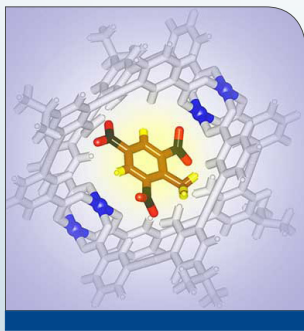


[Advanced materials \(3\)](#)[Autonomous systems & robotics \(1\)](#)[Big data \(1\)](#)[Biotechnology \(2\)](#)[Communications technology \(2\)](#)[Energy \(2\)](#)[Environmental science \(1\)](#)[Imaging technology \(1\)](#)[Materials science \(4\)](#)[Microelectronics \(3\)](#)[Photonics \(3\)](#)[Quantum science \(1\)](#)[S&T policy \(1\)](#)[Science without borders \(2\)](#)[Sensors \(5\)](#)[STEM \(1\)](#)

FEATURE ARTICLES

[New nanosensors for the detection of TNT](#)

[Nanowerk, 09NOV2016](#)

To detect TNT, an international team of researchers (the Netherlands, Hong Kong, Australia) used molecules with a lantern-type cage structure which precisely accommodates a single TNT molecule. They chemically bound an ultra-thin layer of these cages to the

surface of a sensor chip containing a few dozen sensitive nanosensors. Variation of geometric and electronic properties of these complex cage molecules allows them to capture the 'explosive' molecules. The presence of such a molecule also causes the electrical conductance of the underlying silicon nanowires to change in a very characteristic way which confirms the presence of TNT molecules. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: [Sensors](#), [Explosives](#), [Featured Article](#)

[New technology taps power of diatoms to dramatically improve sensor performance](#)

[Science Daily, 08NOV2016](#)

A team of researchers in the US (Oregon State University, Washington University) developed a system using diatoms to interact with and identify compounds through optical signatures. When liquids are deposited on it with carefully controlled inkjet devices, the droplets evaporate quickly, but, in the process, carry the molecules of interest to the diatom surface. This is the key to increasing the sensitivity of the photonic measurements. According to the researchers, their technology was one million more times sensitive at identifying TNT than other common approaches. The technology may find applications in biomedical sensing of cancer biomarkers, forensics and detection of illegal drugs. [TECHNICAL ARTICLE](#)

Tags: [Sensors](#), [Featured Article](#)

S&T NEWS ARTICLES

ADVANCED MATERIALS

['Conductive concrete' shields electronics from EMP attack](#)

[Physorg.com, 14NOV2016](#)

Researchers at the University of Nebraska replaced some standard concrete aggregates with magnetite that absorbs microwaves, carbon and metal components for better absorption as well as reflection. The new concrete works by both absorbing and reflecting electromagnetic waves. Shotcrete, a spray-on method of applying concrete, can be used to cost-effectively retrofit existing buildings, a significant benefit to protect existing critical infrastructure and military installations. The prototype they built exceeds military shielding requirements.

Tags: [Advanced materials](#)

[The thinnest photodetector in the world](#)

[Science Daily, 09NOV2016](#)

An international team of researchers (USA - UCLA, South Korea, Singapore) reports the layer-number-dependent photocurrent generation in graphene/MoS₂/graphene heterostructures. Photoresponse studies reveal that photoresponsivity in one-layer MoS₂ is surprisingly higher than that in seven-layer MoS₂ by seven times. They show that asymmetric potential barriers in the top and bottom interfaces of the graphene/one-layer MoS₂/graphene heterojunction enable asymmetric carrier tunnelling, to generate usually high photoresponsivity in a one-layer MoS₂ device. The device could be used in the Internet of Things, smart devices, wearable electronics and photoelectronics. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#)

[Scientists fabricate a new class of crystalline solid](#)

[PhysOrg.com, 03NOV2016](#)

Glass is an amorphous material with a disordered atomic structure. A team of researchers in the US (Leigh University, Lawrence Berkeley National

continued...

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Laboratory) has developed a novel approach to fabricate rotating lattice single (RLS) crystal lines and 2D layers of unlimited dimensions via a recently discovered solid-to-solid conversion process using a laser to heat a glass to its crystallization temperature but keeping it below the melting temperature. The proof-of-concept, including key characteristics of RLS crystals, was demonstrated using the example of Sb₂S₃ crystals within the Sb-S-I model glass system. The research may open a new field by creating a material with unique, novel properties. [OPEN ACCESS TECHNICAL ARTICLE](#)

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS

[Video Friday: Robot Dance Contest, 500 Drones Flying, and Steady Humanoid](#)

[IEEE Spectrum, 11NOV2016](#)

Here's a series of videos from DFKI's Robotics Innovation Center, where they are doing some impressive work involving humanoid robots, ground robots, and under-water robots.

Tags: Autonomous systems & robotics

BIG DATA

[Artificial-intelligence system surfs web to improve its performance](#)

[Science Daily, 10NOV2016](#)

Researchers at MIT explore the task of acquiring and incorporating external evidence to improve extraction accuracy in domains where the amount of training data is scarce. This process entails issuing search queries, extraction from new sources and reconciliation of extracted values, which are repeated until sufficient evidence is collected. They approach the problem using a reinforcement learning framework where their model learns to select optimal actions based on contextual information. They employ a deep Q-network, trained to optimize a reward function that reflects extraction accuracy while penalizing extra effort. Their experiments on two databases demonstrate that the system significantly outperforms traditional extractors and a competitive meta-classifier baseline. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Big data, Artificial intelligence

BIOTECHNOLOGY

[Researchers create synthetic cells to isolate genetic circuits](#)

[MIT News, 14NOV2016](#)

Researchers at MIT encapsulated genetic circuits in liposomes. These synthetic cells are not alive but are equipped with much of the cellular machinery necessary to read DNA and manufacture proteins. By segregating

circuits within their own liposomes, the researchers are able to create separate circuit subroutines that could not run in the same container at the same time, but can run in parallel to each other, communicating in controlled ways. This approach also allows scientists to repurpose the same genetic tools, including genes and transcription factors to do different tasks within a network. This approach also enables communication between circuits from different types of organisms, such as bacteria and mammals. [TECHNICAL ARTICLE](#)

Tags: Biotechnology, Synthetic biology

[Using a patient's own words, machine learning automatically identifies suicidal behavior](#)

[Science Daily, 08NOV2016](#)

A team of researchers in the US (University of Cincinnati, University of Colorado, Carnegie Mellon University, UCLA, industry partners) reports that machine learning is up to 93 percent accurate in correctly classifying a suicidal person and 85 percent accurate in identifying a person who is suicidal, has a mental illness but is not suicidal, or neither. These results provide strong evidence for using advanced technology as a decision-support tool to help clinicians and caregivers identify and prevent suicidal behavior. [OPEN ACCESS TECHNICAL ARTICLE](#)

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Biotechnology, Artificial intelligence

COMMUNICATIONS TECHNOLOGY

[Researchers found mathematical structure that was thought not to exist](#)

[Science Daily, 14NOV2016](#)

In the 1970s, a group of mathematicians started developing a theory according to which codes could be presented at a level one step higher than the sequences formed by zeros and ones: mathematical subspaces named q-analogs. Until ten years ago no applications were found because of the enormous size of the structures. Using algebraic techniques, computers and their experience, an international team of researchers (Finland, Israel, Germany, USA - UC San Diego, Singapore) have found the largest possible structure described by the theory. The best possible q-analogs of codes may be useful in more efficient data transmission. [Open Access TECHNICAL ARTICLE](#)

[Open Access TECHNICAL ARTICLE](#)

Tags: Communications technology

[Breakthrough in the quantum transfer of information between matter and light](#)

[PhysOrg.com, 11NOV2016](#)

An international team of researchers (Canada, France) uses photons generated by a laser to initialize the hole and record quantum information on it. To read it, they excite the hole again with a laser and then collect the emitted photons. The result is a quantum transfer of information between the stationary qubit, encoded in the spin of the

“Deep inside the chaos lurks an even eerier type of order.”

DOUGLAS HOFSTADTER

hole held captive in the crystal, and the flying qubit. With this technique, a hundred or so picoseconds are sufficient to go from a flying qubit to a static qubit, and vice-versa.

[TECHNICAL ARTICLE](#)

Tags: Communications technology, Quantum science

ENERGY

[Researchers report new thermoelectric material with high power factors](#)

[Nanowerk](#), 15NOV2016

Thermoelectric technology can boost energy consumption efficiency by converting some of the waste heat into useful electricity. Heat-to-power conversion efficiency optimization is mainly achieved by decreasing the thermal conductivity in many materials. A team of researchers in the US (University of Houston, MIT, Morgan State University, Boston College, Lawrence Berkeley National Laboratory) enhanced the power factor by improving the carrier mobility reaching the highest power factor of $\sim 106 \mu\text{W}\cdot\text{cm}-1\cdot\text{K}^{-2}$ at room temperature. This further yields a record output power density in a single-leg device tested between 293 K and 868 K, thus demonstrating the importance of a high power factor for power generation applications. High-output power density can be beneficial for large-scale power generation applications. [TECHNICAL ARTICLE](#)

Tags: Energy, Advanced materials

[Energy storage system of tomorrow](#)

[PhysOrg.com](#), 11NOV2016

Researchers in Germany have developed a marine pumped storage system, when installed at depths of about 600-800 meters upwards, can use the high water pressure in very deep water to store electrical energy with the aid of hollow spheres. To store energy, water is pumped out of the sphere using an electric pump and to generate power, water flows through a turbine into the empty sphere and produces electrical energy via a generator. Storage capacity with the same volume increases linearly with the depth of the water and at 700 meters is about 20 megawatt hours for a 30 m sphere.

Tags: Energy, S&T Germany

ENVIRONMENTAL SCIENCE

[Video: How bacteria make it rain](#)

[PhysOrg.com](#), 10NOV2016

The oceans are covered with a thin film of organic matter and bacteria, many of which launch out of the water and go airborne. But these little particles do more than just take flight—these microbes can actually make it rain. Changes in seawater impact the composition and cloud forming ability

of sea spray aerosols. Ultimately, the goal of researchers' experiments is to provide a more accurate representation of aerosol chemistry in computer climate models.

Tags: Environmental science, Climatology

IMAGING TECHNOLOGY

[Light detector with record-high sensitivity to revolutionize imaging](#)

[Science Daily](#), 14NOV2016

Researchers in Finland have developed a light detector with an external quantum efficiency above 96% over the wavelength range 250–950 nm. Instead of a conventional p–n junction, they use negatively charged alumina to form an inversion layer that generates a collecting junction extending to a depth of 30 μm in n-type silicon. By nanostructuring the photodiode surface, they achieved higher effective charge density, increased charge-carrier concentration in the inversion layer and reliable device response with incident angles up to 70°. The device is expected to improve data quality, reduce the area of photodiodes as well as decrease the cost per pixel. [TECHNICAL ARTICLE](#)

Tags: Imaging technology, S&T Finland

MATERIALS SCIENCE

[Scientists 'scare away' microparticles with laser light](#)

[PhysOrg.com](#), 11NOV2016

An international team of researchers (Germany, Russia) suggests that concentration gradients near a charged solid-liquid interface leads to an unusual phenomenon—a diffusio-osmotic flow, with which it is possible to manipulate particles at a solid-liquid interface. They have shown that by selecting the correct laser wavelength, it is possible to make the particles to move in a desired direction - away from the light spot or to gather toward its center. It was found that diffusio-osmotic flow is very sensitive to water saltiness. In pure water, the velocity increases several times. The technique can be used to pattern a micro- and nanoparticle assembly to specific configurations and sizes at a solid-liquid interface and clear contaminants from surfaces without causing damage. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science

[First random laser made of paper-based ceramics](#)

[Science Daily](#), 10NOV2016

An international team of researchers (Italy, Germany) used conventional laboratory filter paper as a structural

continued...

template impregnating with tetraethyl orthotitanate, an organometallic compound. When it is dried and the cellulose burned off, it leaves behind the ceramic titanium dioxide as residue with strong light scattering effect. The laser is 'random' because the light can also be scattered in the opposite direction. Such materials could be useful as micro-switches or detectors for structural changes. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science, Biomimetics

[Self-healing materials for semi-dry conditions](#) Science Daily, 10NOV2016

Researchers in Japan combined physical and chemical self-healing mechanisms in boronic acid and diols by using polyrotaxane as a backbone structure cross-linked by reversible interactions. The polyrotaxane structure enables stress relaxation in recovery from a shallow dent and the reversible nature of the bonds enables chemical self-healing from a deep cut. The combined approach allowed the materials to recover up to 80% of their strength within 10 minutes (without the combination, the materials could repair only up to 30% of their strength after an hour). The scientists say their materials could be used in a wide variety of applications ranging from external coatings of cars and buildings to medical applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science, S&T Japan

FEATURED RESOURCE

[Data.gov](#)

Data.gov is the home of the US government's open data. You can find Federal, state and local data, tools and resources to conduct research, build apps, design data visualizations, and more. It is an open source.

[Water, water - the two types of liquid water](#) Nanowerk, 10NOV2016

An international team of researchers (UK, Mexico, Spain, USA) found that several physical properties of water, such as dielectric constant or the proton-spin lattice relaxation, seem to flip between two particular characters at around 50 degrees Celsius, give or take 10 degrees. The effect is that thermal expansion, speed of sound and other phenomena switch between two different states at this crossover temperature. These two states could have important implications for studying and using nanoparticles where the character of water at the molecule level becomes important for the thermal and optical properties of such particles. The structure of liquid water can strongly influence the stability of proteins, diseases related to protein misfolding and the food industry.

[TECHNICAL ARTICLE](#)

Tags: Materials science

MICROELECTRONICS

[Computers made of genetic material?](#) Nanowerk, 14NOV2016

In order to produce nanowires, researchers in Germany combined a long single strand of genetic material with shorter DNA segments through the base pairs to form a stable double strand. Using this method, the structures independently take on the desired form. As genetic matter doesn't conduct current well, they placed gold-plated nanoparticles on the DNA wires using chemical bonds. The researchers confirmed that current is conducted through the gold-plated wires—it is, however, dependent on the ambient temperature. In order to improve the conduction, the team aims to incorporate conductive polymers between the gold particles. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, Advanced materials, Biotechnology

[Researchers discover new method to dissipate heat in electronic devices](#) Nanowerk, 10NOV2016

An international team of researchers (USA - UC Riverside, Finland, Republic of Moldova) has demonstrated experimentally that by spatially confining acoustic phonons in nanowires one can change their velocity, and the way they interact with electrons, magnons, and how they carry heat. They used semiconductor nanowires from GaAs and Brillouin-Mandelstam light scattering spectroscopy to study the movement of phonons through the crystalline nanostructures. By changing the size and the shape of the GaAs nanostructures, the researchers were able to alter the energy spectrum of acoustic phonons. Their work creates new opportunities for tuning thermal and electronic properties of semiconductor materials. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Microelectronics

[Engineers develop invisibility cloak for high-tech processing chips](#) PhysOrg.com, 09NOV2016

Photonic-integrated devices need to be adequately spaced apart to prevent signal cross-talk. This fundamentally limits their packing density. Researchers at the University of Utah report the use of nanophotonic cloaking to render neighbouring devices invisible to one another, which allows them to be placed closer together than is otherwise feasible. Devices are broadly complimentary-metal-oxide-semiconductor compatible, have a minimum pitch of 200 nm and can be fabricated with a single lithography step. The nanophotonic cloaks can be generally applied to all passive integrated photonics. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Microelectronics

PHOTONICS

Building a bright future for lasers[Physorg.com](#), 15NOV2016

Two energy levels that are very close together are needed to make terahertz radiation. An international team of researchers (Germany, USA - UCLA) used quantum cascade lasers to produce terahertz photons. They made an artificial surface out of lots of little laser antennas [metal structures that each function like a quantum cascade amplifier]. The net effect is a mirror that reflects terahertz light as it amplifies and focuses it at the same time. They are investigating building cascade lasers using quantum dots which restrict electron motion in all three dimensions. The extra confinement in quantum dots is predicted to drastically reduce how much the electrons scatter, which would allow these lasers to work at room temperature.

Tags: Photonics, Terahertz technology

Carbon nanotubes couple light and matter[Physorg.com](#), 15NOV2016

Organic semiconductors have only limited capacity for charge transport, hence it has not been possible to produce the electrically pumped laser. An international team of researchers (Germany, UK) has succeeded for the first time in demonstrating a strong interaction of light and matter in semiconducting carbon nanotubes. Exciton-polaritons already allow us to vary the wavelength of the light emitted by the carbon nanotubes over a wide range in the near-infrared. The development has applications in telecommunications. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Photonics, Advanced materials

Scientists come up with light-driven motors to power nanorobots of the future[Eurekalert](#), 10NOV2016

An international team of researchers (Ukraine, Taiwan, Russia) has proposed a model nanosized dipole photo-motor based on the phenomenon of light-induced charge redistribution. The motor is activated by a resonant laser pulse, which excites electrons in the cylinder-shaped semiconductor nanocluster causing a separation of charges and giving rise to an electrostatic interaction between the particle and the polar substrate. Subjecting the nanocylinder to periodic resonant laser pulses causes its potential energy in the field of the substrate to vary with time, which in turn enables directed motion. This theory provides a framework for the design of nanomachines, whose motion can be controlled by a laser. They have established the relationship between several model parameters. [TECHNICAL ARTICLE](#)

Tags: Photonics, Energy

QUANTUM SCIENCE

Researchers are a step closer to developing quantum computing[Nanowerk](#), 14NOV2016

An international team of researchers (UK, Italy, USA - Cornell University, France) has shown that large molecules made of nickel and chromium could store and process information in the same way bytes do for everyday digital computers, that it is possible to use supramolecular chemistry to connect “qubits”. They developed algorithms which combine large molecules to create both two qubits and quantum gate. These gates are held together through supramolecular chemistry. Studies of the gates show that quantum information stored in the individual qubits is stored long enough to allow manipulations of the information and hence algorithms. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science

S&T POLICY

Precaution and governance of emerging technologies[Physorg.com](#), 10NOV2016

A team of researchers in the US (Vanderbilt University, Arizona University, North Carolina State University, et al.) expands upon the [NASEM report's](#) recommendations. They argue that targeted measures, as recommended by the report, would not aim to halt research on gene drives but instead would establish conditions under which it can be successful. Precaution can be consistent with support for science, concludes an article. [TECHNICAL ARTICLE](#)

Tags: S&T policy, Science without borders

SCIENCE WITHOUT BORDERS

The Future of Artificial Intelligence and Cybernetics[MIT Technology Review](#), 10NOV2016

It's clear that connecting a human brain with a computer network via an implant could, in the long term, open up the distinct advantages of machine intelligence, communication, and sensing abilities to the individual receiving the implant. Experimental cases indicate how humans—and animals, for that matter—can merge with technology. That, in turn, generates a plethora of social and ethical considerations as well as technical issues. That's why it's vital to include a sense of reflection so that the additional experimentation we'll now witness will be guided by the informed feedback that results.

Tags: Science without borders, Artificial intelligence

2016 R&D 100 Award Winners Unveiled**R&D Magazine, 04NOV2016**

R&D Magazine has announced the Winners of the 54th annual R&D 100 Awards, an international competition that recognizes the 100 most technologically significant products introduced into the marketplace over the past year. The R&D 100 Awards recognize excellence across a wide range of industries, including telecommunications, optics, high-energy physics, materials science, chemistry, and biotechnology.

*Tags: Science without borders***SENSORS****World's First Explosive Detection Drone Unveiled at Israel's HLS & Cyber Event****Defense Update, 15NOV2016**

A company in Israel has developed an explosive detection system called SpectroDrone which detects and analyzes explosives and other hazardous materials, in gas, liquid, powder or bulk form, at a distance of several meters from the threat over an operational radius of up to 3 Km. It uses standoff gated laser spectroscopy techniques, using several laser wavelengths illumination, mainly via UV laser. The payload comprises multiple electro-optical assemblies comprising a laser source emitting several wavelengths, laser range finder and high-resolution camera—all integrated with state of the art spectrometers which operates the software package and proprietary algorithms.

*Tags: Sensors***Spinach as an Infrared Communication Platform****Optics and Photonics News, 10NOV2016**

A team of researchers in the US (MIT, UC Riverside) implanted carbon nanotube sensors designed to detect picric acid—a common nanoparticle in explosives—into the leaves of wild-type spinach plants. It took, on average, 8.3 minutes for the spinach-based sensors to detect picric acid and modify the IR-signal intensity emitted from the leaves. The researchers believe its work could be a step forward in using plants as infrared communication platforms that can send information to a smartphone.

TECHNICAL ARTICLE*Tags: Sensors, Communications technology***Superconducting sensor could detect submarines by the magnetic disturbance of their wake****Next Big Future, 10NOV2016**

Work done in Russia suggests the Debye effect can be turned into something quite potent. In 1990, two contributors to the Soviet military magazine Naval Collection wrote that “as a consequence of the great extent of the

wake, it is easier to detect this anomaly than the magnetic anomaly due to the metallic hull of the submarine.” That suggests that a well-tuned Debye detector might be able to pick up a trail from several kilometers back and follow it to find the submarine. Russia’s claims in this area have long been regarded in the West as exaggerated. The new American interest suggests they might not have been. A new generation of high-tech magnetic sensors based on SQUIDS should be more sensitive than existing ones.

*Tags: Sensors, Military technology***STEM****Hacking a revolution in biology****Physorg.com, 15NOV2016**

A new graduate program at UC San Diego is teaching Ph.D. students how to combine the power of physics and math-based reasoning with practical engineering skills and biology in an effort to unravel the fundamental principles of living systems—principles that will likely encompass concepts reaching well beyond those of traditional biology. These young scientists are to be the foundation of an emerging discipline known as “quantitative biology”—or “qBio.” The goal is to turn biology from a descriptive science into a predictive science, so that in the future we can manipulate biological organisms like the way we currently design airplanes, using wind tunnels and mathematical modeling, instead of just by random trial and error.

*Tags: STEM ■***ABOUT THIS PUBLICATION**

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