

# Matériaux

Bulletin de Veille - 28 février 2020

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### MÉTAUX

## A LA UNE

### The First Molecule in the Universe

13/02/2020 - [www.scientificamerican.com](http://www.scientificamerican.com)



The first "atoms" in the universe were not atoms at all—they were just nuclei that had not found electrons yet. The simplest nucleus, that of common hydrogen, is a bare proton with no frills. When the universe banged into existence, energy was rampant. Everything was smashing into everything else. Protons and neutrons often collided, and some formed larger nuclei, such as that of deuterium (containing a proton and a neutron), as well as helium nuclei with two protons and two neutrons.

## GÉNÉRALITÉS - MATÉRIAUX

### Sweat sensor detects stress levels; May find use in space exploration

26/02/2020 - [www.sciencedaily.com](http://www.sciencedaily.com)

If someone asked you right now how stressed you are, what would you say? A little? A lot? You do not know? Those are all valid responses, but they are not especially useful to researchers and medical professionals because they are subjective and not easily quantified. Nonetheless, in lieu of a better method of measuring stress, the common method for years has consisted of a stress questionnaire. The main alternative to the questionnaire, a blood test, can provide quantitative data but requires a trained professional to draw the blood, and the stress of the procedure itself -- being poked with a large needle -- can skew the results of a lot of people.

### Crystal-stacking process can produce new materials for high-tech devices

05/02/2020 - [www.sciencedaily.com](http://www.sciencedaily.com)

The magnetic, conductive and optical properties of complex oxides make them key to components of next-generation electronics used for data storage, sensing, energy technologies, biomedical devices and many other applications. Stacking ultrathin complex oxide single-crystal layers -- those composed of geometrically arranged atoms -- allows researchers to create new structures with hybrid properties and multiple functions. Now, using a new platform developed by engineers at the University of Wisconsin-Madison and the Massachusetts Institute of Technology, researchers will be able to make these stacked-crystal materials in virtually unlimited combinations.

### The containers the U.S. plans to use for nuclear waste storage may corrode

03/02/2020 - [www.sciencenews.org](http://www.sciencenews.org)



Containers that the U.S. government plans to use to store dangerous nuclear waste underground may be more vulnerable to water damage than previously thought. Millions of liters of highly radioactive waste from the U.S. nuclear weapons program are currently held in temporary storage units across the country. The government's game plan for permanently disposing of this material is to mix radioactive waste into glass or ceramic, seal it in stainless steel canisters and bury it deep

- Making metallic glasses more plastic - Physics World
- Laser-Engraved Metal to Reduce Environmental Impact

## NANOMATÉRIAUX

- New threads: Nanowires made of tellurium and nanotubes hold promise for wearable tech
- Could legacy fibre networks host the global quantum Internet? - Physics World
- Hidden Frequencies in the Electromagnetic Spectrum Unlocked by Graphene Amplifier
- Stress test reveals graphene won't crack under pressure

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- Le plastique polycarbonate en impression 3D

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## AÉROSPATIAL

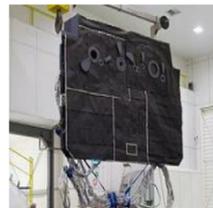
### Researchers develop smaller, lighter radiation shielding

12/02/2020 - [www.sciencedaily.com](http://www.sciencedaily.com)

Researchers at North Carolina State University have developed a new technique for shielding electronics in military and space exploration technology from ionizing radiation. The new approach is more cost effective than existing techniques, and the secret ingredient is...rust. "Our approach can be used to maintain the same level of radiation shielding and reduce the weight by 30% or more, or you could maintain the same weight and improve shielding by 30% or more -- compared to the most widely used shielding techniques," says Rob Hayes, co-author of a paper on the work and an associate professor of nuclear engineering at NC State.

### How ESA-NASA's Solar Orbiter beats the heat

05/02/2020 - [www.spacedaily.com](http://www.spacedaily.com)



When Solar Orbiter launches on its journey to the Sun, there's one key piece of engineering making this ESA-NASA mission possible: the heat shield. Seeking a view of the Sun's north and south poles, Solar Orbiter will journey out of the ecliptic plane - the belt of space, roughly in line with the Sun's equator, through which the planets orbit. Slingshotting repeatedly past Venus in order to draw near the Sun and climb higher above the ecliptic, the spacecraft bounds from the Sun and back toward the orbit of Earth throughout its mission.

## MATÉRIAUX POUR L'ÉNERGIE

### New Self-Charging Battery Enables Improved Output Power and Long-Term Storage

26/02/2020 - [www.azom.com](http://www.azom.com)

Researchers have designed a new kind of battery that integrates negative resistance and negative capacitance within a single cell. This feature allows the cell to self-charge without any energy loss, with significant implications for increased output power and long-term storage for batteries. Bistable energy landscape for a lithium-glass ferroelectric-electrolyte in contact with an aluminum-negative electrode and self-cycling process in an electrochemical aluminum/lithium glass/copper cell.

### World's stinkiest fruit could make super-fast electric chargers

25/02/2020 - [www.newscientist.com](http://www.newscientist.com)



Durian fruits are known for their overpowering smell. The waste parts of the world's smelliest fruit can be recycled into energy storage devices to rapidly charge electric vehicles and gadgets. Vincent Gomes at the University of Sydney and his colleagues used leftovers from notoriously smelly durians and jackfruits, the world's biggest tree fruit, to make superlight, hollow materials called aerogels. The aerogels make efficient component parts for energy storing devices called supercapacitors.

### FS-Laser-Based Technology Creates Solar Power Generators

05/02/2020 - [www.photonics.com](http://www.photonics.com)



A University of Rochester research team has demonstrated that the laser-based technology it used to create unsinkable metallic structures can also be used to create highly efficient solar power generators. The researchers used femtosecond (fs) laser pulses to etch metal surfaces with nanoscale structures that selectively absorb light only at the solar wavelengths. The etched surface not only enhances the energy absorption from sunlight, but also reduces heat dissipation at other

wavelengths, in effect, "making a perfect metallic solar absorber for the first time," professor Chunlei Guo said.

## MATÉRIAUX POUR L'OPTIQUE

### Mirrored chip could enable handheld dark-field microscopes

24/02/2020 - [www.sciencedaily.com](http://www.sciencedaily.com)

Do a Google search for dark-field images, and you'll discover a beautifully detailed world of microscopic organisms set in bright contrast to their midnight-black backdrops. Dark-field microscopy can reveal intricate details of translucent cells and aquatic organisms, as well as faceted diamonds and other precious stones that would otherwise appear very faint or even invisible under a typical bright-field microscope. Scientists generate dark-field images by fitting standard microscopes with often costly components to illumine the sample stage with a hollow, highly angled cone of light.

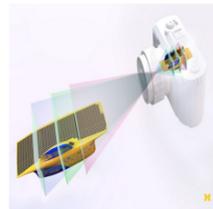
### Lasers etch a 'perfect' solar energy absorber

04/02/2020 - [www.sciencedaily.com](http://www.sciencedaily.com)

The University of Rochester research lab that recently used lasers to create unsinkable metallic structures has now demonstrated how the same technology could be used to create highly efficient solar power generators. In a paper in *Light: Science & Applications*, the lab of Chunlei Guo, professor of optics also affiliated with Physics and the Material Sciences Program, describes using powerful femto-second laser pulses to etch metal surfaces with nanoscale structures that selectively absorb light only at the solar wavelengths, but not elsewhere.

### Transparent graphene photodetectors make advanced 3D camera - Physics World

04/02/2020 - [physicsworld.com](http://physicsworld.com)



A new 3D camera made from a stack of transparent graphene photodetectors can capture and focus on objects that are different distances away from the camera lens. The device, made by researchers at the University of Michigan in the US, might find use in applications as diverse as biological imaging, driverless cars and robotics. Most of today's optical imaging systems use a flat optical detector to record the intensity of light reflected from an object at each pixel. However, since these systems detect light in only one plane, all the information concerning the direction of the light rays is lost. This means that the recorded images are simple 2D projections of the actual 3D object being imaged.

## BIOMIMÉTIQUE

### Vertical fibers in the suckerfish's suction cup-like fin help it hitchhike

26/02/2020 - [www.sciencedaily.com](http://www.sciencedaily.com)

As the hitchhikers of the marine world, the remora fish is well known for getting free rides by gripping onto hosts with its suction disc, a highly modified dorsal fin on its head. Now, work investigating the suction disc -- appearing February 26 in the journal *Matter* -- reveals that one of the secrets to the fish's strong grip lies within the unique architecture of the lip of the disc. "The remora fish's body shape and poor swimming ability don't give him an edge in nature," says senior co-author Li Wen of Beihang University, describing the flat-headed, eel-like fish. "The fish had to evolve its fin into a suction cup for hitchhiking for two reasons: food and mating.

## COLLAGES -ADHÉSIFS

### The combination of plant-based particles and water forms an 'eco' super-glue

24/02/2020 - [www.sciencedaily.com](http://www.sciencedaily.com)

In a study published in *Advanced Materials*, researchers at Aalto University, the University of Tokyo, Sichuan University, and the University of British Columbia have demonstrated that plant-derived cellulose nanocrystals (CNCs) can form an adhesive that fully integrates the concepts of sustainability, performance, and cost which are generally extremely challenging to achieve simultaneously. Unlike Superglue, the new eco glue develops its full strength in a preferred direction, similar to "Peel and Stick" adhesives. When trying to separate the glued components along the principal plane of the bond, the strength is more than 70 times higher when compared to the direction perpendicular to that plane.

## CÉRAMIQUES

### International Space Station Biofabrication Facility Improved Through 3D Printed Ceramics

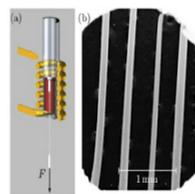
12/02/2020 - [www.azom.com](http://www.azom.com)

3D printed ceramic fluid manifolds are enabling advancements in bioprinting at the International Space Station. Ceramic materials provided better biocompatibility than printed polymers resulting in larger viable structures. The additive manufactured ceramics have been in service since November 2019. A spacecraft arrived at the International Space Station (ISS) on November 2, 2019 with supplies for the 3D BioFabrication Facility (BFF). Besides human cells and bioinks for BFF, also being tested during this mission are new components of Techshot's tissue conditioning system that were manufactured by Lithoz America, LLC.

## MÉTAUX

### Making metallic glasses more plastic - *Physics World*

21/02/2020 - [physicsworld.com](http://physicsworld.com)



Metallic glasses are promising materials for structural engineering, but their poor ductility makes them brittle, limiting their applications. Researchers in China have now shown that these glasses can be made much softer by reducing their size down to the microscale.

As their name implies, metallic glasses have the properties of both metals and glasses – they contain metallic bonds and are thus conducting, but their atoms are disordered like in a glass. These metastable materials are produced by rapid quenching from the liquid state and their physical properties depend on how they have been processed. They can be made more plastic to some extent by applying stress or high temperatures, but the effect – which is related to structural disordering in the material – is limited.

### Laser-Engraved Metal to Reduce Environmental Impact

04/02/2020 - [www.azom.com](http://www.azom.com)

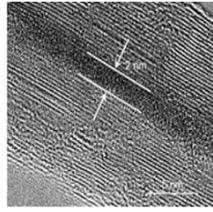
Harnessing new photonics technology, a group of European scientists are currently developing a 1kw, 'dot matrix' ultrafast laser system that can carve flow-optimised metal or plastic surfaces capable of imitating the incredibly efficient skin from sharks. Etching tiny 'spike' structures onto sheet metal or plastic, the new laser system can create a rough surface at a microscopic level. This uneven topography can create a reduction in drag or inhibit the growth of bacteria, algae or even barnacles. Shark's flesh, covered in millions of microscopic denticles - or tiny protruding scales - reduces drag to make it a highly efficient swimmer.

## NANOMATÉRIAUX

### New threads: Nanowires made of tellurium and nanotubes hold promise for

## wearable tech

11/02/2020 - [www.spacedaily.com](http://www.spacedaily.com)



Wearable tech and electronic cloth may be the way of the future, but to get there the wiring needs to be strong, flexible and efficient. Boron nitride nanotubes (BNNT), studied by physicists at Michigan Technological University, encase tellurium atomic chains like a straw, which could be controllable by light and pressure. In collaboration with researchers from Purdue University, Washington University and University of Texas at Dallas, the team published their findings in Nature Electronics this week. As demand for smaller and faster devices grows, scientists and engineers turn to materials with properties that can deliver when existing ones lose their punch or can't shrink enough.

## Could legacy fibre networks host the global quantum Internet? - Physics World

05/02/2020 - [physicsworld.com](http://physicsworld.com)



Researchers have transmitted multidimensional entangled photons across a record-breaking 250 metres of conventional single-mode optical fibre. This result from a team based in South Africa and China suggests that conventional or "legacy" fibre networks could be used as conduits for secure quantum optical communications, bringing the global quantum Internet a step closer to reality.

## Hidden Frequencies in the Electromagnetic Spectrum Unlocked by Graphene Amplifier

04/02/2020 - [www.azom.com](http://www.azom.com)

Light in the THz frequencies hits the 'sandwich' and is reflected with additional energy. Researchers at Loughborough University in the UK have developed a system of detecting and amplifying elusive terahertz waves that will open up a new realm of technological possibilities. Applications in medical and communications are likely to be the first to benefit, with scientists suggesting that the establishment of a safe and non-destructive alternative method to X-rays will be the first major technological advancement to emerge. The Potential of Terahertz Waves Terahertz waves (THz) offer a world of possibilities to scientists and engineers.

## Stress test reveals graphene won't crack under pressure

02/02/2020 - [www.spacedaily.com](http://www.spacedaily.com)

Graphene is a paradox. It is the thinnest material known to science, yet also one of the strongest. Now, research from University of Toronto Engineering shows that graphene is also highly resistant to fatigue - able to withstand more than a billion cycles of high stress before it breaks. Graphene resembles a sheet of interlocking hexagonal rings, similar to the pattern you might see in bathroom flooring tiles. At each corner is a single carbon atom bonded to its three nearest neighbours. While the sheet could extend laterally over any area, it is only one atom thick.

## REVÊTEMENTS

### New method to isolate atomic sheets and create new materials

20/02/2020 - [www.sciencedaily.com](http://www.sciencedaily.com)

Two-dimensional materials from layered van der Waals (vdW) crystals hold great promise for electronic, optoelectronic, and quantum devices, but making/manufacturing them has been limited by the lack of high-throughput techniques for exfoliating single-crystal monolayers with sufficient size and high quality. Columbia University researchers report today in Science that they have invented a new method -- using ultraflat gold films -- to disassemble vdW single crystals layer by layer into monolayers with near-unity yield and with dimensions limited only by bulk crystal sizes..

## Novel Technique to Deposit TiO2 Layers for Efficient Perovskite Solar Cells

12/02/2020 - [www.azom.com](http://www.azom.com)

Worldwide, the need for efficient solar energy harnessing to ensure a highly sustainable future is being accepted more and more. A new class of solar cells developed using perovskites—materials that have a specific crystal structure—is now competing with traditional silicon materials to fulfill the demands in this area.

## Les secrets du revêtement « noir animal » qui permettra à Solar Orbiter d'affronter le Soleil

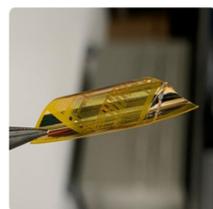
10/02/2020 - [www.industrie-techno.com](http://www.industrie-techno.com)

La sonde américano-européenne Solar Orbiter a décollé dans la nuit du 9 au 10 février en direction du Soleil. Pour protéger ses instruments scientifiques des températures et radiations extrêmes, elle est munie d'un revêtement à base de noir animal : une poudre obtenue à partir d'os d'animaux brûlés. Zoom sur ce revêtement et son procédé d'application développés par la société irlandaise Enbio.

## SEMI-CONDUCTEURS

### Hybrid Organic Transistors can Help Develop Advanced Electronic Displays

13/02/2020 - [www.azom.com](http://www.azom.com)



Scientists at King Abdullah University of Science and Technology (KAUST) have developed a manufacturing method that has led to the creation of hybrid organic transistors for use in sophisticated large-area electronics and electronic displays. Thin-film transistors made from metal oxides have useful properties, including optical transparency and high charge-carrying capacity, and they are increasingly being used in organic light-emitting diode displays.

### Engineers mix and match materials to make new stretchy electronics

07/02/2020 - [www.sciencedaily.com](http://www.sciencedaily.com)

At the heart of any electronic device is a cold, hard computer chip, covered in a miniature city of transistors and other semiconducting elements. Because computer chips are rigid, the electronic devices that they power, such as our smartphones, laptops, watches, and televisions, are similarly inflexible. Now a process developed by MIT engineers may be the key to manufacturing flexible electronics with multiple functionalities in a cost-effective way. The process is called "remote epitaxy" and involves growing thin films of semiconducting material on a large, thick wafer of the same material, which is covered in an intermediate layer of graphene.

## THERMOPLASTIQUES

### Le plastique polycarbonate en impression 3D

11/02/2020 - [www.3dnatives.com](http://www.3dnatives.com)

Le polycarbonate, plus connu sous sa forme d'acronyme PC, est un matériau réputé sur le marché de l'impression 3D pour sa résistance à l'impact et sa transparence. C'est un thermoplastique à la fois léger et solide, idéal pour un grand nombre d'applications professionnelles. Même s'il n'est pas aussi facile à imprimer que du PLA ou du PETG car il nécessite des températures d'extrusion et de plateau assez élevées, le polycarbonate en impression 3D permet de réaliser des pièces complexes qui résistent bien à la chaleur sur des machines à dépôt de matière fondue.

**Service Information Numérique - Pôle Veille**

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