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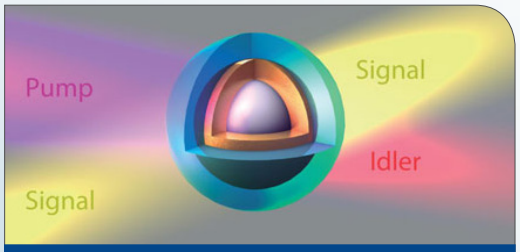
S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

Feature Articles

Photonics researchers create first nanoscale 'optical parametric amplifier'

Nanowerk, 09MAY2016



Rice University's new light-amplifying nanoparticle consists of a 190-nanometer diameter sphere of barium tin oxide surrounded by a 30-nanometer-thick shell of gold. (Image: Alejandro Manjavacas /Rice University)

A team of researchers in the US (Rice University, University of New Mexico) has unveiled a new nanoparticle "optical parametric amplifier" (OPA) that can generate infrared light and boost the output of one light by capturing and converting energy from a second light. The device functions much like a laser, but while lasers have a fixed output frequency, the OPA can be tuned over a range of frequencies that includes a portion of the infrared spectrum. Shrinking an infrared light source to such a small scale could open doors to new kinds of chemical sensing and molecular imaging that aren't possible with today's state-of-the-art nanoscale infrared spectroscopy. TECHNICAL ARTICLE

Tags: Sensors, Photonics, Featured Article

New study exposes growing problem of patent aggregators and negative impact on innovation

Science Daily, 28APR2016

In theory, the rise in patent litigation could reflect growth in the commercialization of technology and innovation. A team of researchers in the US (Harvard University, University of Texas, Dallas, industry partner) reports that the majority of recent patent litigation has been driven by "nonpracticing entities" that patent portfolios just for the sake of enforcing IP rights. The authors recommend advance review procedures that would provide preliminary evaluation as to whether the plaintiff's infringement claims are reasonable and whether the asserted patents are of high quality. Such advance review could cripple trolling and benefit innovative companies. TECHNICAL ARTICLE

Tags: S&T policy, Featured Article

S&T News Articles

ADVANCED MATERIALS

Catalytic nanocages: Hollow and filled with potential

Science Daily, 06MAY2016

Improving the efficiency of catalysts could enhance many chemical reactions used in industry and research laboratories. To improve the catalysts, an international team of researchers (USA - Georgia Institute of Technology, University of Wisconsin–Madison, UT Dallas, Oak Ridge National Laboratory, University of Arizona, China) developed their own synthesis technique to create hollow, shape-selected nanocages. The nanocages have catalytic surfaces both inside and outside their structure, which likely is the reason for the increased activity. The nanocages can be engineered to have many different catalytic facets. TECHNICAL ARTICLE 1, 2, 3

Tags: Advanced materials

Silicon Nanoparticles Could Be a Boon for Fiber Optic Telecommunications

IEEE Spectrum, 06MAY2016

The Raman scattering effect is often leveraged today in fiber optic telecommunication in order to boost signals traveling through long stretches of glass fiber. An international team of researches (Russia, Australia) has demonstrated that silicon nanoparticles can significantly increase the intensity of the Raman effect. The research revealed that silicon's refractive index is so

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large that its magnetic dipole resonance is observed in wavelengths longer than 300 nanometers even though the diameter of the particle is only 100 nanometers. The upshot is that much smaller silicon nanoparticles can be used to produce enhanced optical phenomena, such as spontaneous light emission, and enhanced light absorption. TECHNICAL ARTICLE

Tags: Advanced materials, Communications technology

Small and powerful: Pushing the boundaries of nanomagnets

Nanowerk, 06MAY2016

The next generation of thermally stable data storage devices demands materials that are highly magnetic in a specific direction at small particle sizes. A team of researchers in the US (NRL, Virginia Commonwealth University, NIST) has created $CoFe_2C$ nanoparticles that have magnetic properties comparable to some rare earth magnets, the strongest permanent magnets ever created, at sizes as small as 5 nanometers. The new magnets can lead to nano-magnets that work at room temperature. TECHNICAL ARTICLE 1, 2, 3

Tags: Advanced materials, Government S&T

Engineers look inside nanoparticles to explore how their shape improves energy storage

Nanowerk, 27APR2016

An international team of researchers (USA - Stanford University, SLAC National Accelerator Laboratory, the Netherlands) has obtained a first look inside phase-changing nanoparticles, elucidating how their shape and crystallinity can have dramatic effects on their performance. The work has immediate applications in the design of energy storage materials, but could eventually find its way into data storage, electronic switches and any device in which the phase transformation of a material regulates its performance. TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

Nanometric positioning goes the distance

Science Daily, 27APR2016

Researchers in Singapore developed an electromagnetic drive consisting of fixed permanent magnets inside and around a moving wire coil which moves by electromagnetic Lorentz force when a current is applied, with contactless and frictionless motion. The electromagnetic drive and flexure joints are highly linear in their motion response, resulting in theoretically infinite positioning resolution and a travel range of a few millimeters but limited only by the linear range of the flexure joints. The research has the potential to revolutionize experimentation and fabrication at the nanoscale. TECHNICAL ARTICLE

Tags: Advanced materials

CYBER SECURITY

Cyber researchers are becoming a top hacker target

Defense Systems, 06MAY2016

According to a threat report released this week by the threat analysis firm Nexusguard, researchers and their related groups are becoming high-valued targets for digital criminals. The No. 1 attack method launched against cyber researchers and corporate infrastructure was network time protocol, an exploit that targets the network protocol used for clock synchronization between computers linked by packet-switched data networks with varying levels of latency.

Tags: Cyber security

Prep for next-gen encryption should start yesterday

Government Computer Week, 06MAY2016

Current encryption methods depend on the difficulty of factoring very large numbers, such as those that enable RSA public key encryption. For all intents and purposes, therefore, existing encryption schemes are considered very sound. When standards for quantum resistant cryptography become available, NIST said it will reassess how close the quantum threat is to affecting existing cryptography and then decide whether to deprecate or withdraw the affected standards. Agencies should therefore be prepared to transition away from these algorithms as early as 10 years from now.

Tags: Cyber security

ENERGY

Photonic crystals keep solar cells cool while still catching light

PhysOrg.com, 06MAY2016

Researchers at Stanford University have developed and tested a new material that can cool a solar cell by up to 13° Celsius under the California winter sun. Because heat makes solar cells less efficient, the researchers predict their cooling layer could help solar cells turn approximately 1 percent more sunlight into electricity. The cooler temperatures also mean the solar cells will likely last longer due to greatly reduced efficiency degradation rates. They have demonstrated that the new material keeps the solar cell cooler even as the solar cell absorbs the same amount of sunlight.

Tags: Energy, Solar energy

Clues on the path to a new lithium battery technology

Science Daily, 04MAY2016

One of the most promising light-weight alternatives for batteries is the lithium air battery in which the lithium cobalt oxide cathode is replaced by carbon particles. Researchers in Germany identified a potential culprit for

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"Be less curious about people and more curious about ideas." MARIE CURIE

the decaying electrodes and electrolytic fluid in an experiment: singlet oxygen, an extremely reactive substance created when lithium air batteries are charged. Now, the researchers hope to find a mechanism to prevent the formation of singlet oxygen during charging. TECHNICAL ARTICLE

Tags: Energy, Battery, S&T Germany

ENVIRONMENTAL SCIENCE

Unmanned cloud-seeding aircraft takes flight in Nevada

PhysOrg.com, 04MAY2016

A research team with more than 30 years of weather modification research and expertise at the Desert Research Institute in Nevada has successfully tested a cloud-seeding payload during an experimental flight using a fixed-wing unmanned aircraft. It demonstrates the potential to use unmanned systems as tools for environmental science and innovative natural resource applications.

Tags: Environmental science

INFORMATION TECHNOLOGY

A new spintronics material promises huge leaps in computer data storage

PhysOrg.com, 10MAY2016

An international team of researchers (UK, Czech Republic, Germany, Poland) made a device using antiferromagnetic copper manganese arsenide grown by molecular epitaxy on a semiconductor base. It holds the promise of ultra-high density data storage, uses spintronics rather than electronics to store the data making it resistant to external magnetic fields and external radiation, and it remains stable when the power is turned off. This all happens at room temperature in a material that is relatively easy to make. TECHNICAL ARTICLE

Tags: Information technology, Materials science

Teaching computers to understand human languages

Science Daily, 06MAY2016

Researchers in the UK have developed a set of algorithms that will enable a computer to act in much the same way as a human would when encountered with an unknown word. When the computer encounters a word it doesn't recognize or understand, the algorithms will look up the word in a dictionary and try to guess what other words should appear with this unknown word in the text. It gives the computer a semantic representation for a word that is both consistent with the dictionary as well as with the context in which it appears in the text.

Tags: Information technology, S&T UK

Hybrid nanoantenna as Next-generation platform for ultradense data recording

Science Daily, 27APR2016

Researchers in Russia fabricated nanoantennas using a truncated silicon cone with a thin golden disk located on top. Using nanoscale laser reshaping, they modified the shape of the golden particle without affecting the silicon cone thus changing optical properties of the nanoantenna as a whole. The concept of asymmetric hybrid nanoantennas unifies two approaches that were previously thought to be mutually exclusive: plasmonics and all-dielectric nanophotonics. The new technology promises to bring about a new platform for ultradense optical data recording, and high throughput fabrication of a wide range of optical nanodevices. TECHNICAL ARTICLE

Tags: Information technology, S&T Russia

MATERIALS SCIENCE

New 'smart threads' can change the colour of your clothes instantly (w/video)

Science Alert, 06MAY2016

The colour-shifting threads change their hues in response to electrical charges. It's being developed as part of Google's Project Jacquard that is looking into the potential of making our clothing touch-sensitive and interactive. Right now, it takes a while to change colours, so any kind of fast, responsive display is out of the question for the time being.

Tags: Materials science

Physicists discover new state of the water molecule

Physics World, 06MAY2016

An international team of researchers (USA - Oak Ridge National Laboratory, University of Houston, University of Washington, UK) used neutron scattering to map the locations of hydrogen atoms in water molecules trapped in the mineral beryl—revealing that the atoms tunnel between the six configurations. They have also found evidence that, unlike normal water, a trapped molecule has a zero electric-dipole moment. The research could shed light on how water behaves when confined to tiny spaces, such as in the membranes of living cells. TECHNICAL ARTICLE

Tags: Materials science

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Molybdenum disulfide holds promise for light absorption

Nanowerk, 05MAY2016

By using simple strategies, researchers at Rice University were able to absorb 35 to 37 percent of the incident light in the 400- to 700-nanometer wavelength range, in a layer of molybdenum disulfide that is only 0.7 nanometers thick. They used a combination of numerical simulations, analytical models and experimental optical characterizations. The research has many applications, including development of efficient and inexpensive photovoltaic solar panels. TECHNICAL ARTICLE

Tags: Materials science

Featured Resource

American Physical Society Spotlight

Provides daily news and commentary about selected papers from the APS journal collection. RSS

Physicists explore superconductivity at the two-dimensional limit

PhysOrg.com, 05MAY2016

An international team of researchers (Spain, the Netherlands) who studied the electrical properties of tantalum disulphide report that contrary to expectations, the temperature at which the layered material becomes superconducting increases as the number of layers is reduced, meaning that this property is indeed maintained at the two-dimensional limit. This finding allows us to advance our understanding of superconductivity and paves the way for the miniaturisation of ultrasensitive magnetic field detectors. TECHNICAL ARTICLE

Tags: Materials science

Speedy ion conduction in solid electrolytes clears road for advanced energy devices

Nanowerk, 05MAY2016

The low conductivity of the solid electrolyte has limited its applications. A team of researchers at Oak Ridge National Laboratory examined a prototype system of lithium, lanthanum, titanium and oxygen building blocks which possess the highest bulk conductivity among oxide systems. They found that in this material, lithium ions move fastest in the planar 2D pathways resulting from alternating stacks of atomic layers rich in either lanthanum or lithium. Fine features approximately 5 to 10 nanometers wide, throughout the 3D material provided more directions in which lithium ions could move. TECHNICAL ARTICLE

Tags: Materials science, Government S&T

Can artificial intelligence create the next wonder material?

Nature News, 04MAY2016

Instead of continuing to develop new materials the old-fashioned way—stumbling across them by luck, then painstakingly measuring their properties in the laboratory—researchers are using computer modelling and machine-learning techniques to generate libraries of candidate materials by the tens of thousands. Even data from failed experiments can provide useful input. Many of these candidates are completely hypothetical, but engineers are already beginning to shortlist those that are worth synthesizing and testing for specific applications by searching through their predicted properties. At least three major materials databases already exist around the world, each encompassing tens or hundreds of thousands of compounds.

Tags: Materials science

Optical nonlinearity record: Discovery offers a 'game-changer' for photonics applications

Science Daily, 28APR2016

An international team of researchers (Canada, USA - University of Rochester, Mexico) exploited the unusual optical properties of the transparent electrical conductor indium tin oxide that occurs in the epsilon-near-zero region and demonstrated 100 times greater nonlinearity than other known materials. The 'epsilon-near-zero' region for this material is linked to roughly a wavelength of 1.2 micrometers which is of particular interest to optical communications. TECHNICAL ARTICLE

Tags: Materials science, Communications technology

MICROELECTRONICS

Achieving zero resistance in energy flow

MIT News, 06MAY2016

Improving upon their earlier work, a team of researchers in the US (MIT, Pennsylvania State University) achieved zero resistance to current flowing lengthwise along the edge of their sample circuit at the extremely low temperature of 25 millikelvins (0.025 kelvins), a state physicists call "dissipationless chiral edge transport." This lack of resistance is independent of length. In this system, there is a very special edge channel. The bulk is insulating but the chiral edge channel is metallic and spin polarized, so it is very useful for the next generation electronics and spintronics with low power consumption. TECHNICAL ARTICLE

Tags: Microelectronics

PHOTONICS

Nanotransducers see the light

Nanotechweb, 06MAY2016

Using just beams of light, researchers in the UK have succeeded in producing large forces in actuators made from charged gold nanoparticles coated with

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temperature-responsive polymers. The nanomachines could be used to make pumps, valves, engines and pistons for a host of applications in the nanoworld. TECHNICAL ARTICLE

Tags: Photonics, S&T UK

A compact, efficient single photon source that operates at ambient temperatures on a chip

Nanowerk, 04MAY2016

One of the biggest challenges is the development of efficient, scalable photon sources that can be mounted on a chip and operate at room temperature. Researchers in Israel used tiny nanocrystals made of semiconducting materials and positioned a single nanocrystal on top of a specially designed and carefully fabricated nano-antenna. The nano-antenna efficiently directed the single photons emitted from the nanocrystals into a well-defined direction in space with a record low divergence angle. The photons were then collected with a very simple optical setup, and sent to be detected and analyzed using single photon detectors. TECHNICAL ARTICLE

Tags: Photonics, Quantum science

QUANTUM SCIENCE

New design of primitive quantum computer finds application

PhysOrg.com, 10MAY2016

An international team of researchers (UK, Australia) presents explicit efficient quantum circuits for implementing continuous-time quantum walks on the circulant class of graphs. They show that solving the same sampling problem for arbitrary circulant quantum circuits is intractable for a classical computer, assuming conjectures from computational complexity theory. This is a new link between continuous-time quantum walks and computational complexity theory. It indicates a family of tasks that could ultimately demonstrate quantum supremacy over classical computers. TECHNICAL ARTICLE

Tags: Quantum science

Ferromagnetism + semiconductor = spintronics: New opportunities for improving electronics

PhysOrg.com, 09MAY2016

For the first time, an international team of researchers (Japan, Vietnam) grew an iron-doped semiconductor which shows ferromagnetism up to room temperature in semiconductors that have good compatibility with modern electronics. Their results open a way to realize semiconductor spintronic devices operating at room temperature. TECHNICAL ARTICLE

Tags: Quantum science

First single-enzyme method to produce quantum dots revealed

PhysOrg.com, 09MAY2016

Researchers at Lehigh University used "directed evolution" to alter a bacterial strain called Stenotophomonas maltophilia to selectively produce cadmium sulphide QDs. Because they discovered that a single enzyme produced by the bacteria is responsible for QD generation, the cell-based production route was scrapped entirely. The cadmium sulphide QDs can be generated with the same enzyme synthesized from other easily engineered bacteria such as E. coli. They are working to create many different types of functional materials and make large-scale functional materials as well as individual quantum dots. TECHNICAL ARTICLE

Tags: Quantum science, Biotechnology

Quantum swing—a pendulum that moves forward and backwards at the same time

PhysOrg.com, 09MAY2016

Two-phonon coherences are highly relevant in the new research area of quantum phononics where tailored atomic motions such as squeezed and/or entangled phonons are investigated. Researchers in Germany apply a novel method of two-dimensional terahertz spectroscopy for generating and analyzing non-classical two-phonon coherences with huge spatial amplitudes. Their research paves the way towards generating, analyzing, and manipulating other low-energy excitations in solids such as magnons and transitions between ground and excited states of excitons and impurities with multiple-pulse sequences. TECHNICAL ARTICLE

Tags: Quantum science, S&T Germany

Superconducting quantum-dot turnstile singles out electrons

Physics World, 05MAY2016

An international team of researchers (France, Russia, Finland) has developed a metallic quantum dot sandwiched between two superconductors – which functions as an electronic turnstile, only permitting one electron through at a time. By driving an AC voltage through the device, the researchers can control the tunnelling of electrons into and out of the dot. While such turnstiles have been made before, this is the first where electrons at only one quantum energy level are allowed to pass through. This, say the researchers, makes the device ideal for quantum-metrology applications. TECHNICAL ARTICLE

Tags: Quantum science

Researchers find new way to control quantum systems

PhysOrg.com, 04MAY2016

Researchers in Canada have developed a one-size-fits-all method of indirectly controlling quantum systems that is

applicable to any experiment. It involves soft, frequent touches to the main system from the auxiliary one, which allow researchers to freely steer a quantum system while keeping its quantum nature intact. The new technique could play an important role in a number of quantum technologies, which in turn, promise to impact a wide range of fields, from high performance computing to pharmaceutical drug discovery. TECHNICAL ARTICLE

Tags: Quantum science, S&T Canada

Experimental quantum forgery of quantum optical money

arXiv, 15APR2016

An international team of researchers (Poland, Czech Republic, USA - University of Michigan) demonstrates that it is possible to use quantum states to prepare a banknote that cannot be ideally copied without making the owner aware of only unauthorized actions. They provide the security conditions for quantum money by investigating the physically-achievable limits on the fidelity of 1-to-2 copying of arbitrary sequences of qubits. These results can be applied as a security measure in quantum digital right management. TECHNICAL ARTICLE

Tags: Quantum science, Cyber security

SENSORS

'Lab on a chip': Small devices make a big impact

Science Daily, 07MAY2016

A stumbling block for successful miniaturization and commercialization of fully integrated microfluidic systems has been the development of reliable microfluidic components, such as microvalves and micropumps. An international team of researchers (USA - MIT, Singapore) fabricated a micropump consisting of three microvalves using thermoplastic polyurethane film as membrane. Further miniaturizing the size of microvalve modules could increase the scale of integration and broaden the range of potential applications. TECHNICAL ARTICLE

Tags: Sensors, Biotechnology

Introducing the disposable laser

Nanowerk, 03MAY2016

One obstacle that has held back organic lasers is the fact that they degrade relatively quickly. An international team of researchers (France, Hungary) has invented a way to print lasers using an inkjet printer. The technique doesn't require masks, can be done at room temperature and can print onto flexible materials. The disposable part of the new laser is the printed gain medium, which the researchers call the "lasing capsule." They used two different types of dyes to produce laser emission ranging from yellow to deep red. They expect that with further development it is possible to send data over short plastic fibers and serve as a tool for analysing chemical or biological samples. TECHNICAL ARTICLE

Tags: Sensors, Photonics ■

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