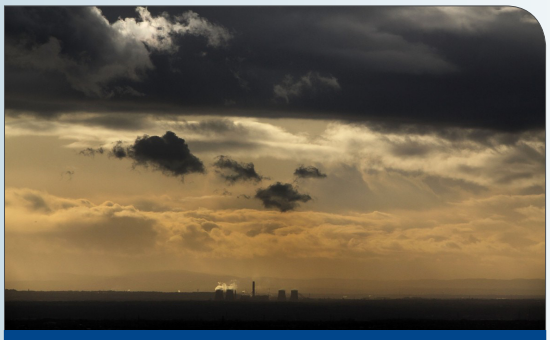
Manchester scientists tie the tightest knot ever achieved

Physorg.com, 12JAN2017

Researchers in the UK 'tied' the molecular knot using self-assembly, weaving molecular strands around metal ions forming crossing points in the right places. The ends of the strands were fused together by a chemical catalyst to close the loop and form the complete knot. With this advance, scientists should be able to probe how knotting affects strength and elasticity of materials which will enable them to weave polymer strands to generate new types of materials. Braiding polymer strands may lead to materials much tougher than kevlar. TECHNICAL ARTICLE

Tags: Materials science, S&T UK, Featured article

Geoengineering Gets Green Light from Federal Scientists



For the first time, funding from the U.S. government may be spent on man-made approaches to ease climate change.

MIT Technology Review, 11JAN2017

The shift in stance appears in an updated roadmap for federal funding of climate research that was published earlier this week by the U.S. Global Change Research Program. The new report is clear that climate intervention cannot substitute for reducing greenhouse gas emissions and adapting to the changes in climate that occur, but some types of deliberative climate intervention may someday be one of a portfolio of tools used in managing climate change.

Tags: Environmental science, Climatology, Featured article

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

UV light for producing customized surfaces

Physorg.com, 16JAN2017

Researchers in Germany show that UV-induced formation and reduction of disulfide bridges (bonds of sulfur atoms) allow for the temporally and spatially controlled thiol-disulfide exchange. They specifically applied disulfide to thiol-modified polymer surfaces and generated precise fluorescent patterns with small structures of up to 10 µm in size. Reversible photochemical modifications are suited for the dynamic adjustment of interface properties, for activating and deactivating specific functions by certain stimuli, or for applying and detaching functional molecule groups. TECHNICAL ARTICLE

Tags: Advanced manufacturing, S&T Germany

ADVANCED MATERIALS

Phase transition discovery opens the door to new electronics

Physorg.com, 17JAN2017

An international team of researchers (the Netherlands, UK, Switzerland) found that in a specific type of nickelate they researched, the phase transition is dual. When the temperature of the material changes, both electronic and magnetic properties of the materials change with it. Using precisely tuned X-ray light as a magnifying tool, they could watch the solid-state transition from the metallic to the insulating state occur in real time. When nickelate is cooled down, insulating nano-domains gradually start to appear until the material is covered with tiny, insulating stripes. Potential future electronics could use nickelate structures as light-controlled ultrafast transistors. In the long run, this discovery may even lead to electronics that mimic neural networks in the human brain. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

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New classes of printable electrically conducting polymer materials for flexible electronics

Nanowerk, 13JAN2017

To make high-performance devices, good ohmic contacts with low electrical resistances are required. An international team of researchers (Singapore, UK) developed the concept of doped conducting polymers with bonded ionic groups in which the doped mobile charges cannot dissipate away because their counter-balancing ions are chemically bonded. They demonstrated that work functions as high as 5.8 electron-volts and as low as 3.0 electron-volts can now be attained for films that can be processed from solutions at low cost. TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

Preventing frost formation with nanoengineered surfaces (w/video)

Nanowerk, 13JAN2017

Researchers at Arizona State University have fabricated an anti-icing coating that responds to surface icing by releasing antifreeze liquid. It consists of an outer porous superhydrophobic epidermis and a wick-like underlying dermis that is infused with antifreeze liquid. The bilayer can be designed to combine optimal antifrosting functionality with a superhydrophobic water repelling exterior to provide coatings that can robustly prevent frost, rime, and glaze accumulation. One of the primary applications of these icephobic coating is in the aviation industry. TECHNICAL ARTICLE

Tags: Advanced materials

Semiconducting nanonetwork could form the backbone of transparent, flexible electronics

Physorg.com, 13JAN2017

Researchers in South Korea have fabricated a new polymer blend consisting of about 15% semiconducting polymer called DPP2T integrated into an inert polystyrene matrix. It forms a web-like nanonetwork, creating highly ordered, continuously connected charge pathways for rapid charge transport. DPP2T light absorption peak is red-shifted to the near-infrared range, so it absorbs much less light in the visible range and has greater optical transparency. According to the researchers, it has excellent characteristics for future transparent, deformable electronic applications. TECHNICAL ARTICLE

Tags: Advanced materials

Physicists 'squeeze' light to cool microscopic drum below quantum limit

Nanowerk, 11JAN2017

Researchers at NIST cooled a vibrating aluminum membrane embedded in a superconducting circuit designed so that the drum motion influences the microwaves bouncing inside an electromagnetic cavity to less than one-fifth of a single quantum. The new technique theoretically could be used to cool objects to absolute zero. The colder the drum, the better it is for any application—sensors would become more sensitive, information can be stored longer, and quantum computation will be without distortion. TECHNICAL ARTICLE

Tags: Advanced materials, Government S&T

Experimental semiconductor eyed for next-generation 'power electronics'

Nanowerk, 10JAN2017

Researchers at Purdue University made an FET out of beta gallium oxide which has ultra-wide bandgap and higher breakdown voltage. They also developed a new low-cost method using adhesive tape to peel off layers of the semiconductor from a single crystal, far less expensive than epitaxy. It can be used to cut films of the beta gallium oxide material into belts or "nano-membranes," which can then be transferred to a conventional silicon disc and manufactured into devices. The technique was found to yield extremely smooth films. Future research may include work to attach the material to a substrate of diamond or aluminum nitride to improve thermal properties. TECHNICAL ARTICLE

Tags: Advanced materials, Microelectronics, Semiconductors

AUTONOMOUS SYSTEMS & ROBOTICS

Navy unmanned swarm boats can perceive what's around them

Defense Systems, 10JAN2017

ONR has demonstrated technological advances in autonomy using groups of swarming Unmanned Surface Vessels (USV) designed to detect enemy ships, perform surveillance missions or even launch attacks. The kits, called Control Architecture for Robotic Agent Command and Sensing (CARACaS) are engineered to provide USVs with an ability to handle dynamic operational situations, including the execution of search patterns, harbor defenses, surveillance or even swarm boat attacks. Other possibilities include using autonomous USVs for supply and weapons transport, countermine operations, electronic warfare and amphibious operations.

Tags: Autonomous systems & robotics, Government S&T, Military technology

BIOTECHNOLOGY

Microbiologists Make Big Leap in Developing 'Green' Electronics

UMass Amherst, 17JAN2017

Bacteria use protein filaments to make electrical connections with other microbes or minerals. Researchers at UMass Amherst took the gene for the protein that assembles into microbial nanowires from G. metallireducens and inserted this into G. sulfurreducens. The result is a genetically modified G. sulfurreducens that expresses the G. metallireducens protein, making nanowires much

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"The difficulty lies, not in the new ideas, but in escaping the old ones"

JOHN MAYNARD KEYNES

more conductive than G. sulfurreducens would naturally produce. They report that G. sulfurreducens will express filament genes from many different types of bacteria. This makes it simple to produce a diversity of filaments in the same microorganism and study their properties under similar conditions. The process can be used for the construction of conductive materials, electronic devices and sensors for medical or environmental applications. Open Access TECHNICAL ARTICLE

Tags: Biotechnology

This Centrifuge Costs 20 Cents to Make and Can Be Used Anywhere (w/video)

MIT Technology Review, 10JAN2017

Researchers at Stanford University have built a device called Paperfuge using essentially just paper discs, some string, and tiny straws to hold a blood sample (the team also 3-D printed a plastic version). By twisting up the string and tugging on the device, it spins at up to 125,000 revolutions per minute. A minute-and-a-half of spinning is enough to separate plasma from whole blood, and 15 minutes of work will isolate malaria parasites if they're present. A centrifuge made of paper could dramatically cut the cost of analyzing blood and diagnosing diseases like malaria in places where standard medical equipment is hard to come by. Open Access TECHNICAL ARTICLE

Tags: Biotechnology

ENERGY

A step toward renewable diesel

MIT News, 16JAN2017

Researchers at MIT modified the metabolic pathways of yeast that naturally produce large quantities of lipids, to make them about 30 percent more efficient. They rewired the metabolism of these microbes to make them capable of producing oils at very high yields. This upgrade could make the production of renewable high-energy fuels economically feasible. TECHNICAL ARTICLE

Tags: Energy, Biotechnology

Flame Retardant in Lithium-ion Batteries Could Quench Fires

IEEE Spectrum, 13JAN2017

The previous method of adding flame retardants directly into batteries' electrolytes significantly reduced battery performance. Now researchers in the US (Stanford University, SLAC National Accelerator Laboratory) have designed a lithium-ion battery in which the separator, the component that keeps the battery's positive and negative electrodes apart, contains a cheap, powerful, and commonly used flame retardant triphenyl phosphate. During normal battery operation, the flame-retardant stays encapsulated within plastic fibers. If the separator gets hotter than 150 degrees C, the plastic melts, releasing the flame retardant. In experiments, the chemical completely quenched flaming electrolyte in 0.4 seconds. Open Access TECHNICAL ARTICLE

Tags: Energy, Battery

Beamed Wireless Power Transfer from Metasurfaces

Optics and Photonics, 11JAN2017

A team of researchers in the US (Duke University, industry partner, Washington University) has devised a method for high-efficiency wireless power transfer using large-aperture metasurfaces. It could provide dynamic focusing and tuning at the power source, and thus consume much less power itself than a traditional phased array. The metasurface antenna would resemble an arrangement of millions of polarizable magnetic dipoles and could steer and focus the microwave beam to devices placed around an average room. Open Access TECHNICAL ARTICLE

Tags: Energy, Battery

ENVIRONMENTAL SCIENCE

Atmospheric scientists take to the skies to test cloud seeding for snow

NSF News, 13JAN2017

A team of researchers in the US (University of Wyoming, industry partner, University of Colorado, University of Illinois at Urbana-Champaign, NCAR) is working on an NSF funded cloud seeding project called SNOWIE (Seeded and Natural Orographic Wintertime Clouds—the Idaho Experiment), which will run from January 7 to March 17. Results from SNOWIE will lead to a new and important understanding of cold-season precipitation—both natural precipitation and precipitation augmented through cloud seeding—and will have an impact throughout the American West, a region that increasingly suffers from drought and water shortage.

Tags: Environmental science, Climatology

Giant Middle East dust storm caused by a changing climate, not human conflict

Eurekalert, 13JAN2017

In August 2015, a dust storm blanketed large areas of seven Middle East nations leading to several deaths, thousands of cases of respiratory ailments and injuries, and canceled airline flights and closed ports. At the time, the storm's unusual severity was attributed to the ongoing civil war in Syria. An international team of researchers (USA - Duke University, Princeton University, Boston University, Israel)

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has found a more likely cause for the unprecedented storm—it was not human conflict, but a combination of climatic factors and unusual weather, very hot period before the storm and unusual wind pattern. Open Access TECHNICAL ARTICLE

Tags: Environmental science, Climatology

Featured Resource

U.S. Global Change Research Program (USGCRP)

USGCRP was established by Presidential Initiative in 1989 and mandated by Congress to assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change. RSS

FORECASTING

Global technological disruption and the predicted pace and scale of possible disruptions

Next Big Future, 09JAN2017

According to Next Big Future these areas should mostly see some progress in the next 5 to 10 years. However, some are more long term or areas where political will and effort are needed to bring what is possible into reality: energy efficiency, energy revolution, additive manufacturing, neuromorphic chips, quantum computers, photonics, automated transportation, urbanization megacities, robotics, hyperbroadband, supermaterials, medicine and public health.

Tags: Forecasting

National Intelligence Council Releases Global Trends Report

National Intelligence Council, 09JAN2016

The report—The Paradox of Progress—is rooted in conversations with more than 2,500 people around the world from all walks of life in more than 35 countries. The next five years will see rising tensions within and between countries. Global growth will slow, just as increasingly complex global challenges impend. An ever-widening range of states, organizations, and empowered individuals will shape geopolitics. It will be much harder to cooperate internationally and govern in ways the public expects.

Tags: Forecasting

MATERIALS SCIENCE

Discovery could lead to jet engines that run hotter—and cleaner"

Ohio State University, 17JAN2017

"Nano twins", microscopic defects, grow inside alloys and weaken them, allowing them to deform under heat and pressure limiting the materials' performance. An international team of researchers (USA - Ohio State University, industry partners, the Netherlands) found that tailoring an alloy's composition and then exposing it to high heat and pressure can not only prevent nano twins from forming, it can make the alloy stronger. In tests, the technique, which they've dubbed "phase transformation strengthening," eliminated the formation of nano twins and decreased alloy deformation by half. Open Access TECHNICAL ARTICLE

Tags: Materials science

Nanotechnology: Lighting up ultrathin films

Eurekalert, 17JAN2017

Transition metal dichalcogenides (TMDs) can be excited with polarized light and therefore have great potential for applications in the field of opto-electronics. However, recent studies of the valley index in TMD semiconductors have led to inconsistent values for the degree of valley polarization. An international team of researchers (Germany, USA - Rice University, Los Alamos National Laboratory) has determined the reasons for these discrepancies to be the quality of the crystals, and can thus vary significantly within the same crystal. Their method can be applied to other monolayer semiconductors and systems made up of several different materials. TECHNICAL ARTICLE

Tags: Materials science

New model could help scientists design materials for artificial photosynthesis

Physorg.com, 12JAN2017

Plants and other photosynthetic organisms use a wide variety of pigments which serve as building blocks that can be arranged in different ways to create antennae which absorb different wavelengths of light depending on the composition of the pigments and how they are assembled. Researchers at MIT have developed a model that uses experimental measurements of the spectrum of light absorbed by different pigment molecules and their surrounding proteins to predict the spectrum of light absorbed by any aggregation, depending on the types of pigments it comprises. The model can also predict the rate of energy transfer between each aggregate. The new model could help guide scientists in designing new types of solar cells made of organic materials that efficiently capture light and funnel the light-induced excitation. TECHNICAL ARTICLE

Tags: Materials science, Solar energy

Sketching out magnetism with electricity

Nanowerk, 12JAN2017

In a proof-of-concept study, an international team of researchers (South Korea, Australia, USA - SLAC National Accelerator Laboratory, Germany) drew magnetic squares in a nonmagnetic material with an electrified pen and read it with X-rays. They demonstrated that magnetic properties can be created and annihilated in a nonmagnetic material with precise application of an electric field. The process is

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reversible. The technique could be used to design new types of memory storage devices with additional layers of information that can be turned on and off with an electric field. This would allow more targeted control. TECHNICAL ARTICLE

Tags: Materials science, Information technology

Measuring how perovskite solar films efficiently convert light to power

Science Daily, 11JAN2017

Although the long diffusion length of photogenerated carriers is believed to be a critical factor responsible for the material's high efficiency in solar cells, a direct study of carrier transport over long distances in organometal halide perovskites is still lacking. Researchers at Case Western Reserve University directly measured diffusion length using spatially scanned photocurrent imaging microscopy. The measurements showed diffusion length averaged about 10 microns. Diffusion length within a well-oriented perovskite film measured up to 20 micrometers. The research indicated that solar cells could be made thicker without harming their efficiency. TECHNICAL ARTICLE

Tags: Materials science

PHOTONICS

Laser Weapons Will Turn Earth's Atmosphere into Lenses, Deflector Shields (w/video)

IEEE Spectrum, 17JAN2017

To overcome atmosphere effects on optics, BAE Systems has been working on the Laser Developed Atmospheric Lens system (LDAL) where pulsed lasers generate their own bubbles of hot air in a controlled way. When these hot air bubbles are layered on top of colder air, the change in density refracts light that passes through. The idea behind LDAL is that if you structure and control air with the same precision that we can build lenses out of glass, you could make a lens as big as you want. This is just a concept right now, long way from even a ground-based prototype.

Tags: Photonics, Disruptive technology

Light source discovery 'challenges basic assumption' of physics

Physorg.com, 16JAN2017

An international team of researchers (South Korea, UK) present a fundamentally different method for producing narrow-bandwidth radiation from a broad spectral bandwidth current source, which takes advantage of the inflated radiation impedance close to cut-off in a medium with a plasma-like permittivity. They found that by embedding a current source in this cut-off region, more than an order of magnitude enhancement of the radiation intensity is obtained compared with emission directly into free space. The method suggests a simple and general way to flexibly use broadband current sources to produce broad or narrow bandwidth pulses. OPEN ACCESS TECHNICAL ARTICLE

Tags: Photonics

New laser based on unusual physics phenomenon could improve telecommunications, computing

Science Daily, 11JAN2017

Researchers at UC San Diego constructed bound states in the continuum (BIC) from a thin semiconductor membrane made of indium, gallium, arsenic and phosphorus.
The membrane is structured as an array of nano-sized cylinders suspended in air. The cylinders are interconnected by a network of supporting bridges, which provide mechanical stability to the device. By powering the membrane with a high frequency laser beam, researchers induced the BIC system to emit its own lower frequency laser beam (at telecommunication frequency). The technology could revolutionize the development of surface lasers, making them more compact and energy-efficient for communications and computing applications. The new BIC lasers could also be developed as high-power lasers for industrial and defense applications. TECHNICAL ARTICLE

Tags: Photonics, Communications technology

QUANTUM SCIENCE

Seeing the quantum future, literally

Science Daily, 16JAN2017

A significant obstacle to building reliable quantum technologies is decoherence. Using techniques from big data, researchers in Australia have developed a technique to predict how the system would disintegrate. Using the technique, they demonstrated it was possible to suppress decoherence in a preventive manner. What might look like random behavior contained enough information for a computer program to predict the future without direct observation, which would otherwise erase the system's useful characteristics. The predictions were remarkably accurate, allowing the team to use their guesses preemptively to compensate for the anticipated changes extending the useful lifetime of the qubits. The technique can be applied to any qubit, built in any technology, including the special superconducting circuits. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science, S&T Australia

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S&T POLICY

Pioneering SESAME light source circulates first beam

Science Daily, 12JAN2017

Sychrotron-light for Experimental Science and Applications in the Middle East (SESAME) was established under the auspices of UNESCO before becoming a fully independent intergovernmental organisation in 2004. SESAME's Members are Bahrain, Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, the Palestinian Authority and Turkey. Its mission is to provide a world-class research facility for the region, while fostering international scientific cooperation. The first call for proposals to carry out research at SESAME was recently issued.

Tags: S&T policy, Particle physics, Science without borders

SCIENCE WITHOUT BORDERS

Mathematical Model Reveals the Patterns of How Innovations Arise

MIT Technology Review, 13JAN2017

An international team of researchers (France, Italy, USA - Cornell University) focused on reviewing scientific attempts to effectively model the emergence of new novelties and their regularities, with an emphasis on more recent contributions: from the plain Simon's model tracing back to the 1950s, to the newest model of Polya's Urn, with triggering of one novelty by another. What seems to be key in the successful modeling schemes proposed so far, is the idea of looking at evolution as a path in a complex space—physical, conceptual, biological, technological—whose structure and topology get continuously reshaped and expanded by the occurrence of the new. Open Access TECHNICAL ARTICLE

Tags: Science without borders, Disruptive technology, Simulation and modeling

Languages still a major barrier to global science, new research finds

Cambridge University, 29DEC2016

English is now considered the common language, or 'lingua franca', of global science. However, a new study suggests that over a third of new scientific reports are published in languages other than English, which can result in these findings being overlooked—contributing to biases in our understanding. Researchers at Cambridge University call on scientific journals to publish basic summaries of a study's key findings in multiple languages, and universities and funding bodies to encourage translations as part of their 'outreach' evaluation criteria. TECHNICAL ARTICLE

Tags: Science without borders, Bibliometrics

SENSORS

Ultra-fast, ultra-sensitive platinum selenide gas sensors

Nanowerk, 12JAN2017

An international team of researchers (Ireland, Germany, Austria) working under the EU Graphene Flagship program, converted thin platinum film into $PtSe_2$ using a metal conversion method. They tested its performance in sensing NO_2. Gas molecules adsorbed onto the surface of the $PtSe_2$ change its conductivity, lowering the resistance. It had extremely high sensitivity, measuring 100 ppb NO_2 at room temperature, fast response and recovered completely within a minute when the inert atmosphere was restored. TECHNICAL ARTICLE

Tags: Sensors ■

About This Publication

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