



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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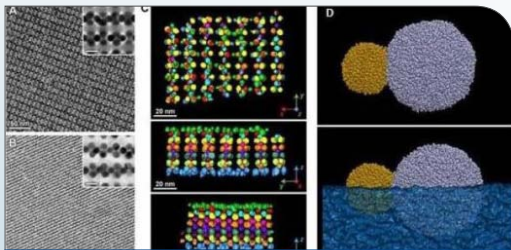
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FEATURE ARTICLES

[New technique produces tunable, nanoporous materials](#)

[Science Daily, 27OCT2017](#)



Left and center: Magnetite- and gold-based nanoparticles self-assemble into lattice-like structures. Right: Individual gold and magnetite based nanoparticles. Credit: Petr Kral

An international team of researchers (Israel, Belgium, Germany, Spain, USA - University of El Paso, University of Illinois at Chicago)

produced thin lattice structures made up of two kinds of nanoparticles: one with a magnetite core and another with a gold core. They developed a technique for chemically etching out one of the two types of nanoparticles from the self-assembled lattice-like structures. The resulting material had tiny, regularly spaced holes. Depending on the type of liquids used in this process, nanoparticles self-assemble into different structures. Based on the known properties of the nanoparticles and the different liquid surfaces they were placed onto, they were able to predict how and why different lattices formed. The nanoporous materials with unique properties can be used to filter molecules or light. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Featured Article

[First close-ups of finger-like growths that trigger battery fires](#)

[Science Daily, 26OCT2017](#)

Using cryo-electron microscopy (cryo-EM), a team of researchers in the US (Stanford University, SLAC National Accelerator Laboratory) captured the first atomic-level images of dendrites which shows that each lithium metal dendrite is a long, beautifully formed six-sided crystal—not the irregular, pitted shape depicted in previous electron microscope shots. They looked at a coating called

SEI, or solid electrolyte interphase, that develops as the dendrite reacts with the surrounding electrolyte. SEI forms on metal electrodes as a battery charges and discharges, and controlling its growth and stability are crucial for efficient battery operation. The ability to see this level of detail for the first time with cryo-EM will give scientists a powerful tool for understanding how batteries and their components work at the most fundamental level. [TECHNICAL ARTICLE](#)

Tags: Energy, Battery, Materials science, Featured Article

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

[Imaging probe printed onto tip of optical fiber](#) [Nanowerk, 30OCT2017](#)

A team of researchers in the US (Lawrence Berkeley National Laboratory, UC Berkeley) developed a technique, called fiber nanoimprinting, to print extremely small devices on the tip of a glass fiber. These devices precisely squeeze and manipulate light in ways that are unachievable by conventional optics. The technique builds tips 30 times faster than today's sculpting approach. The scale-up path is to print many tips instead of sculpting individual tips. Tiny optics could help improve the design of solar cells, pharmaceuticals and semiconductors. The technique opens the door to mass fabrication of nano-optical devices for widespread use. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced manufacturing

ADVANCED MATERIALS

[Nanotube fiber antennas as capable as copper](#) [Nanowerk, 23OCT2017](#)

A team of researchers in the US (Rice University, University of Colorado) developed a metric they called "specific radiation efficiency" to judge how well nanotube fibers radiated signals at the common wireless communication frequencies of 1 and 2.4 gigahertz and compared their results with standard copper antennas. They found the

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fiber antennas matched copper for radiation efficiency at the same frequencies and diameters. Their results support theories that predicted the performance of nanotube antennas would scale with the density and conductivity of the fiber. The antennas may offer practical advantages for aerospace applications and wearable electronics where weight and flexibility are factors. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, Sensors

Scientists discover superconductor with bounce

[Physorg.com](#), 23OCT2017

A team of researchers in the US (University of Connecticut, Drexel University, Iowa State University, Colorado State University) created micropillars of CaFe_2As_2 , not a metallic alloy but an intermetallic more well-known for its novel superconducting properties, and then subjected them to mechanical compression testing. They found a recoverable strain that can exceed 13 percent. The findings offer the possibility of developing cryogenic linear actuation technologies with high precision and high actuation power per unit volume for deep space exploration, and more broadly, suggest a mechanistic path to a class of shape memory materials, ThCr_2Si_2 -structured intermetallic compounds. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

AUTONOMOUS SYSTEMS & ROBOTICS

This AI Technique Was Kept Quiet so Spammers Wouldn't Misuse It

[MIT Technology Review](#), 26OCT2017

A company in the US has published details of a recursive cortical network (RCN) that can generalize beyond what it's initially taught. Taking loose inspiration from neuroscience, an RCN is encoded with assumptions about visual information—like edges or curves—which it then uses to recognize inputs it hasn't encountered in training. The approach is similar to a technique used by researchers from MIT, CMU, and NYU to train a computer to recognize written characters from just one or two examples. It could be used to help robots learn more efficiently. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Autonomous systems & robotics, Artificial intelligence, Emerging technology

BIG DATA

Faster big-data analysis

[MIT News](#), 30OCT2017

As most of the big data is sparse, analytic algorithms end up doing a lot of addition and multiplication by zero. An international team of researchers (USA - MIT, industry, France) has developed a new system called Taco (Tensor algebra compiler). The programmer simply specifies the size of a tensor, whether it's full or sparse, and the location

of the file from which it should import its values. For any given operation on two tensors, Taco builds a hierarchical map that indicates which paired entries from both tensors are nonzero and which entries are paired with zeroes. All pairs of zeroes are discarded. The code offers a 100-fold speedup over existing, non-optimized software packages.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Big data

Best-Ever Algorithm Found for Huge Streams of Data

[Quanta Magazine](#), 24OCT2017

An international team of researchers (USA - Harvard University, Northeastern University, Denmark) has developed a streaming algorithm that works by remembering just enough of what it's seen to tell you what it's seen most frequently. It suggests that compromises that seemed intrinsic to the analysis of streaming data are not actually necessary. It also points the way forward to a new era of strategic forgetting.

Tags: Big data, Information technology

BIOTECHNOLOGY

Mimicking biological process, hydrogel signals and releases proteins

[Science Daily](#), 26OCT2017

Researchers at Pennsylvania State University are studying a novel biomimetic hydrogel system with the ability to recapitulate the procedure of cellular signal transduction and control the sequential release of signaling molecules under physiological conditions. In the presence of a small chemical, the signaling molecule is regulated to change from a DNA-bound state to a free state and the freed signaling molecule is able to regulate intracellular signal transduction and cell migration. Periodic exposure of the hydrogel system to the small chemical leads to sequential protein release. This hydrogel system holds potential as a metabolism-responsive platform for controlled release of signaling molecules and cell regulation in various applications such as, drug delivery, cell regulation, molecular sensing and regenerative medicine. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Biotechnology, Biomimetics

COMMUNICATIONS TECHNOLOGY

'Twisted' light could illuminate new path for wireless communications

[Physorg.com](#), 26OCT2017

An international team of researchers (UK, Germany, New Zealand, Canada, USA - University of Rochester) examined the effects on both the phase and intensity of optical angular momentum carrying light over a real link in an urban environment to assess the viability of these modes of quantum information transfer. The free space link was 1.6km in length and passed over fields and streets and close to high-rise buildings to accurately simulate an urban

continued...

“Engineers use knowledge primarily to design, produce, and operate artifacts. Scientists, by contrast, use knowledge primarily to generate more knowledge.” **WALTER VINCENTI**

environment and atmospheric turbulence that can disrupt information transfer in space. The turbulent atmosphere highlighted the fragility of shaped phase fronts, particularly for high-bandwidth data transfers. Their findings allow researchers to address challenges—not previously observed. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Communications technology

2D semiconductor LED and photodetector advance on-chip optical communications

[Nanotechweb, 23OCT2017](#)

An international team of researchers (USA - MIT, Columbia University, Japan, Spain) made a light-emitting diode based on monolayer or bilayer molybdenum ditelluride that can be integrated onto a silicon waveguide. They have also shown that they can fabricate a high-speed p-n junction photodetector that works at frequencies of up to 200 MHz with a bilayer p-n MoTe₂ junction which can be directly integrated on silicon-based photonic devices. The new results bring us one step closer to high-speed, power-efficient, chip-integrated optical communication devices based on silicon photonics architectures. [TECHNICAL ARTICLE](#)

Tags: Communications technology

CYBER SECURITY

A Bigger, Badder Botnet of Things Has Been Found, and It's Primed to Ravage the Web

[MIT Technology Review, 23OCT2017](#)

Researchers from security firms in China and Israel have published details of a new botnet of things. The new one, called Reaper, is based on the Mirai botnet that caused so much havoc in October 2016. But unlike its predecessor, which simply guessed default passwords of connected devices in order to ensnare them in its network, Reaper uses software exploits to hack into them.

Tags: Cyber security

To Secure the Internet of Things, We Must Build It Out of “Patchable” Hardware

[IEEE Spectrum, 23OCT2017](#)

Security attacks on the IoT can have catastrophic consequences and mass-produced smart devices may simply not have hardware capable of being programmed to resist all the threats that will arise in their lifetimes. A team of researchers in the US (University of Florida, industry) proposes that the various gizmos making up the IoT should be built so that their very hardware can adapt to future security threats. According to the authors, engineers must

permit not just the software but also the hardware to be patchable on devices intended to become part of the IoT because it may not be possible to fix all security vulnerabilities simply by modifying the software. It must work under highly aggressive energy constraints as some wireless devices draw on average just a few microamperes. Their work provides a design that can operate well under such constraints.

Tags: Cyber security

ENERGY

It's Big and Long-Lived, and It Won't Catch Fire: The Vanadium Redox-Flow Battery

[IEEE Spectrum, 26OCT2017](#)

The first redox-flow batteries were developed in the early 1970s at NASA as a possible energy source for deep-space missions. Vanadium redox-flow batteries started out as a modest research project at the PNNL and came together in 2007. The plant opened in early 2017 in the northern Chinese port city of Dalian. It is turning out battery systems for some of the world's largest energy storage installations. It's on target to produce 300 megawatts' worth of batteries by the end of this year, eventually ramping up to 3 gigawatts per year. [Related article](#)

Tags: Energy, Battery, S&T China, S&T Policy

FOREIGN S&T

China claims successful Magnetic submarine and ship propulsion tests

[Next Big Future, 29OCT2017](#)

Permanent magnet propulsion motor technology can replace reduction gears and significantly reduce running sound to the lowest possible level. The Chinese navy is adding a shaftless rim-driven pumpjet, a revolutionary and silent propulsion system, to their newest attack submarine, the Type 095 SSN. Integrated Electrical Propulsion System (IEPS) turns all the output of the ship's engine into electricity. The high electrical output can also be used to power motors for the propellers or potentially high-energy weapons. When coupled with quieter reactors, the rim-driven pumpjet and IEPS can drastically reduce the acoustic signature of any SSN. There has been general acceptance that there is potential benefit for quieter submarines using this technology, but the US has opted for more conventional approaches for quieter submarines.

Tags: Foreign S&T, Military technology, S&T Canada

MATERIALS SCIENCE

Tiny diamonds light the way for new quantum technologies[Physorg.com](#), 31OCT2017

Researchers in Australia have observed, at room-temperature, superradiance from single, highly luminescent diamond nanocrystals with spatial dimensions much smaller than the wavelength of light, and each containing a large number of embedded nitrogen-vacancy centres. When the nitrogen-vacancy centres within the diamond lattice work together you get superradiance. Superradiance has previously only been seen at very low temperatures or in very large samples. This is the first time it's been seen in diamonds at room temperature. Nanodiamonds have the potential to be used in minute compasses for navigation, biomedical imaging and can potentially create better solar cells. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science, S&T Australia

FEATURED RESOURCE

Science Daily RSS Newsfeeds

Science Daily offers more than 400 specific RSS feeds in a variety of topics. Each item contained in a feed includes the story's headline, summary, and link back to the full-text version on the ScienceDaily web site. Feeds are updated with new stories as frequently as every hour.

Making glass invisible: A nanoscience-based disappearing act[Science Daily](#), 30OCT2017

An international team of researchers (USA - Brookhaven National Laboratory, Harvard Medical School, India) used self-assembly of a block copolymer material as a template for etching the glass surface into a "forest" of nanoscale cone-shaped structures with sharp tips. The nanoscale features have the effect of making the refractive index change gradually from that of air to that of glass, thereby avoiding reflections. The glass is antireflective over a broad wavelength range and across a wide range of viewing angles. The amount of light passing through the nanostructured surfaces was above 95%. The new glass could enhance the energy-conversion efficiency of solar cells and could be a promising alternative to the damage-prone antireflective coatings conventionally used in lasers. The technique can be used to nanotexture almost any material. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science***Researchers look to patterns to envision new engineering field**[Nanowerk](#), 26OCT2017

According an international team of researchers (France, USA - University of Illinois at Urbana-Champaign), two-dimensional materials create moire patterns when stacked on top of each other and are skewed, stretched, compressed or twisted. By manipulating the orientation of stacked layers of 2-D thin films like graphene, wires of single-atom thickness can be assembled, building the foundation to write nanocircuitry. The thinner the wire, the faster electrons can travel, meaning this technology has the potential to produce the quickest transmitting wires and circuits possible. Being able to engineer the moire pattern itself is a path to new lightweight and less-intrusive devices that could have applications in the biomedical and space industries. [TECHNICAL ARTICLE](#)

*Tags: Materials science***A new effect in electromagnetism discovered - 150 years later**[Physorg.com](#), 23OCT2017

Researchers at the IBM Watson Research Center, NY, demonstrated a magnetic parallel dipole line (PDL) system that serves as a unique diamagnetic trap with a one-dimensional camelback potential along its longitudinal axis. The system can be realized with a pair of transversely magnetized cylindrical magnets and a cylindrical graphite rod as the trapped object. The camelback potential effect only occurs when the length of the PDL system is beyond certain critical length. The length of the trapped rod determines the effective camelback potential and is subject to maximum and minimum values for the trap to be stable. These characteristics are important for designing the PDL trap system for various sensing applications. [TECHNICAL ARTICLE](#)

Tags: Materials science, Science without borders

MICROELECTRONICS

Deep-depletion: A new concept for MOSFETs[Science Daily](#), 26OCT2017

Diamond is the most ideal material in wide bandgap development. To increase its hole channel carrier mobility, an international team of researchers (France, UK, Japan) incorporated a new approach to solve this problem by using the deep-depletion regime of bulk-boron-doped diamond MOSFETs, increasing the mobility by an order of magnitude. It enables the production of simple diamond MOSFET structures from single boron-doped epilayer stacks. Similar principles of this work could apply to other wide bandgap materials. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Microelectronics

Taming “Wild” Electrons in Graphene**R&D Magazine, 23OCT2017**

The chiral nature of the charge carriers that is responsible for high mobility also makes it difficult to control their motion and prevents electronic switching. An international team of researchers (USA - Rutgers University, UT Austin, Belgium, Japan) created voltage through a high-tech microscope with an extremely sharp tip about the size of an atom. The sharp tip created a force field that traps electrons in graphene or modifies their trajectories, similar to the effect a lens has on light rays. Electrons can be trapped without creating holes in the graphene, and released providing an efficient on-off switching mechanism. The research paves the way for nano-scale transistors, ultra-fast amplifiers, supercapacitors and ultra-low resistivity wires. **TECHNICAL ARTICLE**

*Tags: Microelectronics, Advanced materials***NEUROSCIENCE****Novel technology provides powerful new means for studying neural circuits****Science Daily, 26OCT2017**

A Brown University-developed technology called “trans-Tango” allows scientists to exploit the connections between pairs of neurons to find out which neurons are connected with which others and how they act together. It has the potential to enable scientists to control circuit functions. A team of researchers in the US (Stanford University, Harvard Medical School, Columbia University) has demonstrated circuit tracing and the possibility of manipulations such as activating or shutting off connected neurons. They are working on developing applications to manipulate behavior. **TECHNICAL ARTICLE**

*Tags: Neuroscience***Researchers demonstrate ‘mind-reading’ brain-decoding tech****Medical Express, 23OCT2017**

Researchers at Purdue University used the fMRI data from subjects watching video clips to train the convolutional neural network model to predict the activity in the brain’s visual cortex while the subjects were watching the videos. Then they used the model to decode fMRI data from the subjects to reconstruct the videos, even ones the model had never watched before. The model was able to accurately decode the fMRI data into specific image categories. They were also able to use models trained with data from one human subject to predict and decode the brain activity of a different human subject, a process called cross-subject encoding and decoding. **TECHNICAL ARTICLE**

*Tags: Neuroscience***PHOTONICS****Guiding the random laser****Science Daily, 27OCT2017**

Random lasers perform using a pump, a highly-disordered gain medium but no optical cavity. A team of researchers in the US (University of New Mexico, UC San Diego, Clemson University) used Anderson localizing optical fiber, made of a ‘satin quartz’, to develop a device that has all the qualities of a random laser, plus spectral stability and it is highly directional. When pulled into long rods, the porous material forms dozens of microscopic air channels in each fiber that controls the laser. Once filled with a gain medium and pumped using a single-colored green laser, the random laser becomes less random and highly controllable. A laser signal with very low spatial coherence can be of practical importance in many optical platforms including image transport with fiber bundles and biomedical imaging. **OPEN ACCESS TECHNICAL ARTICLE**

*Tags: Photonics***And suddenly, the dam broke, letting the grains of light gush forth...****Physorg.com, 26OCT2017**

An international team of researchers (France, Italy) has shown that the tiny drops of water trapped behind the dam behave like grains of light of a laser beam when they propagate in an optical fibre. To mimic the rupture of a dam in an optical fibre, they injected laser beams into a fibre. Laser’s variations in intensity versus time corresponds to the difference in water levels located upstream and downstream of the dam. The sudden transition between the two intensities gradually and inextricably evolves towards a smoother transition. The dam is broken! **TECHNICAL ARTICLE**

*Tags: Photonics***Reflecting light off satellite backs up Wheeler’s quantum theory thought experiment****Physorg.com, 26OCT2017**

In the 1970s, Johan Wheeler wondered if it is possible that light could somehow choose to behave as a wave or a particle depending on what scientists did in trying to measure it. Researchers in Italy demonstrated Wheeler’s idea testing wave-particle duality by measuring light bounced from a satellite back to Earth. They report that the light behaved just as Wheeler had predicted - demonstrating either particle-like or wave-like behavior, depending on the behavior of those studying it. **OPEN ACCESS TECHNICAL ARTICLE**

Tags: Photonics, S&T Italy

QUANTUM SCIENCE

Lens trick doubles odds for quantum interaction

Science Daily, 31OCT2017

Researchers in Singapore used a super-resolution imaging technique, 4Pi microscopy, to efficiently couple light to a single atom. They observed 36.63% extinction of the incident field, and modified photon statistics of the transmitted field—indicating nonlinear interaction at the single-photon level. The results pave the way to few-photon nonlinear optics with individual atoms in free space, quantum computing and metrology. [OPEN ACCESS](#)

TECHNICAL ARTICLE

Tags: Quantum science

Nanomagnets levitate thanks to quantum physics

Science Daily, 27OCT2017

An international team of researchers (Austria, Germany) has shown that electron spin allows the stable levitation of a single nanomagnet in a static magnetic field, which should be impossible according to the classic Earnshaw theorem. Through comprehensive stability analyses depending on the object's radius and the strength of the external magnetic field, they showed that, in the absence of dissipation, a state of equilibrium appears. This mechanism relies on the gyromagnetic effect: Upon a change in direction of the magnetic field, an angular momentum occurs. They also showed that the equilibrium state of magnetically levitated nanomagnets exhibits entanglement of its degrees of freedom. Levitated nanomagnets are also of high interest for technical applications, for example for developing high precision sensors. The findings could open new fields of research. [TECHNICAL ARTICLE](#)

Tags: Quantum science, Materials science

S&T POLICY

Fast, tiny, stealthy manned and unmanned tanks

Next Big Future, 29OCT2017

DARPA's Ground X-Vehicle Technology program (GXV-T) seeks to investigate revolutionary ground-vehicle technologies to simultaneously improve mobility and survivability through means other than adding more armor, including avoiding detection, engagement, and hits by autonomously avoiding inbound threats. Four technical areas where advanced technologies could be developed to meet the program objectives are: Radically Enhanced Mobility, Survivability through Agility, Crew Augmentation, Signature Management.

Tags: S&T policy, Government S&T, Military technology

Creating the engineer of 2020: Innovation at Eindhoven University of Technology

Eurekalert, 27OCT2017

Eindhoven University of Technology in the Netherlands redesigned its entire undergraduate program elaborating on a series of three courses on patents and standards. They found that the program redesign led to an almost 50% rise in intake. The efforts to increase workload while maintaining student satisfaction levels eventually proved to be successful. It provided increased opportunities for students and a valuable model for other universities.

TECHNICAL ARTICLE

Tags: S&T policy, Science without borders

Why Artificial Intelligence Should Be More Canadian

MIT Technology Review, 16OCT2017

Canada has produced several big breakthroughs in artificial intelligence in recent years, and its government is keen to establish the country as a global epicenter of AI. Both deep reinforcement learning and deep neural networks, which the method exploits, were pioneered by researchers working at Canadian universities. The country's government is now investing in big efforts to spur more AI research. Google, DeepMind, Facebook and others have also opened research centers in Toronto, Montreal, Alberta, and elsewhere in the country. Canadian culture might offer the right guidance for the technology's development and concerns about the technology's path, including ethical risks and unknown consequences.

Tags: S&T policy, Artificial intelligence, S&T Canada

SENSORS

How to store information in your clothes invisibly, without electronics

University of Washington, 31OCT2017

Researchers at the University of Washington manipulated the polarity of magnetized fabric and encoded different forms of data including 2D images and bit strings. The bits could be read by swiping a commodity smartphone across the fabric, using its inbuilt magnetometer. The results showed that magnetized fabric retained its data even after washing, drying and ironing. Using a glove made of magnetized fabric, they could perform six gestures in front of a smartphone, with a classification accuracy of 90.1%. Using magnetized thread, they created fashion accessories like necklaces, ties, wristbands and belts with data storage capabilities and authentication applications. [OPEN ACCESS](#)

TECHNICAL ARTICLE

Tags: Sensors, Flexible electronics ■

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