Volume 7, Issue 21 ▪ 02JUN2017

S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

Feature Articles

Breakthrough curved sensor could dramatically improve digital camera image quality

Science Daily, 30MAY2017

A team of researchers in the US (Microsoft, partners) placed individual sensors cut from a thinned CMOS image-sensor wafer into custom-made molds and then used pneumatic pressure to push each sensor down into the mold. Tests showed that curving the sensors did not change any of their electrical or imaging characteristics. The prototype camera with curved sensors exhibited a resolution more than double that of a high-end SLR camera with a similar lens. Toward the edges of the image, the curved sensor was about five times sharper than the SLR camera. The technology could be used to create better cameras for surveillance, head-mounted displays and advancements in autonomous vehicle navigation.

Tags: Sensors, Imaging technology, Featured article

Researchers find new way to control light with electric fields

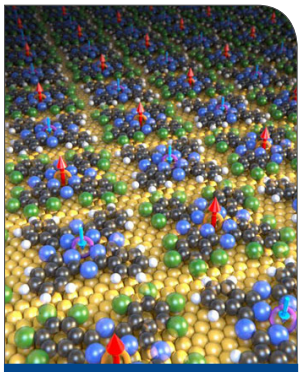
Eurekalert, 25MAY2017

A team of researchers in the US (North Carolina State University, Temple University) worked with thin films of molybdenum sulfide, tungsten sulfide and tungsten selenide to develop a technique that allows them to change the refractive index within the red range of the visible spectrum by 60 percent – two orders of magnitude better than previous results. The greater the voltage applied to the material, the greater the degree of change in the index. The technique may provide capabilities to control the amplitude and phase of light pixel by pixel in a way as fast as modern computers. It may find applications in goggle-free virtual reality lenses and projectors, the animation movie industry or camouflage. TECHNICAL ARTICLE

Tags: Photonics, Featured Article

Wafer-thin ferrimagnet developed for future quantum technologies

Nanowerk, 22MAY2017



Phthalocyanines with iron (orange) and manganese (violet) centers co-assemble on a gold surface into a checkerboard pattern. (Image: University of Basel)

For mathematical and geometrical reasons, it has so far not been possible to produce two-dimensional ferrimagnets. An international team of researchers (Switzerland, India, Sweden) has demonstrated that when phthalocyanines are applied to a gold surface, it becomes magnetic, and that the magnetism of the iron and manganese is of different strengths and appears in opposing directions – all characteristics of a ferrimagnet. Special electrons attached to the surface in the gold substrate are responsible for this type of magnetism. Two-dimensional, quasi-flat ferrimagnets would be suitable for use as sensors, data storage devices or in a quantum computer. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials, Featured Article

S&T News Articles

ADVANCED MATERIALS

Nanogenerators Could Charge Your Smartphone

IEEE Spectrum, 26MAY2017

Low power output has prevented wider adoption of triboelectric nanogenerators (TENGs) that harvest static electricity from friction. Researchers in South Korea have developed a new polymer to serve as a dielectric material. It has nearly twice the dielectric constant which doubled the density of the charges compared to other

continued...

BACK TO TOP

nanogenerators. When the dipole direction of the film is aligned, it improved the material's charge accepting characteristics, resulting in a 20-fold increase in output power. Improved power output could make TENGs well suited for charging applications. Open Access TECHNICAL ARTICLE

Tags: Advanced materials

High pressure key to lighter, stronger metal alloys, scientists find

Science Daily, 25MAY2017

A team of researchers in the US (Stanford University, University of Tennessee, Oak Ridge National Laboratory, SLAC National Accelerator Laboratory) has successfully created a high-entropy alloy made of CrMnFeCoNi with a hexagonal close-packed (HCP) structure. In CrMnFeCoNi, the hcp phase is retained following decompression to ambient pressure, yielding metastable fcc-hcp mixtures. In the future, materials scientists may be able to fine-tune the properties of high-entropy alloys further by mixing different metals and elements together. Open Access TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

One-dimensional crystals for low-temperature thermoelectric cooling

Science Daily, 24MAY2017

Researchers in Japan studied the thermal and electrical properties of one-dimensional crystals composed of tantalum, silicon and tellurium for thermoelectric cooling at temperatures below 250 K (-23°C). The thermo-electric characteristics of these crystals were varied at temperatures ranging from the cryogenic level of 50 K up to room temperature by doping with molybdenum and antimony. The crystals' thermoelectric power factors greatly exceeded around room temperature, indicating their suitability for low-temperature applications. The findings may have applications in localized cooling of tiny electronic devices. TECHNICAL ARTICLE

Tags: Advanced materials, S&T Japan

AUTONOMOUS SYSTEMS & ROBOTICS

Interactive tool helps novices and experts make custom robots

Science Daily, 30MAY2017

Researchers at Carnegie Mellon University have developed an interactive design tool which enables both novices and experts to build customized legged or wheeled robots using 3D-printed components and off-the-shelf actuators. It has a drag-and-drop interface and an auto-completion feature. Once the design is complete, the tool provides a physical simulation environment to test the robot before fabricating it, enabling users to iteratively adjust the design to achieve a desired look or motion.

Tags: Autonomous systems & robotics

BIG DATA

TOP 10 insideBIGDATA Articles for April 2017

Inside Big Data, 28MAY2017

A monthly heads-up for the top 10 most viewed articles appearing on Inside BIGDATA is presented to help readers catch up with important news and features flowing across their many channels.

Tags: Big data

COMMUNICATIONS TECHNOLOGY

A network of crystals for long-distance quantum communication

Physorg.com, 29MAY2017

To build a quantum repeater, scientists have investigated atomic gases which usually require heavy experimental apparatus. Researchers in Switzerland have developed a protocol based on a crystal that can emit quantum light as well as store it for a long time. They have demonstrated quantum correlations between a single photon and a spin excitation in up to 12 temporal modes, in a $^{151}Eu^{3+}$ doped Y_2SeO_5 crystal. After a storage time of 1 ms, the spin excitation is converted into a second photon. The quantum correlation of the generated photon pair was verified. The results show that solid-state rare-earth crystals could be used to generate remote multi-mode entanglement, an important resource for future quantum networks. Open Access TECHNICAL ARTICLE

Tags: Communications technology, Quantum science

High-speed internet lane created for emergency situations

Science Daily, 23MAY2017

Researchers at Rochester Institute of Technology have created the Multi Node Label Routing protocol designed with an immediate failover mechanism. It discovers alternate routes based on the labels assigned to the routers. The labels and protocols leverage the connectivity relationship that exists among routers, which are already sitting on a nice structure. The new protocol runs below the existing internet protocols, allowing normal internet traffic to run without disruption. The labels in turn carry the structural and relational connectivity information among routers. In tests, it recovered in 30 seconds from a link failure while BGP protocol took 150 seconds.

Tags: Communications technology

ENERGY

Self-healing catalyst films for hydrogen production

Physorg.com, 26MAY2017

Engineering stable electrodes using highly active catalyst nanopowders for electrochemical water splitting is challenging. Researchers in Germany added catalyst

continued...

"Science can only ascertain what is, but not what should be."

ALBERT EINSTEIN

nanoparticles in the form of a powder to the solution, which surrounds the electrodes. The particles form film on the electrodes and regenerate during the reaction. This self-healing effect lasts as long as catalyst particles were present in the solution. The measurements showed that hydrogen was produced in a stable manner over several days. The researchers are now investigating the influence of particle shape and size and influence of the electrolyte solution on the efficiency and stability of the catalysts. TECHNICAL ARTICLE

Tags: Energy, S&T Germany

IMAGING TECHNOLOGY

Laser-engraved graphene pixels work in extreme environments

Nanotechweb, 26MAY2017

Linear dynamic range (LDR) is limited by graphene's intrinsic hot-carrier dynamics, which causes deviation from a linear photoresponse at low incident powers. An international team of researchers (UK, Spain) engineered photoactive junctions in $FeCl_3$-intercalated graphene using laser irradiation. Photocurrent measured at these planar junctions shows an extraordinary linear response with an LDR value at least 4500 times larger than that of other graphene devices while maintaining high stability against environmental contamination without the need for encapsulation. The findings pave the way toward the design of ultrathin photodetectors for high-definition imaging and sensing. OPEN ACCESS TECHNICAL ARTICLE

Tags: Imaging technology, Advanced materials

Supervision for US Soldiers using Tactical Augmented Reality that replaces night vision, GPS and more

Next Big Future, 26MAY2017

A heads-up display device with Tactical Augmented Reality (TAR) is helping Soldiers precisely locate their positions, as well as the locations of friends and foes. The eyepiece is connected wirelessly to a tablet the soldiers wear on their waist and it is wirelessly connected to a thermal site mounted on their rifle. The image of the target and other details can be seen through the eyepiece. The key technological breakthrough was miniaturizing the image to fit into the tiny one-inch-by-one-inch eyepiece. TAR's wireless system allows a Soldier to share the images with other members of the squad.

Tags: Imaging technology, Military technology

Saab has camouflage that works against infrared and radar for vehicles

Next Big Future, 25MAY2017

The Mobile Camouflage System, developed by the Saab company, provides wheeled-vehicle and combat vehicle platforms with multi-spectral signature management properties that enable the platform to blend in with environmental surroundings. It significantly reduces the probability of detection visually by sensors such as Near Infrared, Short-wave Infrared, Long-wave Infrared, Mid-wave Infrared and radar. Each system is engineered to fit like a second skin to the vehicle and not interfere with operations, vehicle performance or maintenance.

Tags: Imaging technology, Military technology

INFORMATION TECHNOLOGY

Faster, more nimble drones on the horizon

MIT News, 25MAY2017

The speed of autonomous vehicles is limited by how fast the on-board cameras can process images. To efficiently process the deluge of data, an international team of researchers (Switzerland, USA - MIT, Arizona State University) has developed an algorithm to tune a DVS camera to detect only specific changes in brightness that matter for a particular system, vastly simplifying a scene to its most essential visual elements. Eventually, the results could also help to increase the speeds for more complex systems such as drones and other autonomous robots.

Tags: Information technology, Autonomous systems & robotics

MATERIALS SCIENCE

Harvard team creates a cold-atom Fermi-Hubbard antiferromagnet

Physorg.com, 26MAY2017

To calculate the effect of quantum-mechanical interactions on the electronic properties of materials, researchers at Harvard University have created a physical entity which is close to simulating the Fermi–Hubbard model. They have realized an antiferromagnet in a repulsively interacting Fermi gas on a two-dimensional square lattice. After filling the lattice with atoms, the entire scheme behaved like an antiferromagnetic insulator. Their creation could be used to study a wide variety of physics problems, and possibly help in the search for a high-temperature superconductor. TECHNICAL ARTICLE

Tags: Materials science, Quantum science

continued...

Pioneering new methods for designing magnetism

Nanowerk, 26MAY2017

Researchers in Japan have fabricated tunnel diodes having a quantum well with varying quantum size composed of GaMnAs. By varying the direction of magnetization and measuring the tunneling current, they found that the symmetry of the directions of the easy magnetization axes changes significantly according to changes in voltage. The findings may open the door to new methods for controlling magnetization, and ultimately lead to the development of low-energy electronic devices. Open Access TECHNICAL ARTICLE

Tags: Materials science, Microelectronics

Graphene on silicon carbide can store energy

Science Daily, 23MAY2017

To study the effects of defects on the surface of graphene in a controlled manner, an international team of researchers (Sweden, USA - Stanford University) used graphene created on a crystal of silicon carbide. When silicon carbide is heated to 2000 °C, silicon atoms on the surface move to the vapor phase and only the carbon atoms remain. They found that anodizing graphene created more edges and that the capacity of the anodized graphene to store electricity was quite high. It may be possible to tailor the surface for other functions or create a sensor that has its own built-in battery. TECHNICAL ARTICLE

Tags: Materials science, Advanced materials

Featured Resource

Physics Stack Exchange

Physics Stack Exchange is a question and answer site for active researchers, academics and students of physics. Other Stack Exchange sites

MICROELECTRONICS

Magnetoelectric memory cell increases energy efficiency for data storage

Eurekalert, 30MAY2017

An international team of researchers (Russia, France) has developed a magnetoelectric random access memory (MELRAM), the core of which is based on combining the properties of nanometer scale magnetic alloys terbium-cobalt and iron-cobalt stacked on top of one another. Their interaction is the basic mechanism for control of magnetic states by the electric field. The technology has the potential to increase power efficiency, and thereby decrease heat waste, by orders of magnitude for read operations at room temperature. The research could aid production of devices such as instant-on laptops, close-to-zero-consumption flash drives, and data storage centers that require much less air conditioning. TECHNICAL ARTICLE

Tags: Microelectronics

The Most Complex 2D Microchip Yet

IEEE Spectrum, 26MAY2017

Researchers in Austria have developed a microchip made of a thin film of molybdenum disulfide that has 115 transistors. It can execute user-defined programs stored in external memory, perform logic operations, and transmit data to its periphery. Although this prototype operates on single-bit data, the researchers say their design is readily scalable to multibit data. The invention is compatible with existing semiconductor manufacturing processes. The improvements in the quality of electrical contacts in these circuits should result in an ultimate scaling limit for 2D transistors of about 1 nanometer. TECHNICAL ARTICLE

Tags: Microelectronics

NEUROSCIENCE

No evidence that brain-stimulation technique boosts cognitive training

Science Daily, 25MAY2017

Researchers in Sweden report that in their study, stimulation did not modulate gains from pre- to posttest on latent factors of either trained or untrained tasks in a statistically significant manner. A supporting meta-analysis, including younger as well as older individuals, showed that when combined with training, tDCS was not much more effective than sham tDCS at changing working memory performance assessed in the absence of stimulation. These results question the general usefulness of current tDCS protocols for enhancing the effects of cognitive training on cognitive ability. TECHNICAL ARTICLE

Tags: Neuroscience, S&T Sweden

Humans rely more on 'inferred' visual objects than 'real' ones

Medical Express, 16MAY2017

Researchers in Germany found that in situations with a blind spot, the brain 'fills in' the missing information from its surroundings. While fill-in is normally accurate enough, it is mostly unreliable because no actual information from the real world ever reaches the brain. In experiments, they found that there was in fact a strong bias towards the filled-in stimulus inside the blind spot. According to the researchers, understanding how we integrate information from different sources with different reliability can inform us about the exact mechanisms used by the brain to make decisions based on our perceptions. Open Access TECHNICAL ARTICLE

Tags: Neuroscience, S&T Germany

continued...

PHOTONICS

Light-matter interaction detected in single layer of atoms

Science Daily, 30MAY2017

An international team of researchers (USA - University of Central Florida, Brazil, Spain) used graphene to demonstrate elastic scattering. Their technique involved random illumination of the atomic monolayer from all possible directions and then analyzing how the statistical properties of the input light are influenced by miniscule defects in the atomic layer. The technique provides an effective way of discovering those defects, a simple and robust way to assess structural properties of 2D materials and control the complex properties of optical radiation at subwavelength scales. TECHNICAL ARTICLE

Tags: Photonics, Materials science

Research develops world's highest gain high-power laser amplifier

Physorg.com, 26MAY2017

An international team of researchers (UK, USA - Lawrence Livermore National Laboratory, France, South Korea, China) collided long, high-energy laser pulse in plasma with a short, very low energy pulse. At the point where they collide, they produce a beat wave driving the electrons into a regular pattern. This acts as a very high reflectivity, time-varying mirror amplifying the low energy pulse and compressing its energy into an ultra-short duration pulse of light. The findings could pave the way for the development of the next generation of laser systems delivering ultra-intense and ultra-short pulses and at a fraction of the cost of existing lasers. OPEN ACCESS TECHNICAL ARTICLE

Tags: Photonics

Let there be light

Eurekalert, 25MAY2017

An international team of researchers (UK, USA - Harvard University) created deterministic arrays of hundreds of quantum emitters in tungsten diselenide and tungsten disulphide monolayers, emitting across a range of wavelengths in the visible spectrum. Their method may enable the placement of emitters in photonic structures such as optical waveguides in a scalable way. The technique leads to large quantities of on-demand, single photon emitters, paving the way for integrating ultra-thin, single photons in electronic devices. OPEN ACCESS TECHNICAL ARTICLE

Tags: Photonics, Quantum science

QUANTUM SCIENCE

Project develops a new radical approach to probe complex quantum systems for quantum simulations

Nanowerk, 26MAY2017

Making use of long-wavelength radiation–based quantum gate technology, an international team of researchers (UK, USA - industry partner, Denmark, Japan) has developed a blueprint for a trapped ion–based scalable quantum computer module. A high error–threshold surface error correction code can be implemented in the proposed architecture to execute fault-tolerant operations. With appropriate adjustments, the proposed modules are suitable for using photonic interconnects. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science

Synopsis: Entangling Atoms by Sculpting their Wave Functions

American Physical Society Synopsis, 26MAY2017

Researchers in Germany have created entanglement of two neutral atoms trapped inside an optical cavity through carving with weak photon pulses reflected from the cavity. They implemented two different protocols and the generation of all four Bell states with a maximum fidelity of (90 ± 2)%. The protocol works for any distance between cavity-coupled atoms, and no individual addressing is required. The result constitutes an important step towards applications in quantum networks, e.g. for entanglement swapping in a quantum repeater. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science, Communications technology

Toward mass-producible quantum computers

MIT News, 26MAY2017

One promising approach for building quantum computers requires the ability to position defects in complex diamond structures at precise locations, where the defects can function as qubits. A team of researchers in the US (MIT, Harvard, Sandia National Laboratory) demonstrated direct, maskless creation of atom-like single silicon vacancy centres in diamond nanostructures via focused ion beam implantation. This method should facilitate the development of scalable solid-state quantum information processors. TECHNICAL ARTICLE

Tags: Quantum science

Magnetic switch turns strange quantum property on and off

Science Daily, 25MAY2017

An international team of researchers (USA - NIST, University of Maryland, MIT, Harvard University, China, Switzerland, Japan) built a graphene nanostructure consisting of a central region doped with positive carriers surrounded by a negatively doped background. They found

continued...

that as the external magnetic field was increased past a threshold value, there was sudden jumps in conductivity when electron orbits started encompassing the Dirac point, reflecting the switch of the Berry phase from zero to π. The tunability of conductivity by such minute changes in magnetic field is promising for future applications in quantum devices. TECHNICAL ARTICLE

Tags: Quantum science

Unveiling the quantum necklace

Nanowerk, 25MAY2017

An international team of researchers (Japan, China) studied the phase diagram of a Rashba spin-orbit-coupled Bose-Einstein condensate confined in a two-dimensional toroidal trap. In the immiscible regime, they found an azimuthally periodic density distribution with the periodicity highly tunable as a function of the spin-orbit-coupling strength and it favors an odd number of petals in each component. This allows for a wide range of states that can be created. They showed that both components possess states with persistent flows. All features of the odd-petal and the persistent flow states can be explained using a simple but effective model. The researchers have found a way to create a stable necklace. TECHNICAL ARTICLE

Tags: Quantum science

Classical synchronization indicates persistent entanglement in isolated quantum systems

Physorg.com, 22MAY2017

An international team of researchers (Germany, Italy) has demonstrated that isolated systems comprising large numbers of quantum objects can synchronize in a very similar way to classical systems of physics. Quantum coherence and entanglement arise persistently through the same transition as synchronization. This direct link between classical and quantum cooperative phenomena may further our understanding of strongly correlated quantum systems and can be readily observed in state-of-the-art experiments, for example, with ultracold atoms.

Open Access TECHNICAL ARTICLE

Tags: Quantum science

SENSORS

Nano fiber feels forces and hears sounds made by cells

Physorg.com, 15MAY2017

Researchers at UC San Diego have developed a compact nanofibre optic force transducer (NOFT) from an extremely thin fiber of tin dioxide, coated with a thin layer of polyethylene glycol, and studded with gold nanoparticles. To use the device, researchers dip the nano optical fiber into a solution of cells, send a beam of light down the fiber and analyze the light signals it sends out. These signals, based on their intensity, indicate how much force or sound the fiber is picking up from the surrounding cells. Some applications include detecting the presence and activity of a single bacterium; monitoring bonds forming and breaking; sensing changes in a cell's mechanical behavior that might signal it becoming cancerous or being attacked by a virus; or a mini stethoscope to monitor cellular acoustics in vivo. TECHNICAL ARTICLE

Tags: Sensors, Biotechnology ■

About This Publication

To **SUBSCRIBE** or **UNSUBSCRIBE**, visit https://tin-ly.sainc.com/ASDRE/Subscription. To provide feedback or ask questions, contact us at asdre-st-bulletin-reply@sainc.com. This publication is authored and distributed by:

Ryan Zelnio, Ph.D., Associate Director - Tech Watch / Horizon Scans, Office of Net Technical Assessments, OSD AT&L/OASD(R&E)

Ms. Hema Viswanath, TW/HS, ONTA Corporate Librarian