



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

[Advanced materials \(5\)](#)

[Big data \(2\)](#)

[Biotechnology \(3\)](#)

[Communications technology \(2\)](#)

[Cyber security \(2\)](#)

[Energy \(2\)](#)

[Environmental science \(1\)](#)

[Information technology \(1\)](#)

[Materials science \(1\)](#)

[Microelectronics \(1\)](#)

[Photonics \(2\)](#)

[Quantum science \(1\)](#)

[S&T policy \(3\)](#)

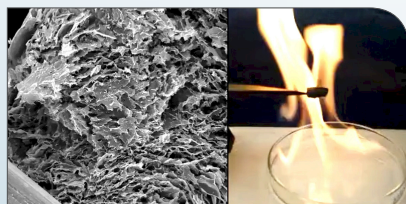
[Science without borders \(2\)](#)

[Sensors \(4\)](#)

FEATURE ARTICLES

[Super-light graphene and ceramic metamaterial possesses high strength, other attributes](#)

[Physorg.com, 10AUG2017](#)



A new composite material combines ultra-lightweight with flame-resistance, super-elasticity and other attributes that could make it ideal for various applications.
Credit: Purdue University

An international team of researchers (China, USA - Kansas State University, Purdue University, Arizona State University, Wright-Patterson Air Force Base) has fabricated a composite combining nanolayers of aluminum oxide and graphene. It has a honeycomb microstructure that provides super-elasticity and structural robustness. The light weight, high-strength and shock-absorbing properties could make the composite a good substrate material for flexible electronic devices and “large strain sensors.” Because it has high electrical conductivity, yet it is an excellent thermal insulator, it might be used as a flame-retardant, thermally insulating coating, as well as sensors and devices that convert heat into electricity. **TECHNICAL ARTICLE**

Tags: Advanced materials, Featured Article

[Breakthrough device heals organs with a single touch](#)

[Science Daily, 08AUG2017](#)

Researchers at Ohio State University have developed a new technology, Tissue Nanotransfection (TNT), that can generate any cell type of interest for treatment within the patient’s own body. TNT approach is to topically reprogram tissues through a nano-channelled device validated with well-established and newly developed reprogramming models of induced neurons and endothelium, respectively. They demonstrated the technique in mice and pigs by reprogramming the skin cells to become vascular cells in badly injured legs and healing the leg by the second week. TNT doesn’t require any laboratory-based procedures, it

can be implemented at the point of care and it is non-invasive. **TECHNICAL ARTICLE**

Tags: Biotechnology, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Two-Dimensional Versions of High-K Materials Offer New Future for Chips](#)

[IEEE Spectrum, 11AUG2017](#)

A team of researchers in the US (Stanford University, SLAC) has found that hafnium selenide and zirconium selenide possess the same perfect band gap seen in silicon when they are thinned down to two-dimensional materials. The combination can be shrunk down ten times smaller. According to the researchers, with these 2D materials, the shortest transistors would be about ten times smaller than what is possible with silicon.

TECHNICAL ARTICLE

Tags: Advanced materials

[Scalable nanowire photonic crystals](#)

[Nanowerk, 09AUG2017](#)

An international team of researchers (Canada, USA - University of Michigan, South Korea) has demonstrated that the bottom-up synthesis of InGaN nanowire photonic crystals with precisely controlled size, spacing, and morphology using epitaxy can minimize defects and dislocations. The crystals exhibited remarkable stable emission compared to conventional InGaN light emitters. The luminescence emission, in terms of both the peak position and spectral linewidths remained virtually invariant in the temperature range of 5–300 K and under excitation densities of 29 W cm⁻² to 17.5 kW cm⁻². According to the researchers, with their unique characteristics the bottom-up GaN nanowire photonic crystals are well suited for ultrahigh-efficiency, large-area LED and laser devices, as well as integrated nanophotonic circuits in the ultraviolet and visible spectral range.

TECHNICAL ARTICLE

Tags: Advanced materials, Microelectronics, Photonics

continued...

[BACK TO TOP](#)

New solid nanomaterial lubricant shown to reduce friction and wear on steel surfaces

Nanowerk, 08AUG2017

An international team of researchers (USA, Purdue University, industry partner, Sweden) made nanosize zinc-oxide particles lubricant from a slurry of graphene, zinc oxide and polyvinylidene difluoride. It has superior thermal conductivity, high strength and provides ultralow friction. Zinc adheres graphene to the contact interface, maintaining improved tribological performance under high contact pressure. In tests, it demonstrated substantial friction and wear reduction compared to unlubricated sliding. The durability and resilience of this adhesive coating suggest exceptional potential as a dry lubricant for high load-bearing applications. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

Photonic nanostructures by design

Nanotechweb, 07AUG2017

Quasi-random photonic nanostructured surfaces are ideal for optoelectronics applications. Researchers at Northwestern University used “wrinkle lithography” and computer-based calculations to make these structures in amorphous silicon at the wafer scale which strongly absorb light in the middle-wavelength range of the solar spectrum. The new manufacturing procedure can transfer polymer wrinkle patterns onto different materials to produce a nearly unlimited number of quasi-random nanostructures. They are testing their model in other materials. Using the technique, surfaces can be designed for specific applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

BIG DATA

Building a More Logical Data Warehouse with a Data Vault

Inside Big Data, 14AUG2017

The article discusses the rise of the data vault as a database modeling method that provides long-term historical storage of data from multiple operational systems and enables users to look at historical data and trace data to determine where it originated. It treats the problem of data warehousing as two issues: data collection and data use. It is essentially a different way of modeling content and its relationships to data. Rather than forcing all data into a unified model based on user needs, a data vault alters the unified model to allow information to be collected and loaded easily. While there are some structural changes to capture keys and relationships, the data values themselves are not touched.

Tags: *Big data*

Artificial Intelligence Should Not Be Left Unsupervised

Inside Big Data, 10AUG2017

According to the author, the benefits of AI cannot be denied but there is a cost associated to adopting it. The real problem with AI is the lack of human interaction. Some of the dangers are it could outsmart markets and human researchers and can end up creating weapons humans could not possibly understand and it could lead to an existential threat for humanity without regulation.

Tags: *Big data, Artificial intelligence*

BIOTECHNOLOGY

A Waveguide Made of Living Cells

Optics and Photonics, 10AUG2017

Researchers using light to explore biological tissues face the problem of scattering in opaque media that limits the light's penetration depth. An international team of researchers (USA - San Francisco State University, Canada, UK, Russia) used the living cells suspended in the medium to create an optical pipe that allows light to penetrate to greater depth. They shone a green laser at moderate power through a suspension containing a common strain of cyanobacteria. The microbes, driven by a combination of nonlinear optical effects, coalesced to form a needle-like waveguide that could transmit the light a distance of four centimeters through seawater. The bacteria survived their laser-light bath. The research has possible applications in biology and medicine. [TECHNICAL ARTICLE](#)

Tags: *Biotechnology, Photonics*

Scientists use gene editing to eliminate viruses in live pigs

Science Daily, 10AUG2017

Gene editing techniques could prove useful for removing virus genes from the pig genome, paving the way for pig-to-human transplants, yet efforts have so far only been successfully demonstrated in cell lines, not live animals. An international team of researchers (USA - Harvard University, industry partner, China, Denmark) has demonstrated the feat in live animals. They edited the pig genome to deactivate a family of retroviruses. The results hold important implications for transplant medicine in humans. [TECHNICAL ARTICLE](#)

Tags: *Biotechnology, Synthetic biology*

COMMUNICATIONS TECHNOLOGY

First data transmission through terahertz multiplexer: 100 times faster than today's best

Science Daily, 10AUG2017

Because of the nature of terahertz waves, signals in terahertz communications networks will propagate as directional beams, not omnidirectional broadcasts as in

“It is the responsibility of scientists never to suppress knowledge, no matter how awkward that knowledge is.” **CARL SAGAN**

existing wireless systems. A user at a particular location (and therefore at a particular angle from the multiplexing system) will communicate on a particular frequency. Based on this principle, a team of researchers in the US (MIT, Georgia Institute of Technology) built a multiplexer and transmitted two video signals error-free at a rate of 10 gigabits per second. According to the researchers, with further refinement the transmission rate could reach 50 gigabits per second. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Communications technology

[New technique to suppress sound waves from disorder to improve optical fiber communication](#) Science Daily, 07AUG2017

The transport of sound and heat, in the form of phonons, can be limited by disorder-induced scattering. Most solid-state systems do not have chiral properties, but these properties can be induced through magnetic fields. A team of researchers in the US (University of Illinois at Urbana-Champaign, University of Maryland, NIST) shows that asymmetric optical pumping of a symmetric resonator enables a dramatic chiral cooling of clockwise and counter-clockwise phonons, while simultaneously suppressing the hidden action of disorder. Their technique can potentially improve upon the fundamental thermal limits of resonant mechanical sensors, which cannot be attained through sideband cooling. The result could have a wide-ranging impact on sensors and communication systems. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Communications technology

CYBER SECURITY

[Researchers Embed Malware Into DNA to Hack DNA-Sequencing Software](#) IEEE Spectrum, 10AUG2017

To demonstrate how a strand of DNA can be used to wield an attack, researchers at the University of Washington used a two-bit encoding scheme to synthesize DNA to target the software program FASTQ which is commonly used to read and compress DNA. Their exploit triggered a buffer overflow when the FASTQ program tried to read the 176 base pairs on their strand. A portion of the code also granted the team remote control of the sequencing machine's computer and later caused it to crash. One way to keep this exploit from wreaking havoc would be to improve the security of the software that could be targeted by such attacks. However, these programs are often written in labs by research scientists who are not necessarily versed in the latest computer security practices. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Cyber security, Biotechnology

[Harnessing Autonomy for Countering Cyberadversary Systems \(HACCS\)](#)

DARPA, 03AUG2017

The HACCS program will investigate the feasibility of creating safe and reliable autonomous software agents that can effectively counter malicious botnet implants and similar large-scale malware. The program will do so by developing a quantitative framework and established parameters for their safe, reliable, and effective use. HACCS performers will develop the techniques and algorithms necessary to measure the accuracy of identifying botnet-infected networks, the accuracy of identifying the type of devices residing in a network, and the stability of potential access vectors. [BAA](#)

Tags: Cyber security, DARPA

ENERGY

[New technique creates long carbon nanotubes out of thin air](#)

Nanotechweb, 10AUG2017

To decrease the concentration of atmospheric CO₂ researchers at George Washington University have developed a low-energy, facile process, called “C2CNT”. They synthesized CNTs using a system comprising a molten lithium carbonate electrolyte, a Nichrome anode, a nickel-copper alloy cathode, and CO₂ as the only reactant. It yields CNT “wools” that can be woven into composites and textiles. The sole feedstock in the C2CNT process is CO₂ which can be obtained from atmospheric or industrial sources. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Advanced materials

[New battery is activated by your spit](#)

Science Daily, 08AUG2017

Researchers at SUNY Binghamton created a high-performance, paper-based, bacteria-powered battery by building microbial fuel cells with inactive, freeze-dried exoelectrogenic cells. Within minutes of adding saliva to the cells, the battery generates power. The battery generated power from one drop of saliva could be used by POC diagnostic platforms. Power density is a few microwatts per centimeter square. [TECHNICAL ARTICLE](#)

Tags: Energy, Biotechnology

[Super-heatwaves of 55 °C to emerge if global warming continues](#)

Science Daily, 09AUG2017

The European Commission's Joint Research Centre's study analyses changes in yearly probability for high humidity heatwaves since 1979 under different global warming scenarios to estimate the magnitude and impact of heat waves. An international team of researchers (Italy, Norway, the Netherlands) reports that if global temperatures rise by 4°C, a new super-heatwave will appear with apparent temperature peaking at above 55°C - a level critical for human survival. It will affect densely populated areas such as USA's East coast, coastal China, large parts of India and South America. Under this global warming scenario Europe is likely to suffer annual heatwaves with apparent temperature of above 40°C regularly while some regions of Eastern Europe may be hit by heatwaves of above 55°C. Researchers recommend urgent mitigation and adaptation action to address the impacts of heatwaves, and new adaptation measures might be necessary to cope with heat stress. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

Tags: *Environmental science, Climatology*

FEATURED RESOURCE

[Futurism](#)

Futurism covers breakthrough technologies and scientific discoveries that will shape humanity's future.

INFORMATION TECHNOLOGY

[A new tool for multilayer networks](#)

Physorg.com, 11AUG2017

A network may have many layers—corresponding to different types of relationships in a social network. Researchers at the Santa Fe Institute have developed an algorithm that identifies relationships not only within individual layers, but also across multiple layers and it can also predict missing information. In tests, the model successfully predicted missing connections in the data both within and between the layers. [TECHNICAL ARTICLE](#)

Tags: *Information technology*

MATERIALS SCIENCE

[Vapor harvesting gets the edge](#)

Nanowerk, 13AUG2017

An international team of researchers (Saudi Arabia, China) aims to improve the efficiency of collection methods for water harvesting through considering the influence of attributes of different surfaces, including wettability and edge effect. They found that variation in the edge of the surface structures significantly affects water-droplet formation, and that rough-edged structures mimicking those found in nature are highly effective. They plan to use solar energy to evaporate seawater and wastewater to condense them into purified water. [TECHNICAL ARTICLE](#)

Tags: *Materials science*

MICROELECTRONICS

[Making an ultra-small silicon 'chip'](#)

Nanowerk, 08AUG2017

A team of researchers in the US (Johns Hopkins University, UMass at Amherst) propose a new synthetic chemistry approach which produces ultra-small materials that resemble a fragment of the semiconductor silicon. The process uses a precisely defined pattern of reactive sites (chemical hooks). The hooks control the structure as the material, a polymer, grows. Being able to create small pieces of silicon-like materials may make it easier to manufacture designer electronic circuits with properties tuned for specific uses. The research provides a synthetic chemical route to new forms of silicon-like materials. The resulting materials could be used in solar cells and computers.

[TECHNICAL ARTICLE](#)

Tags: *Microelectronics, Advanced materials*

PHOTONICS

[Single photons set for telecom wavelengths](#)

Physics World, 10AUG2017

By shining laser light at carbon nanotubes containing special defects, an international team of researchers (USA - Los Alamos National Laboratory, NERL, Rice University, Japan) has developed a technique to deliver single photons at room temperature and at wavelengths suited to the telecommunications industry. The technique allows the researchers to tune the light emitted by the nanotubes across a range of infrared wavelengths. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

Tags: *Photonics*

[Record for fastest light pulse set](#)

Science Daily, 07AUG2017

An international team of researchers (University of Central Florida, China) has demonstrated a 53-attosecond X-ray flash which is also shorter in wavelength. The new light reaches an important spectral region, called "water window," where carbon atoms absorb strongly, but water does not. The capability is invaluable for the development of

continued...

next-generation logic and memory chips for mobile phones and computers that are a thousand times faster than those in use today. It has applications in biology to study living cells and understanding photosynthesis to improve harvesting solar energy. [OPEN ACCESS TECHNICAL ARTICLE](#).
 Tags: *Photonics*

QUANTUM SCIENCE

[Blind quantum computing for everyone](#)

[Physorg.com](#), 11AUG2017

In blind computing, the quantum servers do not have full information about the tasks they are computing, which ensures that the clients' computing tasks are kept secure. Until now, blind quantum computing required clients to have their own quantum devices to delegate tasks for blind quantum computing. An international team of researchers (China, Canada) has implemented a proof-of-principle experiment for completely classical clients. Via classically interacting with two quantum servers that share entanglement, the client accomplished the task. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science*

S&T POLICY

[Disruptioneering: Streamlining the Process of Scientific Discovery](#)

[DARPA](#), 11AUG2017

DARPA's Defense Sciences Office announced the first programs under its new Disruptioneering effort which pushes for faster identification and exploration of bold and risky ideas with the goal of accelerating scientific discovery. Fundamental Design (FUN DESIGN) aims to investigate new fundamental computational and mathematical building blocks for representing novel and optimized designs of mechanical systems. Imaging Through Almost Anything, Anywhere (ITA3) seeks to determine the 3-D resolution/range trade space based on the use of all-pervasive low-frequency, electromagnetic waves, combined with simple computational methods to consider the challenge of imaging through metal containers, walls, ground, fog, water, and other complex media. [BAA](#)

Tags: *S&T policy, DARPA, Government S&T*

[The Future Role of A.I. in the Military](#)

[R&D Magazine](#), 10AUG2017

A recent [report](#) from the Harvard's Belfer Center for Science and International Affairs states that advancements in the last five years have made it possible for the U.S. military to expand its use of A.I. in the near future— but only if certain questions are addressed first. The authors propose three goals for developing future policy on A.I. and national security: preserving U.S. technological leadership, supporting peaceful and commercial use and mitigating catastrophic risk. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *S&T policy, Artificial intelligence*

[Will computational advances help stealth survive digital air defenses?](#)

[Defense Systems](#), 07AUG2017

The Mitchell Institute [study](#) analyzes the impact of digital age improvements, looking at how technology influences both the cost and the pace of improvements to stealth aircraft design. It examines the role of “computational power” in the evolution of stealth technology and its long-term viability. The improvements to radar are counterbalanced by the impact of that same digital technology on stealth aircraft design and the dynamic between offensive and defensive capabilities.

Tags: *S&T policy, Military technology*

SCIENCE WITHOUT BORDERS

[The Thorny Question of Whether Humans Can Observe Single Photons](#)

[MIT Technology Review](#), 08AUG2017

The controversy over whether the human eye can detect single photons has profound significance for the way we will develop future sensors and related technologies. Technologies developed so far cannot yet clearly say whether humans can observe single photons. The energy of a single photon is almost unimaginably small. The ability to detect such a small amount of energy would reveal just how powerful biological senses can be, even in warm wet environments. Whatever the limit turns out to be, expect significant technological advances as a result. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Science without borders, Photonics*

[Half of papers searched for online are free to read](#)

[Nature News](#), 07AUG2017

A [study](#) examined reader data from a web-browser extension [Unpaywall](#), analyzed server logs of 100,000 papers that Unpaywall users tried to access during one week in June, and found that 47% of accessed studies were legally available to read for free somewhere on the web. Around half the content being accessed was published in the past two years. [RELATED ARTICLE](#)

Tags: *Science without borders*

SENSORS

[All-carbon humidity sensor handwritten on paper](#)

[Nanowerk](#), 10AUG2017

Researchers in China designed a humidity sensor by handwriting electrodes and the sensitive materials (o-MWCNTs) on paper substrates. The marker was fabricated by injecting the ink (aqueous dispersion of o-MWCNTs) in the refill of a blank marker. o-MWCNTs exhibited good stability and excellent dispersibility in water. The device provides increased contact area between

the sensitive material and water molecules; the top layer of hydrophilic cellulose paper could enhance the response of the humidity sensor. The device is flexible, disposable, and potentially wearable. [TECHNICAL ARTICLE](#)

Tags: Sensors, S&T China

[Two ways to improve optical sensing using different resonator techniques](#)

[Physorg.com, 10AUG2017](#)

Two international teams of researchers (USA - Washington University, University of Central Florida, Michigan Technological University, Germany) used different techniques to couple two or more modes of light such that their modes and their corresponding frequencies coalesce, resulting in more sensitivity. One group connected three traditional sensors for more precise tuning and the other used just one resonator but coupled light traveling in both directions around it. Both teams overcame the limitation imposed by the strength of the perturbations under study by coupling modes of light, allowing them to coalesce resulting in increased sensitivity. [TECHNICAL ARTICLE 1, 2](#)

Tags: Sensors, Photonics

[Spinning diamonds for quantum precision](#)

[Physorg.com, 08AUG2017](#)

Researchers in Australia used the NV center in diamond as a sensor. They rotated the frame rapidly to suppress the noise created by carbon-13 spins and preserve the longevity of the quantum state to determine the ideal pseudo field. The technique could be used to improve the precision of quantum MRI scanners and answer fundamental questions in physics. [TECHNICAL ARTICLE](#)

Tags: Sensors, Quantum science, S&T Australia

[Invisibility cloak takes one step closer to revealing itself](#)

[Physorg.com, 07AUG2017](#)

Existing invisibility cloaks using metamaterials struggle to bend light that is visible to the naked eye and they have a tendency to absorb part of the light that shines through them. An international team of researchers (Greece, France) is addressing these problems by coating flat lenses with skin-thin layers of gallium nitride increasing the optical transmission of the flat lenses from 60 % to almost 90 %, and investigating whether gallium nitride can replace the remaining losses by emitting light of its own.

Tags: Sensors, S&T EU ■

ABOUT THIS PUBLICATION

The appearance of external hyperlinks in this publication does not constitute endorsement by the United States Department of Defense (DoD) of the linked web sites, nor the information, products or services contained therein. In addition, the content featured does not necessarily reflect DoD's views or priorities.

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

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

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