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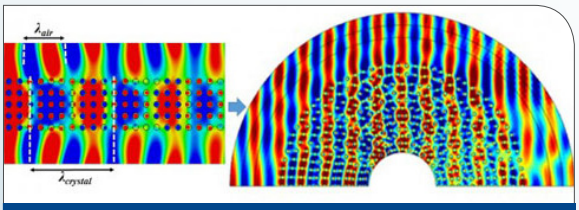
S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

FEATURE ARTICLES

Invisibility cloak with photonic crystals

Nanowerk, 31AUG2016



Photonic crystals open up possibilities for using more practical materials for invisibility cloaking. (Image: Elena Semouchkina, Michigan Tech)

Researchers at Michigan Technological University are building the cloak medium from properly structured crystals composed of dielectric rods which are able to provide superluminal phase velocity of propagating waves. That is, the waves move faster than the speed of light. Such velocity allows for preserving the original wave front while waves curve past the cloaked object. Unlike metamaterials, the resonances in these crystal "atoms" do not define wave transmission. Photonic crystals also possess the required anisotropy of their refractive indices. That means wave phase velocities are different between the various crystal faces. TECHNICAL ARTICLE

Tags: Imaging technology, Featured Article

Saving Science

The New Atlantis, 01AUG2016

Stoked by fifty years of growing public investments, scientists are more productive than ever, pouring out millions of articles in thousands of journals covering an ever-expanding array of fields and phenomena. But much of this supposed knowledge is turning out to be contestable, unreliable, unusable, or flat-out wrong. Only through direct engagement with the real world can science free itself to rediscover the path toward truth. Science isn't self-correcting, it's self-destructing. To save the enterprise, scientists must come out of the lab and into the real world.

Tags: S&T policy, Science without borders, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

Engineers use microwaves to produce high-quality graphene

Science Daily, 02SEP2016

Removing oxygen from graphene oxide to obtain high-quality graphene has been a major challenge over the past two decades. An international team of researchers (USA - Rutgers University, South Korea, France) found that baking the exfoliated graphene oxide for just one second in a 1,000-watt microwave oven can eliminate virtually all of the oxygen from graphene oxide. Large-scale production of graphene is necessary for applications such as printable electronics, electrodes for batteries and catalysts for fuel cells. TECHNICAL ARTICLE

Tags: Advanced materials

For the first time, carbon nanotube transistors outperform silicon

PhysOrg.com, 02SEP2016

Researchers at the University of Wisconsin used polymers to selectively sort out the semiconducting nanotubes and aligned them using "floating evaporative self-assembly". Their carbon nanotube transistors achieved current that is 1.9 times higher than silicon transistors. The research is a critical advance toward exploiting carbon nanotubes in logic, high-speed communications, and other semiconductor electronics technologies. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

Making the switch, this time with an insulator

Nanowerk, 02SEP2016

A team of researchers in the US (Colorado State University, University of Alabama, Argonne National Laboratory, University of Notre Dame, University of Wyoming) demonstrated a new way to switch magnetic moments of electrons in a thin film of a barium ferrite, which is a magnetic insulator. This could prove to be a major breakthrough in spintronics, by allowing a spin

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current-based memory storage device to be simpler, and also maintain more efficiency per electron. A property known as perpendicular magnetic anisotropy, key for information storage, originates from the intrinsic magneto-crystalline anisotropy of the insulator, rather than interfacial anisotropy in other cases. Open Access TECHNICAL ARTICLE

Tags: Advanced materials, Quantum science

'Materials that compute' advances as Pitt engineers demonstrate pattern recognition

EurekAlert, 02SEP2016

Researchers at the University of Pittsburgh modeled computations utilizing Belousov-Zhabotinsky gels, a substance that oscillates in the absence of external stimuli, with an overlaying piezoelectric cantilever. They show how these materials would perform the computations for pattern recognition. Since the devices convert chemical reactions to electrical energy, there would be no need for external electrical power. This would also be ideal for a robot or other device that could utilize the material as a sensory skin. Open Access TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

More surprises in graphene land

Nanowerk, 02SEP2016

Graphene signaled a change in the dynamics of research in the related areas and the narrowing of the gap between basic and applied science. An international team of researchers (Switzerland, USA - MIT) provides new insights on the origin and strength of the spin-orbit coupling induced in graphene on transition metal dichalcogenides. The induced spin-orbit interaction in graphene by proximity effect (and detected through weak antilocalization measurements) is found to be about two orders of magnitude larger than in pristine graphene. This seems to be a promising start for the design of novel heterostructures with tailored spin-orbit coupling. Open Access TECHNICAL ARTICLE

Tags: Advanced materials

Researchers weld graphene sheets to form tough, porous material (w/video)

Nanowerk, 02SEP2016

An international team of researchers (India, USA - Rice University, University of Texas, industry partner, Brazil) used spark plasma sintering to weld flakes of graphene oxide into porous solids that compare favorably with the mechanical properties and biocompatibility of titanium, a standard bone-replacement material. They controlled the density of the material by altering the voltage that delivers the highly localized blast of heat that makes the nanoscale welds. TECHNICAL ARTICLE

Tags: Advanced materials, Biotechnology

Super-material holds a quantum surprise

Nanowerk, 02SEP2016

Nanometer-thin films made from strontium titanate are promising as platforms for next-generation electronics because, under the right fabrication conditions, they present high mobility and two-dimensional superconductivity simultaneously. Researchers in Japan have demonstrated that this metal oxide also exhibits unique quantum behavior when precisely doped with rare-earth lanthanum atoms. The unusual quantum Hall behavior of $SrTiO_3$ arises from the contribution of d-type electron orbitals that are more localized—and hence better correlated into a network—than carriers in silicon and gallium arsenide semiconductors. Open Access TECHNICAL ARTICLE

Tags: Advanced materials, S&T Japan

Engineers treat printed graphene with lasers to enable paper electronics

PhysOrg.com, 01SEP2016

A team of researchers in the US (Iowa State University, Ames National Laboratory, Purdue University) found that treating inkjet-printed, multi-layer graphene electric circuits and electrodes with a pulsed-laser process improves electrical conductivity without damaging paper, polymers or other fragile printing surfaces which can be used for flexible, wearable and low-cost electronics. They developed computer-controlled laser technology that selectively irradiates inkjet-printed graphene oxide. TECHNICAL ARTICLE

Tags: Advanced materials, Flexible electronics

Researchers trick solid into acting as liquid

PhysOrg.com, 01SEP2016

A team of researchers in the US (University of Central Florida, UCLA) found that the internal crystal structure of pellets made out of COF-5, a nano sponge-like, non-flammable manmade material, arranged into precise patterns that allow lithium ions to flow easily - like in a liquid. The finding could open possibilities for smaller electronic, optical and computing devices. TECHNICAL ARTICLE

Tags: Advanced materials

Shape of 'molecular graphene' determines electronic properties

PhysOrg.com, 31AUG2016

Polyaromatic hydrocarbons form an important class of molecules, which can be regarded as small graphene species and which play a prominent role in the development of organic electronics. Researchers in the Netherlands have shown that the edge structures of these apparently similar molecules are responsible for spectacular differences in transport properties, allowing for smarter design of new materials. Open Access TECHNICAL ARTICLE

Tags: Advanced materials

continued...

"It is the facts that matter, not the proofs. Physics can progress without the proofs, but we can't go on without the facts" RICHARD FEYNMAN

AUTONOMOUS SYSTEMS & ROBOTICS

How maggots are influencing the future of robotics

PhysOrg.com, 02SEP2016

Researchers working on the EU-funded MINIMAL project found that despite having fewer than 10,000 neurons, the maggots are capable of learning certain cues quickly and flexibly. The team's work on the learning process of the maggot could benefit the information environment. Looking even further into the future, it might one day even be possible that the larvae themselves could become engineered computational devices, capable of performing critical signal processing tasks.

Tags: Autonomous systems & robotics, Biomimetics

COMMUNICATIONS TECHNOLOGY

The Incredible Loudness of Whispering

DARPA News, 30AUG2016

Researchers at UC San Diego working on DARPA's HERMES program describe the use of "optical combs" residing within a single hair-thin glass fiber to perform an amount of high-speed signal processing that normally would require a power-hungry supercomputer. The new receiver opens the way to a new channel of assured communication because it can retrieve direct-sequence, very weak signals and reconstruct the signal at almost no energy expenditure. With the addition of narrow-band filtering, sub-noise command and control signals could be received even in the presence of jamming power up to 100,000 times stronger.

Open Access TECHNICAL ARTICLE

Tags: Communications technology

ENERGY

Engineers develop a plastic clothing material that cools the skin

PhysOrg.com, 01SEP2016

A team of researchers in the US (Stanford University, SLAC National Accelerator Laboratory) has developed a low-cost, plastic-based textile which cools the body by letting perspiration evaporate through the material and provides a second revolutionary cooling mechanism: allowing heat that the body emits as infrared radiation to pass through the textile. They claim that the wearer feels nearly 4 degrees Fahrenheit cooler than if they wore cotton clothing. Cooling the person rather than the building where they work or live will save energy. Open Access TECHNICAL ARTICLE

Tags: Energy

Renewable energy breakthrough: Solar-powered reaction 100 times faster

Science Daily, 01SEP2016

A team of researchers in the US (Stanford University, SLAC National Accelerate Laboratory) synthesized one of the catalyst candidates, strontium iridium oxide. Experiments probing the surface of the material indicated that a corrosion process released strontium atoms into the surrounding fluid during this initial period. This left a film of iridium oxide just a few atomic layers thick that was much more active than the original material, and 100 times more efficient at promoting the oxygen evolution reaction than any other acid-stable catalyst known to date. TECHNICAL ARTICLE

Tags: Energy, Solar energy

ENVIRONMENTAL SCIENCE

Blowing bubbles to catch carbon dioxide

PhysOrg.com, 01SEP2016

A team of researchers in the US (Sandia National Laboratory, University of New Mexico) combined a relatively thick hydrophobic layer with a thin hydrophilic layer and made tiny nanopores in it to protect the watery membrane so it doesn't "pop" or leak out. They combined the membrane with carbonic anhydrase, an enzyme to speed up dissolving CO2. This innovation makes the Memzyme more than 10 times more selective while maintaining an exceptionally high flow rate. The CO2 Memzyme produces 99 percent pure CO2, which can be used in many industries. TECHNICAL ARTICLE

Tags: Environmental science, Government S&T, Materials science

IMAGING TECHNOLOGY

Machine learning techniques enable models from partial image data

PhysOrg.com, 31AUG2016

Researchers in Saudi Arabia used enormous volumes of data available on residential buildings to develop a scheme that 'learns' and creates a probabilistic graphical model to encode the relationships between the features in the data. A user can then sample specific features or fix observed features and compute the unobserved structure. Finally, there is an optimization step that translates building features into 3-D building models. Once trained, the model can generate a large variety of buildings, and by setting hard constraints, plausible complete models can be created even from partial observations. TECHNICAL ARTICLE

Tags: Imaging technology, Pattern recognition

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INFORMATION TECHNOLOGY

A data-cleaning tool for building better prediction models

EurekAlert, 31AUG2016

A team of researchers in the US (Columbia University, US Berkeley) has developed software that hands much of the dirty work over to machines. Called "ActiveClean," the system analyzes a user's prediction model to decide which mistakes to edit first, while updating the model as it works. With each pass, users see their model improve.

Tags: Information technology

MATERIALS SCIENCE

New combination of materials could speed up computers

PhysOrg.com, 05SEP2016

An international team of researchers (USA - NIST, Germany, Sweden) identified a binary metallic ferromagnetic alloy of cobalt and iron with damping approaching the magnitude of 10-4. The damping is proportional to the number of electronic states at the highest occupied energy level and damping can be used to achieve maximum energy-efficient data transfer inside the material. This material is becoming a standardised reference material for comparison in the hunt for new and even better alloys. TECHNICAL ARTICLE

Tags: Materials science

Featured Resource

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MICROELECTRONICS

Grabbing an electron by the tail

Nanowerk, 02SEP2016

A team of researchers in the US (University of Minnesota, Pacific Northwest National Laboratory) deposited ultra-thin, alternating layers of neodymium titanium oxide and strontium titanium oxide by generating beams of the constituent elements Nd, Ti, Sr, and O, and aimed the beams at a small wafer of a crystalline oxide. The oxide wafer functioned as the foundation for the layered thin-film material, allowing the atoms to crystallize into the desired structure. The sequencing of the elemental beams allowed the layered structure to be precisely controlled, down to the level of single atomic layers. The technique enables a new generation of ultra-small transistors. TECHNICAL ARTICLE

Tags: Microelectronics

Memory for future wearable electronics

Science Daily, 02SEP2016

Researchers in South Korea constructed a memory called two-terminal tunnelling random access memory (TRAM). TRAM is made up of a stack of one-atom-thick or a few atom-thick 2D crystal layers: One layer of MoS2 with two electrodes (drain and source), an insulating layer of hexagonal boron nitride (h-BN) and a graphene layer. By applying different voltages between the electrodes, electrons flow from the drain to the graphene layer tunnelling through the insulating h-BN layer. The graphene layer becomes negatively charged and memory is written and stored and vice versa, when positive charges are introduced in the graphene layer, memory is erased. Flexibility and stretchability are two key features of TRAM. Open Access TECHNICAL ARTICLE

Tags: Microelectronics, Flexible electronics

Electronic circuits printed at one micron resolution

Science Daily, 01SEP2016

An international team of researchers (Japan, China) developed a printing technique capable of forming metal circuits with 1 μm line width on flexible substrates. Using this technique, they fabricated minute organic TFTs. The principle of this printing technique is as follows: First, form hydrophilic and hydrophobic micro-patterns on the substrate by irradiating it with parallel vacuum ultraviolet at a wavelength of 200 nm or less. Then, coat only the hydrophilic patterns with metal nanoparticle inks. They plan to apply the technique in various fields such as large-area flexible displays and sensors. The process is applicable to medical and bioelectronics fields. TECHNICAL ARTICLE

Tags: Microelectronics

PHOTONICS

Tapping into light's hidden information to push fundamental diffraction limit

Physics World, 02SEP2016

Diffraction limits the minimum distance that can be measured between two adjacent sources of light. Researchers in Singapore used a theory known as "quantum metrology" to work out which physical measurements would yield the most information when carried out on light. They found it is possible to measure the distance between two light sources with an accuracy that doesn't depend on how close the sources are to one another. To find ways of separating the "useful parts" of the light from the "noisy parts" they propose carrying out sifting using waveguides with spatially varying refractive indices. Open Access TECHNICAL ARTICLE

Tags: Photonics

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Nonlinear optical quantum-computing scheme makes a comeback

PhysOrg.com, 29AUG2016

Researchers in Canada have shown that it should be possible to use "cross-Kerr nonlinearities" to create a cross-phase (CPHASE) quantum gate. This gate takes zero, one or two photons as input. When the input is zero or one photon, the gate does nothing. But when two photons are present, the gate outputs both with a phase shift between them. One important use of such a gate is to entangle photons, which is vital for quantum computing. CPHASE gates could play an important role in optical quantum computers of the future. TECHNICAL ARTICLE 1, TECHNICAL ARTICLE 2

Tags: Photonics, Quantum science, S&T Canada

QUANTUM SCIENCE

Google's Quantum Dream May Be Just Around the Corner

MIT Technology Review, 01SEP2016

Several scientists familiar with Google's progress suggest that a functioning 50-qubit quantum chip, enough to overpower conventional supercomputers at a certain kind of calculation, could be ready by the end of 2017. More information

Tags: Quantum science

Simulated quantum magnetism can control spin interactions at arbitrary distances

PhysOrg.com, 31AUG2016

An international team of researchers (USA - Purdue University, CalTech, Germany) developed a scheme for simulating quantum magnetism that provides full control of interactions between pairs of spins at arbitrary distances in 1D and 2D lattices, and demonstrated the scheme's wide utility by generating several well-known spin models. The researchers state that their results allow the introduction of geometric phases into the spin system that could generate topological models with long-range spin–spin interactions. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science

Quantum Entanglement Distribution in Next-Generation Wireless Communication Systems

arXiv, 18AUG2016

According to researchers in Australia, there is a possibility for next-generation wireless networks (beyond 5G) to accommodate direct quantum-entanglement distribution in the millimeter-wave regime without the need to integrate additional optical communication hardware into the transceivers. They analyzed the distribution of quantum entanglement over communication channels in the millimeter-wave regime and confirmed it, but its implementation will be very demanding from both a system-design perspective and a channel-requirement perspective. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science, S&T Australia

SCIENCE WITHOUT BORDERS

Are we ready for Robotopia, when robots replace the human workforce?

PhysOrg.com, 01SEP2016

If we grant, for the sake of argument, the premise that massive technological unemployment is plausible, how will society cope? In his newly released book, Why the Future is Workless, author Tim Dunlop accepts the demise of jobs as inevitable. Thus, he says, we must rethink our jobs-based economy. Not only that, we have to rethink job-centric human values.

Tags: Science without borders, Autonomous systems & robotics

Could artificial intelligence help humanity? Two California universities think so

PhysOrg.com, 01SEP2016

Scientists are increasingly looking ahead to the ways in which AI might actually aid human lives. Recently two centers devoted to studying the ways in which AI can help humanity were opened in California. The UC Berkeley-led center will seek to understand how human values can be built into AI's design, and create a mathematical framework that will help people build AI systems that are beneficial to humanity. The USC center seems to operate in a mindset perpendicular to the one at UC Berkeley: It seeks to harness AI's existing capabilities to solve problems in messy, complicated human contexts.

Tags: Science without borders, Artificial intelligence

Future Airplanes Will Fly On Twistable Wings

IEEE Spectrum, 31AUG2016

For three decades, engineers at aerospace companies, universities, and defense labs have been working on twistable aircraft wings that could be instantaneously and minutely adjusted to improve fuel efficiency. With these wings, aircraft designers could get closer to optimal performance by increasing an airplane's lift-to-drag ratio, which is a measure of aerodynamic efficiency, in response to variations in speed, altitude, air temperature, and other flight conditions.

Tags: Science without borders, Space technology

SENSORS

Standing still may help improve antennas that scan in all directions

Science Daily, 30AUG2016

Antennas often need to trace circles in the sky. But spinning large objects nonstop takes a lot of time and mechanical energy. Scanning from a stationary position

could speed up long-range detection and communications. Researchers at the University of Wisconsin-Madison are working out a new strategy to create antennas that spin their beams in circles while the devices stand still. Rather than building a phased array from numerous individual antennas, the team instead plans to create special reflective surfaces that achieve the same effect, but only rely on one single signal source.

Tags: Sensors ■

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