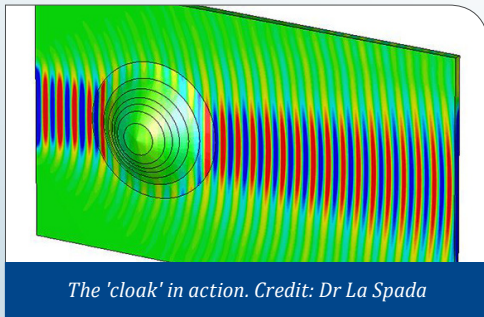


[Advanced manufacturing \(2\)](#)[Advanced materials \(5\)](#)[Autonomous systems & robotics \(2\)](#)[Biotechnology \(1\)](#)[Communications technology \(2\)](#)[Cyber security \(1\)](#)[Energy \(1\)](#)[Imaging technology \(1\)](#)[Information technology \(1\)](#)[Materials science \(3\)](#)[Neuroscience \(1\)](#)[Photonics \(5\)](#)[Quantum science \(2\)](#)[Science without borders \(3\)](#)[Sensors \(2\)](#)

## FEATURE ARTICLES

### [Scientists move one step closer to creating an invisibility cloak](#)

Science Daily, 15JUL2016



The 'cloak' in action. Credit: Dr La Spada

Researchers in the UK coated a curved surface with a nanocomposite medium, which has seven distinct layers where the electric property of each layer varies depending on its position. The effect is to 'cloak' the object. The underlying design approach has much wider applications, ranging from microwave to optics for the control of any kind of electromagnetic surface waves. It could allow for antennas in different shapes and sizes to be attached in awkward places and a wide variety of materials. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors, S&T UK, Featured Article

### [Researchers report cybersecurity risks in 3-D printing](#)

Science Daily, 13JUL2016

An international team of researchers (USA - New York University, UT Dallas, United Arab Emirates) examined two aspects of 3D printing that have cybersecurity implications: printing orientation and insertion of fine defects. The researchers reported that the orientation of the product during printing could make as much as a 25 percent difference in its strength. However, since CAD files do not give instructions for printer head orientation, malefactors could deliberately alter the process without detection. New cybersecurity methods and tools are required to protect critical parts from such compromise. [TECHNICAL ARTICLE](#)

Tags: Advanced manufacturing, Cyber security, Featured Article

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

[Additive manufacturing techniques featuring atomic precision could one day create materials with Legos flexibility and Terminator toughness](#)

Science Daily, 12JUL2016

A team of researchers in the US (Oak Ridge National Laboratory, University of Tennessee) provides an overview of existing paths to 3-D materials. The ultimate goal is to create and customize materials at the atomic scale. Being able to assemble matter atom by atom in 3-D will enable us to design materials that are stronger and lighter, more robust in extreme environments and provide economical solutions for energy, chemistry and informatics. [TECHNICAL ARTICLE](#)

Tags: Advanced manufacturing, Government S&T

### ADVANCED MATERIALS

[Tiny transformers: Chemists create microscopic and malleable building block](#)

Science Daily, 18JUL2016

An international team of researchers (USA - New York University, South Korea) discovered that metallic particles encased in oil droplets were tethered by many chemical bonds. Breaking those tethers via a photocatalytic reaction caused the metallic particle to free itself, producing an overall shape change. With the ability to change their contours, these particles mimic alterations that occur in nature. The microscopic self-assembling particles can serve as the next generation of building blocks in the creation of synthetic materials. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials

[Chinese researchers have an improved aircraft engine alloy](#)

Next Big Future, 15JUL2016

Researchers in China report that Ti-45Al-8Nb single crystals with controlled lamellar orientations can be fabricated by directional solidification without the use

*continued...*

[BACK TO TOP](#)

of complex seeding methods. At 900 °C, yield strength remains high at 637 MPa, with 8.1% ductility and superior creep resistance. The alloy could provide expanded opportunities for higher-temperature applications such as in aeronautics and aerospace. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T China*

### [Graphene sheets tear themselves to ribbons](#)

[Nature News, 13JUL2016](#)

Researchers in Ireland report that puncturing a hole in graphene with a diamond tip and repeatedly moving that tip back and forth—rather like rucking up a carpet—causes narrow strips of carbon to curl spontaneously upwards, tearing out of the graphene layer and even folding back on themselves. If the researchers can use multiple diamond tips in different shapes and further control the process, one can envision forming a pre-designed ribbon network ready to serve as electrodes in a specific circuitry of a future device. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### [Invisible particles ‘seen’ for the first time](#)

[Nanowerk, 13JUL2016](#)

An anapole is a distribution of charges and currents that does not radiate or interact with external electromagnetic fields. An international team of researchers (Australia, Germany, Russia, Singapore) theoretically predicted the existence of anapoles in nanoparticles; they created them at visible wavelengths in silicon nanodisks. When the nanoparticle is excited by anapole light excitation, it does not scatter the light since it concentrates the energy at close distances and is invisible at long distances. It could be useful for the design of novel nanolasers. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### [Engineered ‘sand’ may help cool electronic devices](#)

[Science Daily, 12JUL2016](#)

A team of researchers in the US (Georgia Institute of Technology, Howard University) has shown for the first time that you can take a packed nanoparticle bed that would typically act as an insulator, and by causing light to couple strongly into the material by engineering a high dielectric constant medium like water or ethylene glycol at the surfaces, you can turn the nanoparticle bed into a conductor. Using the collective surface electromagnetic effect of the nanoparticles, the thermal conductivity can increase 20-fold, allowing it to dissipate heat. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

## AUTONOMOUS SYSTEMS & ROBOTICS

### [Oxbotica’s New Autonomous Vehicle Software Learns As It Goes](#)

[MIT Technology Review, 15JUL2016](#)

A company in the UK developed a system, called Selenium, that can ingest data from visual cameras, laser scanners, or radar systems. It then uses a series of algorithms to establish where the “it” is, what surrounds it, and how to move. It takes any vehicle and makes it into an autonomous vehicle. The company plans for the software to be used to control not just autonomous cars, but warehouse robots, forklifts, and self-driving public transport vehicles.

*Tags: Autonomous systems & robotics, Artificial intelligence, S&T UK*

### [Video Friday: Robotic Telepresence, Pepper Helper, and a Long Journey](#)

[IEEE Spectrum, 15JUL2016](#)

This is a demonstration of the EU’s RECONFIG project, which is trying to teach robots how to work together. The project also worked on simple and intuitive visual communication and body language, like having one robot point at something it needs help picking up, which another robot can interpret.

*Tags: Autonomous systems & robotics*

## BIOTECHNOLOGY

### [Augmenting humans with an electroadhesive boost: an ankle exoskeleton charges ahead](#)

[Carnegie Mellon University, 16JUL2016](#)

Researchers at Carnegie Mellon University have developed a sophisticated, functional device that can be used in exoskeletons that compensate for a person’s disability or enhance their athletic performance. The device is three to 30 times lighter than other clutch mechanisms with the same holding force; it consumes 340 to 750 times less energy compared to previous devices; and operates at four to 20 times lower voltage than previous electrostatic components in robots.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Biotechnology*

## COMMUNICATIONS TECHNOLOGY

### [Exploring networks efficiently](#)

[MIT News, 13JUL2016](#)

Biologists have long suspected that ants base their population-density estimates on the frequency with which they bump into other ants while randomly exploring their environments. Researchers at MIT show that beyond offering support for biologists’ suppositions, this theoretical framework also applies to the analysis of social networks, of collective decision making among robot swarms, and of communication in ad hoc networks, such as networks of low-cost sensors scattered in forbidding environments. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Communications technology*

*continued...*



“The greatest enemy of knowledge is not ignorance, it is the illusion of knowledge.”

STEPHEN HAWKING

### **Mobile-phone expansion could disrupt key weather satellites**

Nature News, 12JUL2016

As Hurricane Patricia barreled down on Mexico last October one crucial shot failed to download for NOAA forecasters. The culprit was radio interference from mobile-phone companies. If the mobile-broadband companies are allowed to share a crucial, additional set of frequencies that overlaps with the communications range of NOAA's next generation of GOES satellites, the problem may get worse. Relaying data from 27,000 ground stations including stream gauges, tsunami buoys and seismic stations may also be interrupted. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Communications technology, S&T Policy

### CYBER SECURITY

### **Seven Teams Hack Their Way to the 2016 DARPA Cyber Grand Challenge Final Competition**

DARPA News, 08JUL2016

The Cyber Grand Challenge is designed to speed the development of automated security systems able to defend against cyberattacks as fast as they are launched. The winners successfully squared off against dozens of other teams for the opportunity to compete head to head next year for nearly \$4 million in prizes—and the chance to help revolutionize cybersecurity going forward.

Tags: Cyber security, Government S&T

### ENERGY

### **Electricity generated with water, salt and a 3-atoms-thick membrane**

Science Daily, 13JUL2016

The system, developed by an international team of researchers (Switzerland, USA - University of Illinois at Urbana-Champaign), consists of two liquid-filled compartments separated by a thin membrane made of molybdenum disulfide with a nanopore, through which seawater ions pass into the fresh water until the two fluids' salt concentrations are equal. The membrane allows positively-charged ions to pass through, while pushing away most of the negatively-charged ones creating voltage between the two liquids causing current. According to their calculations, a 1m<sup>2</sup> membrane with 30% of its surface covered by nanopores should be able to produce 1MW of electricity.

[TECHNICAL ARTICLE](#)

Tags: Energy

### IMAGING TECHNOLOGY

### **Researchers generate 3D images using just one photon per pixel (w/video)**

PhysOrg.com, 13JUL2016

An international team of researchers (USA - MIT, Boston University, Italy) has developed an algorithm that can generate high-quality 3D images using a single-photon camera that detects just one signal photon per pixel. The new framework has the highest photon efficiency to date, resulting in visibly better reconstruction accuracy and an order of magnitude better depth resolution. Single-photon cameras have potential applications in low-light conditions, such as biological imaging, astronomy, and providing 3D vision for self-navigating advanced robotic systems, such as unmanned aerial vehicles and exploration rovers.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Imaging technology

### INFORMATION TECHNOLOGY

### **Smallest hard disk to date writes information atom by atom**

Nanowerk, 18JUL2016

An international team of researchers (the Netherlands, Portugal, Spain) built a memory of 1 kilobyte (8,000 bits), where each bit is represented by the position of one single chlorine atom. They reached a storage density of 500 Terabits per square inch, 500 times better than the best commercial hard disk currently available. [TECHNICAL ARTICLE](#)

Tags: Information technology

### MATERIALS SCIENCE

### **Researchers use acoustic voxels to embed sound with data**

Science Daily, 18JUL2016

A team of researchers in the US (Columbia University, MIT, industry partner) has developed a method to control sound waves, using a computational approach to inversely design acoustic filters that fit within an arbitrary 3-D shape while achieving target sound filtering properties. They designed acoustic voxels, small, hollow, cube-shaped chambers through which sound enters and exits, as a modular system. The research could lead to cloaking and new designs of sonar systems or underwater communication systems. [TECHNICAL ARTICLE](#)

Tags: Materials science

**Pushing a single-molecule switch**

Science Daily, 15JUL2016

An international team of researchers (Germany, Spain, UK, Poland) has demonstrated that an intramolecular hydrogen atom transfer can be triggered in a suitable organic molecule adsorbed on a surface by bringing a sharp metallic tip sufficiently close. The reaction, called tautomerization, is important in organic chemistry and molecular biology and also an interesting phenomenon for molecular electronic devices. Their results also provide a novel strategy to gain a deeper atomistic insight into catalytic reactions, leading to a new control of chemistry at the atomic level. [TECHNICAL ARTICLE](#)

Tags: *Materials science***A new spin on reality**

Science Daily, 14JUL2016

Through computer simulation, researchers in Japan have confirmed the existence of a new kind of spin liquid and explain how it can be predicted and its existence can be corroborated through a neutron scattering experiment. Spin liquid is a magnetic material in which the magnetism of the atoms fluctuates continuously between different directions even at low temperatures. The finding is significant because there is a strong relationship between the mathematical description and gauge symmetry. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

Tags: *Materials science, S&T Japan***FEATURED RESOURCE****Quanta Magazine**

Quanta Magazine is an editorially independent online publication launched by the Simons Foundation to enhance public understanding of science; focuses on developments in mathematics, theoretical physics, theoretical computer science and basic life sciences. [RSS](#)

**NEUROSCIENCE****Using wireless interface, operators control multiple drones by thinking of various tasks**

Science Daily, 13JUL2016

Researchers at Arizona State University have discovered how to control multiple robotic drones using the human brain. A controller wears a skull cap outfitted with 128 electrodes wired to a computer. The device records electrical brain activity. If the controller moves a hand or thinks of something, certain areas light up. A wireless system sends the thought to the robots.

Tags: *Neuroscience***PHOTONICS****Detecting Photons With a Thermometer**

American Physical Society Focus, 15JUL2016

Researchers in Finland built a small electronic circuit that detects microwave photons based on the heat they produce. In a demonstration, the device detected as few as 200 photons, which is 10 times more sensitive than previous thermally based photodetection techniques. Research is pushing the frontiers of sensitivity for thermal detectors.

[TECHNICAL ARTICLE](#)Tags: *Photonics***Study opens new realms of light-matter interaction**

PhysOrg.com, 15JUL2016

Researchers at MIT report that their new approach could cause certain kinds of interactions between light and matter, which would normally take billions of years to happen, to take place instead within billionths of a second, under certain special conditions. The method can enable the simultaneous emission of two photons that are entangled. Such generation of entangled photons is an important element in quantum devices, such as those that might be used for cryptography. [TECHNICAL ARTICLE](#)

Tags: *Photonics***Dense yet transparent materials offer new way to control light**

PhysOrg.com, 14JUL2016

A special class of materials called "hyperuniform materials" made of plastic or glass that contain light-scattering particles spaced in a disordered, but not completely random pattern, can be both dense and transparent. Researchers in France have shown that most of the light waves interfere with each other, stopping all the scattered light except for light traveling in the forward direction through the material as if it were going through a homogeneous material, making the material appear transparent. The wavelengths of light for which the material is transparent depends on the exact characteristics of the material used. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

Tags: *Photonics, Materials science, S&T France***Quantum-confined bandgap narrowing mechanism for light harvesting**

Nanowerk, 14JUL2016

Researchers in Australia report that when TiO<sub>2</sub> particles are mixed with graphene quantum dots, the resulting composite absorbs visible light by a quantum-confined bandgap narrowing mechanism. The bandgap can be tuned by the size of graphene quantum dots. This mechanism may be applicable to all semiconductors. It may allow the design of a new class of composite materials for light harvesting, optoelectronics, high efficiency paintable solar cells and water purification using sun light. [TECHNICAL ARTICLE](#)

Tags: *Photonics, Advanced materials**continued...*

**Light-modified material modifies light**

Nanowerk, 13JUL2013

An international team of researchers (UK, Singapore) used a tightly controlled series of much shorter femto-second optical pulses to set chalcogenide glass into incremental states between completely crystalline and completely disordered states. This technique can even be used to write complex structures like lenses, diffraction gratings, holograms and metamaterials, directly into a phase-change chalcogenide glass film. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Advanced materials*

**QUANTUM SCIENCE****Making Hard Problems for Quantum Computers**

American Physical Society Synopsis, 14JUL2016

Relatively small size quantum annealers do not show a significant improvement over classical counterparts. In the new study, an international team of researchers (USA - University of Southern California, Spain) proposes a way of identifying harder problems so that differences become starker. They have devised an algorithm that starts with a random Ising-type problem and then optimizes the hardness, which is defined by the solution time for a classical computer. The team showed that they could increase the hardness by more than 2 orders of magnitude. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

**Physicists blur the line between classical and quantum physics by connecting chaos and entanglement**

Science Daily, 12JUL2016

A team of researchers in the US (UC Santa Barbara, Boston University) devised an experiment using three quantum bits and manipulating them with electronic pulses causing them to interact, rotate and evolve in the quantum analog of a highly sensitive classical system. The result is a map of entanglement entropy of a qubit that, over time, comes to strongly resemble that of classical dynamics. They conclude that in almost any quantum system, including on quantum computers, if you just let it evolve it is going to thermalize. The study's findings have fundamental implications for quantum computing. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

**SCIENCE WITHOUT BORDERS****How Charles Kao Beat Bell Labs to the Fiber-Optic Revolution**

Science Daily, 15JUL2016

This is the story of how a 1966 milestone paper that set off the entire field of fiber-optic communications came to be a wonderful example of how the key to a big technological breakthrough can come down to asking the right question. [TECHNICAL ARTICLE](#)

*Tags: Science without borders*

**There's a problem with the way that we're ranking scientific journals**

Science Alert, 15JUL2016

In a new study, an international team of researchers (UK, Canada) report that journal impact factors can't truly give an indication of how influential their articles really are. What they found was that up to 75 percent of the articles in any given journal had a much lower citation count than the journal's impact factor. They hope that this analysis helps to expose the exaggerated value attributed to the Journal Impact Factor and strengthens the contention that it is an inappropriate indicator for the evaluation of research or researchers. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Science without borders, Bibliometrics*

**How Feynman Diagrams Almost Saved Space**

Quanta Magazine, 03JUL2016

Richard Feynman's famous diagrams embody a deep shift in thinking about how the universe is put together.

*Tags: Science without borders*

**SENSORS****New method uses nanoparticles to quickly identify chemical warfare agents**

Nanowerk, 15JUL2016

Researchers in India decorated iron oxide nanoparticles with a substance called poly methacrylic acid-co-ethylene glycol dimethacrylate. This made the particles more "sticky," helping them attach more easily to the chemical warfare agent particles in the samples. They tweaked different aspects of the extraction method and eventually were able to identify the agents at low concentrations of about 0.1 micrograms per milliliter. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Sensors, Military technology* ■



## 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>. To provide feedback or ask questions, contact us at [asdrest-bulletin-reply@sainc.com](mailto:asdrest-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