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SPINOFF REPORT

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"Don't always walk on the smooth roads, walk ways that no one has travelled before, so as to leave behind traces and not only dust"

Antoine de Saint-Exupéry

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Sincerely yours, SPINOFF.COM Team

1 – Products

2 – Technology

3 – Prototypes

4 – Research

PRODUCTS

A CAR MONITORING DEVICE CARSENSE

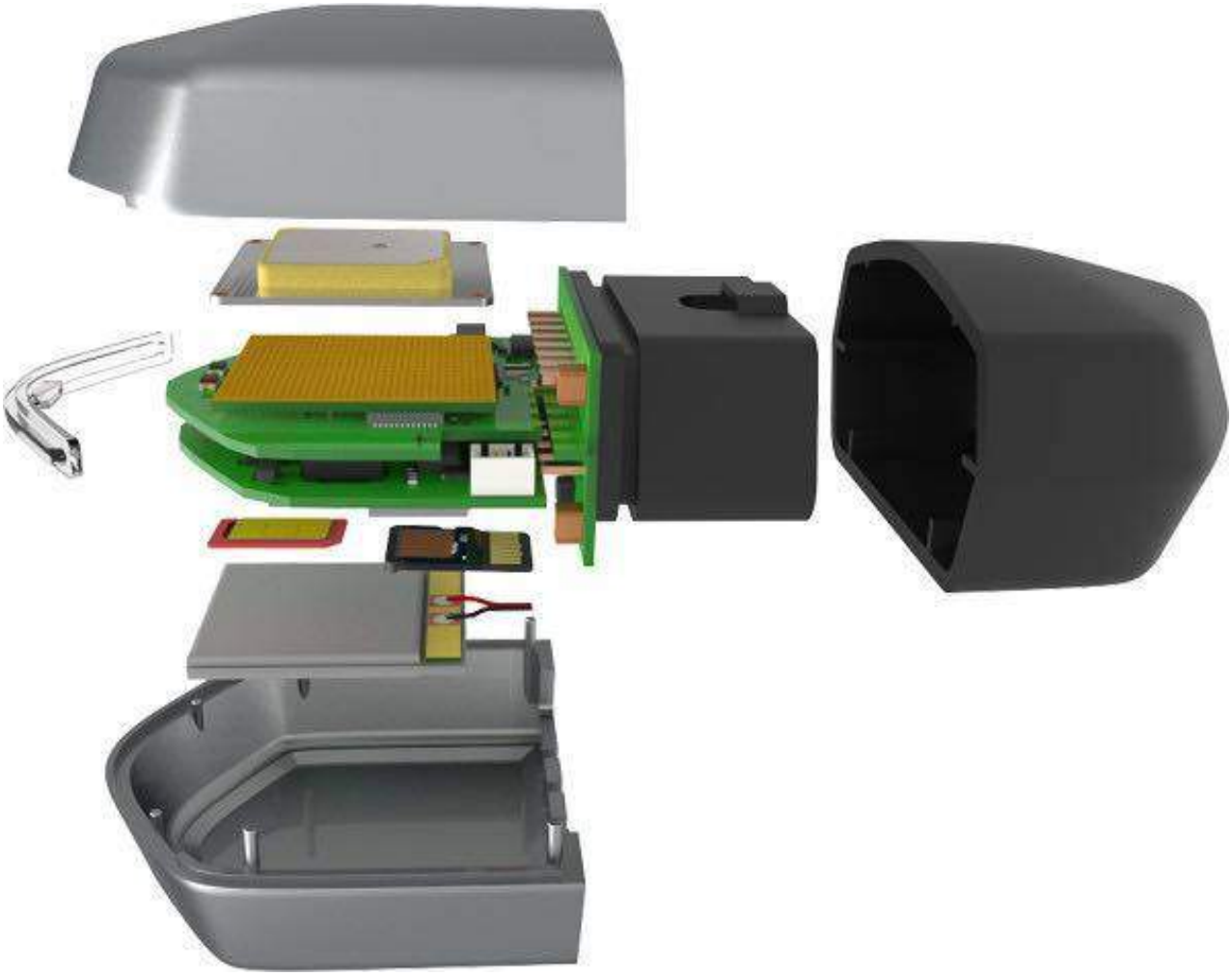
The Indian spinoff CarSense has developed a device, which connects a car and the user, remotely providing a wide range of information about the condition and location of the car. CarSense has the ability to send an SOS alert to your emergency contacts in case of an accident and even notifies the user in case of a rash driving or towing incident. Furthermore, it can provide fuel efficiency report in order to reduce emissions and improve mileage that is based on driving style feedback.

Built-in GPS: GNSS engine for GPS/QZSS, A-GPS support. Accurate location tracking, always
source - carsense.in

With the rapid development and improvement of the field of machine building, the car has a fairly stable technology, in its essence, being a separate vehicle not attached to other systems, devices or the Internet. Most people rely on their vehicles, especially those whose everyday life and professional activities require constant moving. It is obvious that users require maximum comfort and versatility. Mr. Urmil Shah, co-founder, said that the designers' team wanted to provide the ability of the connecting cars and owners in order to seamlessly monitor and control all aspects of their cars with just a tap on their phone.

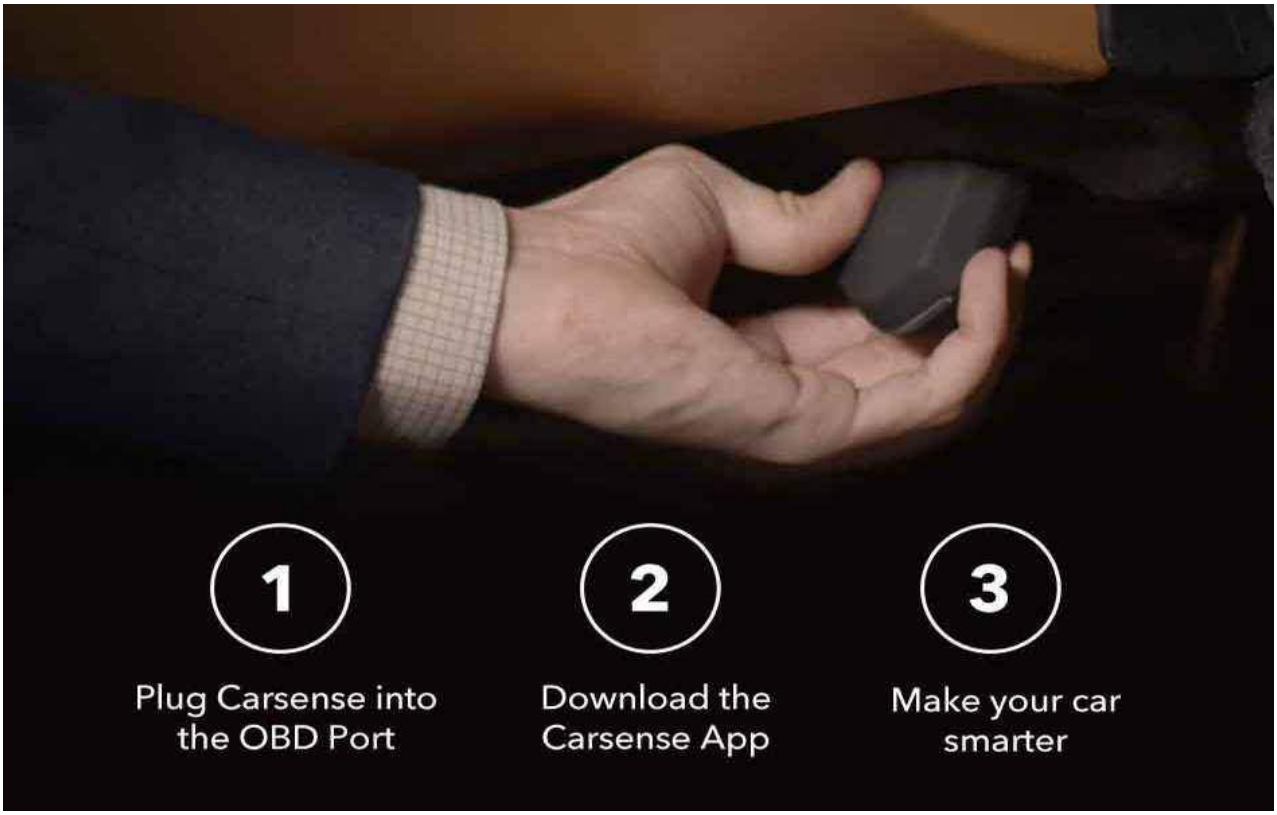
The companies man goal is based on the building the seamless customer experience in order to come out on the market with a completely plug-and-play product. Consequently, the company has developed a product that can be integrated into the car system easily without the need for the special modification or adding some tools. CarSense can monitor the car to ensure its safety, send alert signals in case repairs are required, give insights on the car's fuel economy and even more. The owner simply needs to plug the CarSense into

the OBD port of the car, download the app on the phone and just sync the device with the app.



Built-in Accelerometer. Bandwidth: X,Y Axis-1600Hz; Z Axis-600Hz. Precision: 0.012G. Unmatched accuracy in motion detection and reporting
source - carsense.in

Furthermore, the device allows users to do a lot more than simply track the car. The real-time speed monitoring and receiving towing and theft alerts are provided by the system. The device will notify owners if the vehicle is in need of repairs such as engine, battery or brakes problems. All its functions make this invention emergency-alarming and safe. The device was tested at extreme temperatures at -40 ° C to +70°C. In addition, CarSense is the highly-comfortable device in many cases as it has the ability to note all trips that are made by the car, manage all car documents and monitor driving behavior and analyze the feedback.



Active Wireless Sync: built-in PIFA antenna for GSM and GPS; cellular 2G and Bluetooth 4.1 (BLE). Manage your car no matter how far you are
source - carsense.in

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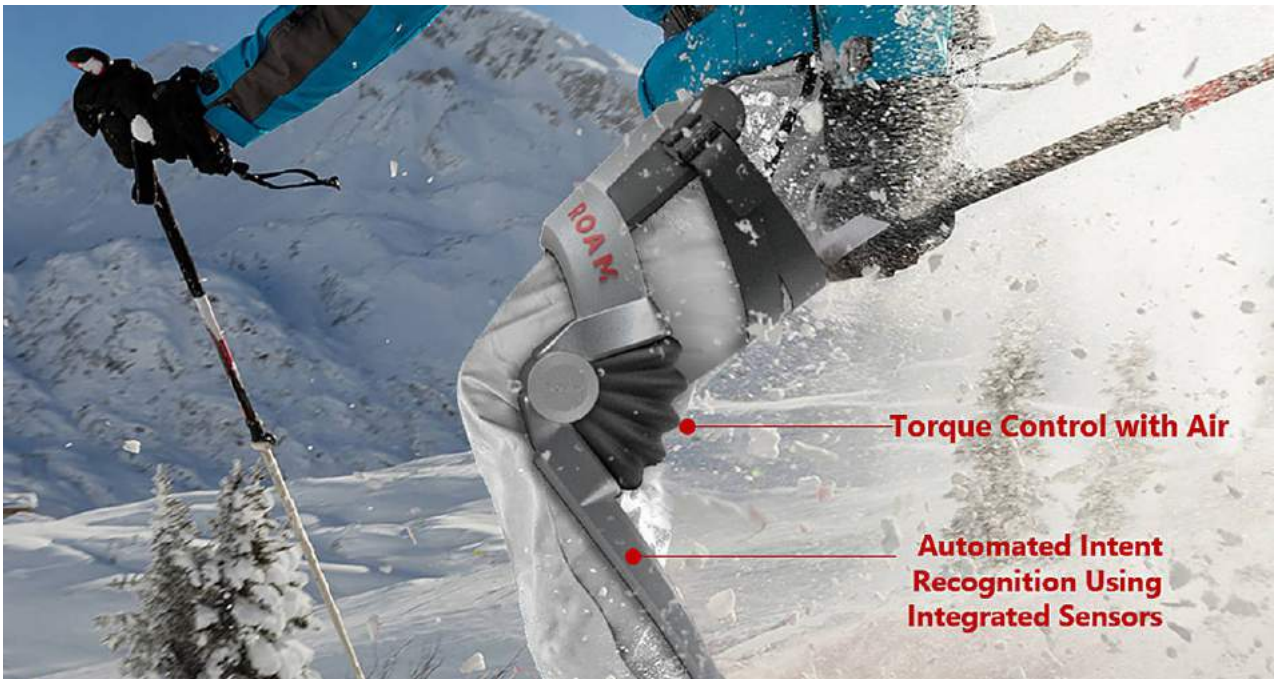
Patent status:	+
On market since:	-
Regions:	India
Industries:	Creative Industries, Transport Systems and...
Source links:	CarSense
	The Economic Times

AN EXOSKELETON FOR SKIERS AND SNOWBOARDERS

A new kind of exoskeleton designed to offer leg support to skiers and snowboarders has been developed by the researchers at spin-off company Roam Robotics. The cost is $2500. The gadget, powered by soft pneumatic actuators, will be rentable at ski resorts for way less than it’s full purchase price. Roam believes that without any training at all, it'll enable you to ski better for longer without getting nearly as tired.

Electric motors need only batteries and motors, and for most exoskeletons that setup is more efficient. Electric actuators can also go forwards and backwards, while pneumatic actuators work in opposition like muscles do, meaning that you effectively need twice as many of them to achieve the same degree of freedom. Instead of focusing on the softness aspect of pneumatic actuators, Roam is leveraging the order of magnitude cost and weight reduction that the give you relative to electric motors. Overall, the pneumatic system is a bit more complex, and it's not going to give a skier the same performance as an electric motor would. But in an assistive exoskeleton application, you may not care about those things nearly as much as you do about weight and cost.



An exoskeleton for skiers and snowboarders
source - roamrobotics.com

The way Roam Robotics' exoskeleton works is simple. It's essentially a shock absorber that takes over some of the work you'd otherwise be doing with your quads. As you bend your knees, pressurized air is pumped into the nylon actuator, which expands to provide some counterforce between the ski boot that the exoskeleton is attached to on one end and your quad on the other. The main point is that your muscles have to do less work. For older folks, the system will help them ski better even if their strength and stamina are limited. Younger skiers will be able to go down the slopes faster and more aggressively.

Sensors allow the exoskeleton to do its thing autonomously, gradually learning how you ski and providing the right amount of assistance at just the right time. In total, the existing

system weighs 9 kilograms (20 pounds), including both the device itself and the backpack that holds the batteries and pneumatic system - although that could decrease by as much as 50 percent.

This is not to say that Roam Robotics is stuck with just skiing and snowboarding as applications. The company is likely expecting to learn an awful lot from this first real-world use case, and once the technology is proven, it will be able to expand relatively quickly into applications like lift assistance for industry and commerce, or support for the elderly to help them with sit-to-stand transitions as well as stair climbing. And maybe if you need to move some furniture, you'll be able to go down to your local store and rent one for a few hours.

The systems are built with very few parts and the manufacturing approach allows the researchers to be very robust to external impacts. The researchers have logged well over 200 hours skiing with the most recent devices all over the world and not had any device failures. In addition to that, the same technology powered early running work which saw hundreds more hours running on treadmills.

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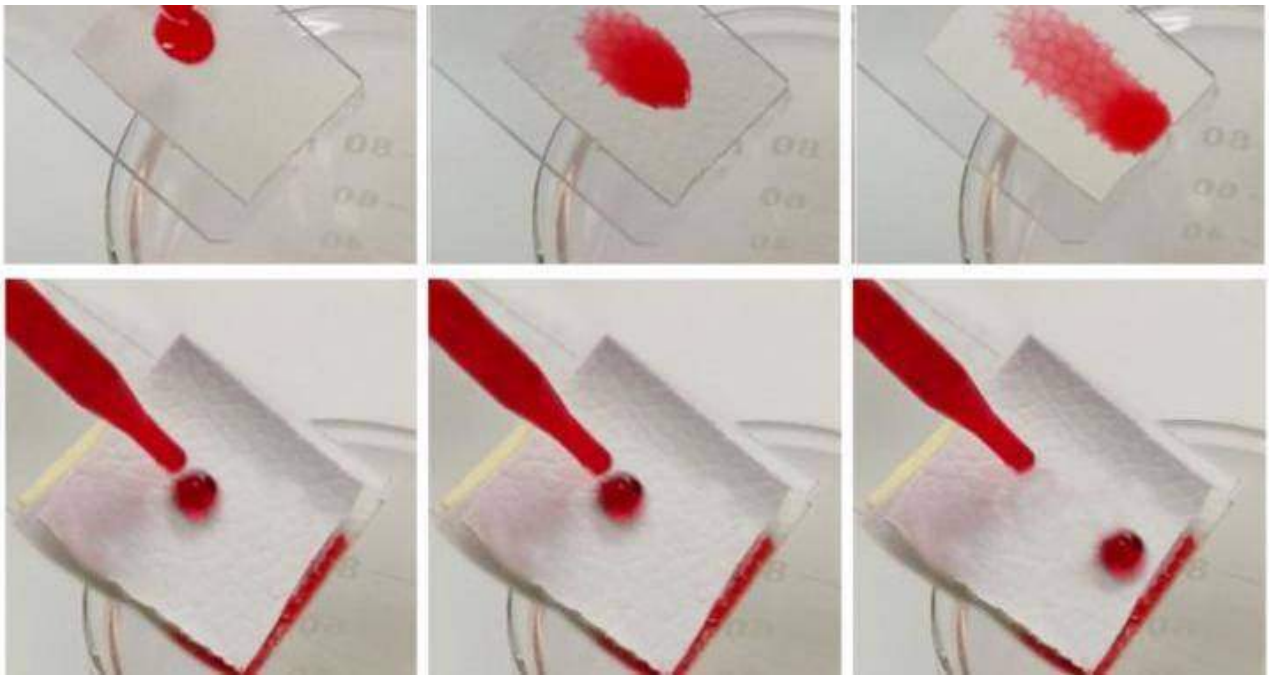
On market since:	2018
Regions:	United States
Industries:	Sports and Recreation
Source links:	Roam Robotics

TECHNOLOGY

A BETTER FAKE LEATHER, INSPIRED BY PLANTS

A nano-coating for synthetic leather that cleans itself and won't get sticky on a hot day has been developed by the researchers at The Ohio State University. They discovered a way to adapt the same nature-inspired coating to plastic-based synthetic leather. Both water and oil roll off the coating, which keeps the leather-like surface from getting sticky up to temperatures of 70 degrees Celsius (158 degrees Fahrenheit). The coating could make for cleaner, less sticky furniture, handbags, clothing and shoes, automotive interiors - any products for which people use synthetic leather.

Synthetic leather is made from fabric coated with plastic, usually polyurethane (PU) or polyvinyl chloride (PVC). Both PVC and PU can be molded into flat sheets with grooves that give it a leather-like texture. Like genuine leather, synthetic leather is somewhat permeable to liquids. Unlike genuine leather, it gets sticky at high temperatures because heat softens the plastic surface.



Oil rolls off self-cleaning synthetic leather
source - osu.edu

As in their previous experiments creating water- and oil-repellant surfaces, the researchers tried to devise a bumpy texture by spraying a coating of silica nano-particles on the surface of the synthetic leather. But the team discovered very fast that the plasticizers in the synthetic leather - that is, the chemicals that give plastic its plasticity - prevented the nano-particles from sticking, especially inside the leather-look grooves. So they cleaned the surface with an ultraviolet light treatment commonly used in computer chip manufacturing.

The result is that the nano-particles stuck to the cleaned synthetic leather, creating a bumpy surface. After that the researchers sealed the nano-particles with a silicone resin. The coating was almost transparent, so the leather-like texture was still visible. The researchers coated samples of PU and PVC and tested them for water and oil repellency and self-cleaning properties, as well as durability and heat resistance.

A nano-coating won't get sticky
source - osu.edu

They squeezed droplets of oil and water onto the synthetic leather and tested how much the surface would have to be tilted for the droplet to roll off. Water rolled off with a tilt of 2 degrees and oil with a tilt of 4 degrees. Any tilt below 10 degrees is considered super-liquiphobic. To see how wear affected the coating, the researchers scratched a groove into the surface by dragging a small sapphire bead back and forth over it 100 times. The tilt angle required to get droplets to roll off the scratched surface increased to 7 degrees - still super-liquiphobic - but only when the droplet rolled across (that is, perpendicular to the direction of) the worn-in groove.

To check self-cleaning, the researchers sprayed black silicon carbide powder on the leather and measured how much of the powder could be washed away by a single water droplet. On untreated synthetic leather, the water washed away about 10 percent of the powder, while on the treated leather, 90 percent of it was washed away. It won't prevent a very hot seat from burning you. At least your favorite 'leather' jacket will look and feel the same.

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On market since:	-
Regions:	United States
Industries:	Creative Industries
Source links:	The Ohio State University News

DIAMOND IMPURITIES TO SEE ON THE MICROSCOPIC SCALE

A system that uses nitrogen-vacancy centers (atomic-scale impurities in diamonds) to read the nuclear magnetic resonance (NMR) signals produced by samples as small as a single cell has been developed by the researchers at Harvard University. The system will enable researchers to peer into previously unseen biological processes as well as the chemical properties of materials, and could help open the door to answers to a host of new questions in fields ranging from condensed-matter physics to chemistry to neurobiology.

This gives the researchers for the first time a tool for conducting NMR on samples that are similar to the volume of a single cell, while still maintaining high spectral resolution. There are two major challenges the team addresses with this work. There's the spatial size, or the volume of the samples, and the other is the spectral resolution. To do useful NMR spectroscopy at these small scales, you need to have both.

A close-up detail of the donated magnet
source - harvard.edu

Discovered at Harvard in the 1940s, NMR works by exciting the atoms in a sample by using powerful magnetic fields and measuring the radio frequencies they emit. Since each molecule emits specific frequencies, chemists and physicists have learned to read those radio spectra to learn everything from the material properties of various molecules to how proteins are folded. In conventional systems, those signals are measured using wire coils similar to radio antennas. For smaller samples, however, the signals are simply too weak to detect.

From their first nanoscale detection of an NMR signal in 2013, Harvard scientists refined the NV technology, and in 2014 were able to detect a single proton. By 2016 they had used NV to capture the NMR signal produced by a single protein. Although they could detect signals from tiny samples, the NV centers were far from ideal. Obtaining that detail

from nanoscale samples, remains a challenge because quantum mechanical fluctuations that would be unimportant in larger samples remain dominant at tiny scales, and molecules in solution diffuse away from the sensor, resulting in lower resolution.

Green lasers and magnets used to detect NMR signals
source - harvard.edu

The researchers developed a technique to take repeated measurements triggered by a clock that was synchronized to the NMR signal. By stringing those measurements together, they were able to measure signals with far higher resolution than before. After that the team tested the system against three types of molecules - trimethyl phosphate, xylene, and ethyl formate - to show it was capable not only of detecting NMR signals, but of achieving spectral resolutions down to about one hertz, sufficient to observe key chemical signatures at the micron scale for the first time.

The team plans to continue exploring ways to boost the signal from micron-scale samples with a goal of making the system both faster - the tests described in the study took as long as 10 hours to obtain data - and more applicable to living samples. Researchers also need to focus on enhancing the sensitivity of the NV centers, so they can detect faint signals produced samples in weak concentrations.

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On market since:	-
Regions:	United States
Industries:	Manufacturing
Source links:	Harvard News

TINY, LIGHT-SENSITIVE CHIPS COULD ONE DAY RESTORE SIGHT TO THE BLIND

A system that replaces light-sensitive cells has been developed by the researchers at Stanford University. Age-related macular degeneration, a disease that slowly degrades light-sensitive cells in the retina, is the leading cause of vision loss and blindness among people 65 and older. Doctors can't prevent such loss of sight - but a new system may ease the burden. The device - a combination of image-processing goggles and tiny silicon chips implanted in the retina - has been more than a decade in the making.

Although the device's resolution is not yet where its designers hope to get it – currently the technology can only reach 20/200 vision, which is not enough to read clearly or drive safely - a five-patient feasibility study has begun in Paris, with a second planned later in the year in the Eastern United States. The researchers learned about artificial retinas, assistive devices intended to treat patients who have lost some of the light-sensitive cells in their retinas to diseases such as age-related macular degeneration or retinitis pigmentosa.

A new system can help prevent loss of sight
source - stanford.edu

But artificial retinas that were after that in development had a number of drawbacks. For one thing, none of them achieved decent resolution. At the time, the best artificial retina corresponded to about 20/1200 vision. In addition, most old devices needed many wires. Some systems implanted a camera directly into the eye, which required elaborate wiring just to power it. Other devices mounted the camera onto glasses and fed the images through a cable to an electrode array placed on the retina. All the options demanded invasive, complex surgery and long-term maintenance issues, including managing problematic cables that crossed the eye wall, sometimes affecting the remaining healthy rods and cones.

Pixium Vision, the company that licensed the photovoltaic retinal prosthesis, or PRIMA,

technology in 2013, manufactured a device for humans and got approval for clinical testing in late 2017. Clinical trials started last month, and so far three patients have been implanted with the device. Those surgeries went well, and patients report seeing bright white patterns in their formerly damaged areas, within the resolution limits researchers had expected. Thorough testing is now being conducted to assess the quality of this prosthetic vision, including how well patients can make out various shapes and letters.

Professor Daniel Palanker works with CS senior Jack Boffa
source - stanford.edu

The researchers still face important challenges - the most important is further enhancing resolution. Right now, pixels in human implants are 100 micrometers in size, and tests demonstrated that 50 micrometer pixels also work well, providing spatial resolution equivalent to about 20/200 vision. Eventually, the researchers would like to get it to 20/40 – what the state requires for a driver's license - and the lab expects to publish a new design for achieving that resolution later this year. The team of researchers is also developing better ways of processing images, so that patients can distinguish objects more easily.

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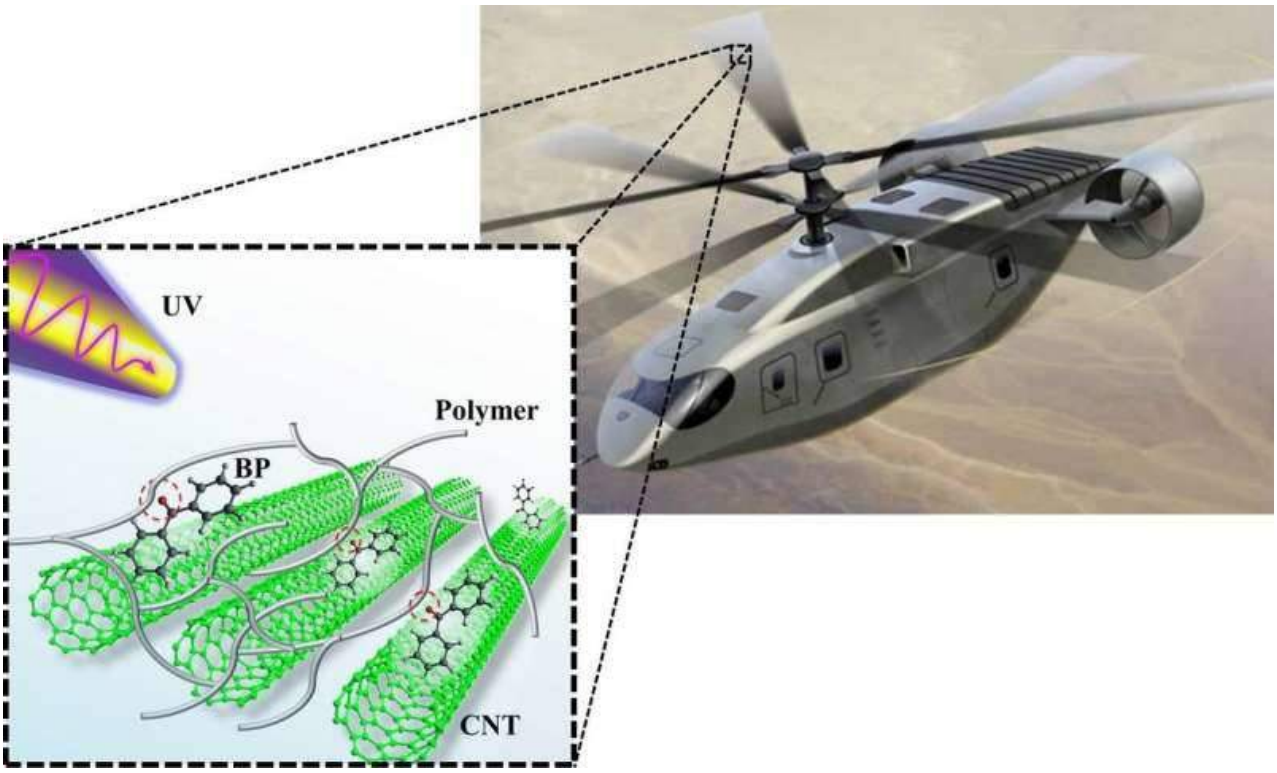
On market since:	-
Regions:	United States
Industries:	Healthcare
Source links:	Stanford News

A NEW TECHNIQUE TO MAKE ADAPTIVE MATERIALS

A technique that causes a composite material to become stiffer and stronger on-demand when exposed to ultraviolet light has been engineered by the researchers at the U.S. Army Research Laboratory and the University of Maryland. This on-demand control of composite behavior could enable a variety of new capabilities for future Army rotorcraft design, performance and maintenance. The focus of the research was on controlling how molecules interact with each other. And the aim was to have them interact in such a way that changes at a small size, or nanoscale, could lead to observed changes at a larger size, or macroscale.

A significant motivation for this work is the desire to engineer new structures, starting from the nanoscale, to enable advanced rotorcraft concepts that have been proposed in the past, but were infeasible due to limitations in the existing composites. One of the most important capabilities envisioned by these concepts is a significantly decreased maintenance burden due to compromises the researchers make to fly at high speeds.

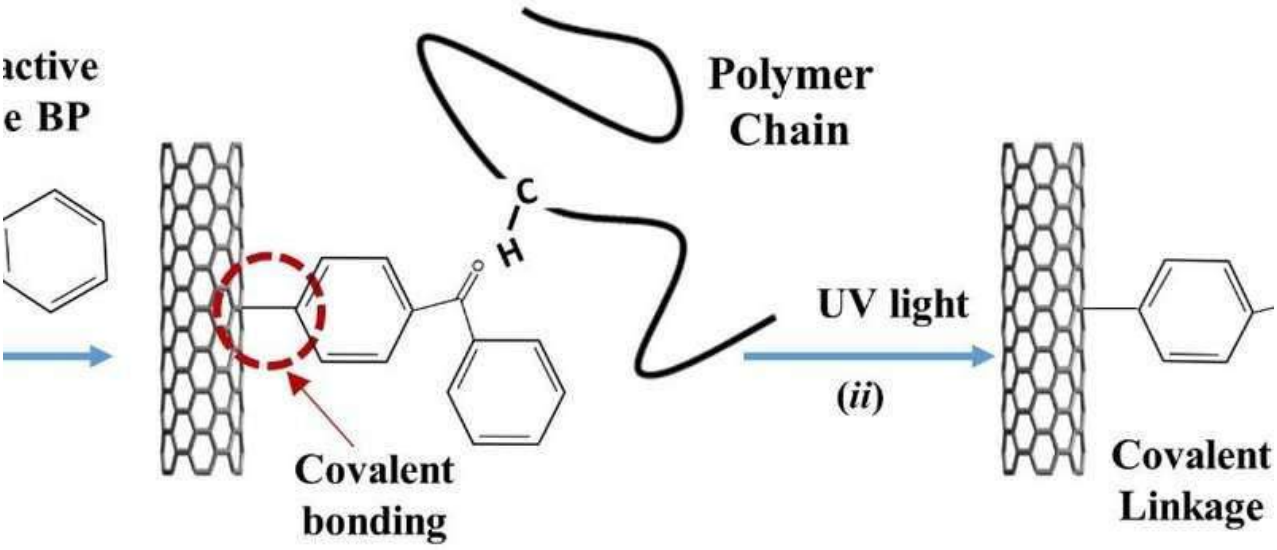


A rotorcraft concept, which represents reactive reinforcements
source - arl.army.mil

The reduced scheduled maintenance of future Army aviation platforms is an important technological driver for future operating concepts. The enhanced mechanical properties with potentially low weight penalties, enabled by the new technique, could lead to nanocomposite based structures that would enable rotorcraft concepts that the engineers cannot build today.

The technique consists of attaching ultraviolet light reactive molecules to reinforcing agents like carbon nanotubes. These reactive reinforcing agents embedded in a polymer after that. Upon ultraviolet light exposure, a chemical reaction occurs such that the interaction between the reinforcing agents and the polymer increases, making the material stiffer and stronger. The chemistry used here is generally applicable to a variety of reinforcement and polymer combinations thereby expanding the utility of this control

method to a wide range of material systems.



The synthetic process researchers use to create photoresponsive reinforcing agents
source - arl.army.mil

This research demonstrates that it is possible to control the overall material property of these nanocomposites through molecular engineering at the interface between the composite compounds. This is not only important for fundamental science but also for the optimization of structural component response. In this instance, the development of advanced structures to enable leap-ahead Army aviation capabilities not currently feasible due to limitations in mechanical properties of the existing materials. This is especially important for the envisioned future operating environment which will require extended periods of operation without the opportunity to return to stationary bases for maintenance.

Future structures based on this work may help lead to novel composites with controlled structural damping and low weight that could enable low maintenance, high speed rotorcraft concepts that are currently not feasible. In addition, controllable mechanical response will allow for the development of adaptive aerospace structures that could potentially accommodate mechanical loading conditions.

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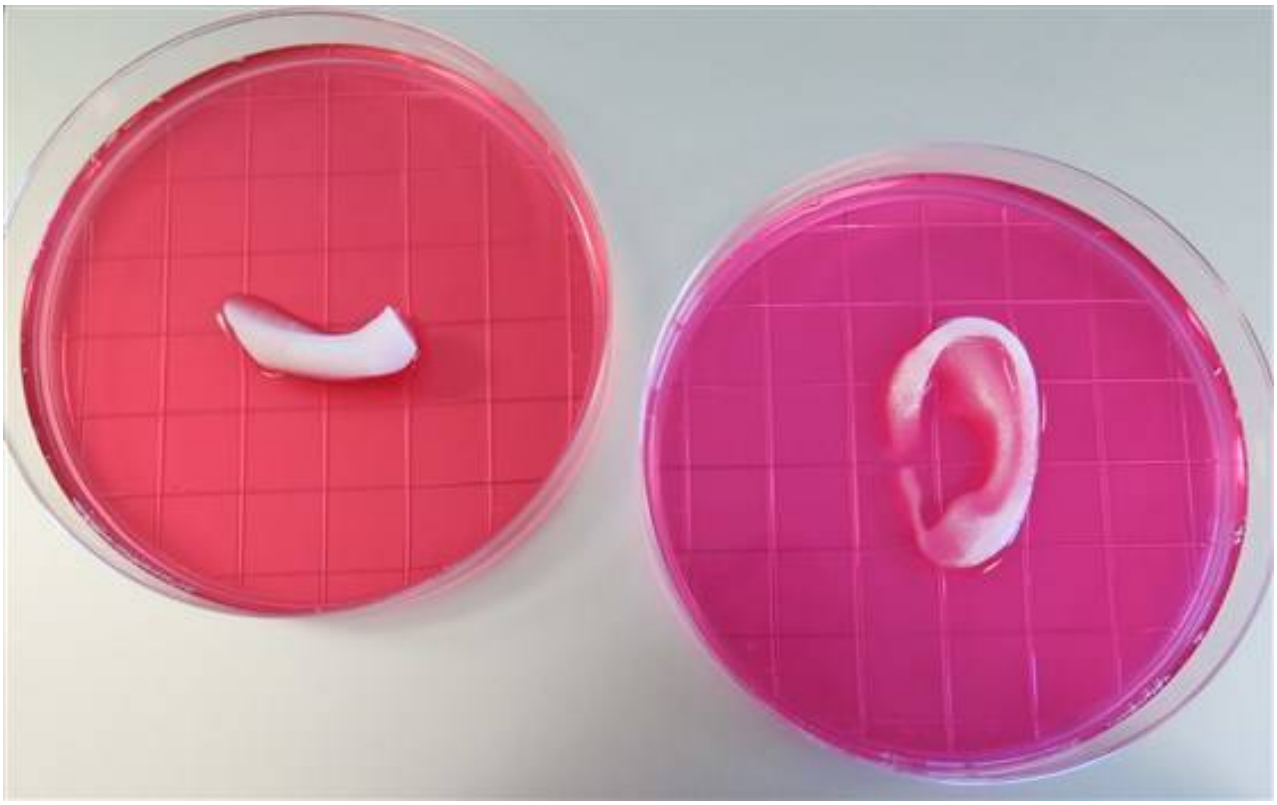
On market since:	-
Regions:	United States
Industries:	Aerospace, Defence and Marine
Source links:	U.S. Army Research Laboratory

PRINTED LIVING BODY PARTS

A combination of living cells and a special gel to print out living human body parts - including ears, muscles and jawbones, has been developed by the researchers at Wake Forest University. It's an advance on previous attempts, which either involved making a plastic scaffold and after that trying to get cells to grow in and on it, or that printed out organ shapes that ended up being too floppy and dying. The new approach mixes live cells with a gel that starts out as a liquid but quickly hardens to the consistency of living tissue, and layers them in with tiny tunnels that serve as passages for nutrients to feed the cells until blood vessels can grow in and do the job naturally.

The researchers are actually printing the scaffolds and the cells together. They demonstrate that they can grow muscle. They can also make ears the size of baby ears and jawbones the size of human jawbones. The team of researchers is able to print all kinds of things. They describe both the new 'bioprinting' technology and the organs they have been able to grow using it. The researchers present an integrated tissue-organ printer (ITOP) that can fabricate stable, human-scale tissue constructs of any shape.



Completed ear and jaw bone structures
source - wfu.edu

The correct shape of a tissue construct is obtained from a human body by processing computed tomography (CT) or magnetic resonance imaging (MRI) data. The team of researchers has been working for more than a decade to make grow-your-own organ transplants. They are not the only one trying - other teams are working on bioprinted hands, for instance. The team of researchers has already made the first full organ ever grown and implanted into a human, the bladder, and rabbit penises that were the first solid organs.

They have been working under contract with the Armed Forces Institute of Regenerative Medicine, which is looking for novel ways to help military personnel injured in battle. But the principles could apply to any patient needing a new ear, organ or a replacement for a

shattered jaw. The challenge is that living body parts are complicated. It's not enough to make a heart-shaped blob of tissue. Even a simple structure, like an ear, has several types of cells and they must all be fed by tiny capillaries. What happens if you don't have them is the surface gets fed but if you make them any larger the central core with not get fed and they will die.

A printed bone structure
source - wfu.edu

The researchers started out with actual inkjet printers but they've now developed customized devices. They started trying to design printers specific to human tissues. Because the cells need vital nutrients, as the researchers print the cells they can create microchannels. And within 24 hours, blood vessels start to sprout in these microchannels.

The team's also working to print out livers, lung tissue and kidney tissue. Currently, people must rely on organs taken from other peoples who have just died, or a kidney or piece of liver from generous and courageous live donor willing to go through the surgery. According to the United Network for Organ Sharing, more than 121,000 Americans are on the waiting list for an organ.

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On market since:	-
Regions:	United States
Industries:	Healthcare
Source links:	Wake Forest News

SAFE RED GLARE ROCKET FOR SOLDIER TECHNOLOGY AND FIREWORKS

An environmentally-friendly red light flare popular in fireworks displays and among Soldiers who use them in training and battlefield operations as signaling devices has been developed by the researchers at the U.S. Army Research Laboratory and the Ludwig Maximilian University. The formula is a lithium-based red-light-emitting pyrotechnic composition of high purity and color quality, and avoids a list of environmentally-objectionable elements, namely strontium and chlorinated organic materials, both considered hazardous to humans.

The new formulation is based on a non-hygroscopic dilithium nitrogen-rich salt that serves as both oxidizer and red colorant. The formulation may draw interest from the civilian fireworks and military pyrotechnics communities for further development as they both have a vested interest in the development of environmentally conscious formulation.

A mid-burn image of the strontium- and halogen-free red flare burning
source - arl.army.mil

To achieve red-light-emission of high color purity, the authors report a formulation consisting of powdered magnesium and hexamine as the fuels, nitrocellulose, an epoxy binder system, and a lithium-based high-nitrogen salt, which serves as both the oxidizer and colorant. When burned, this formulation was found to exhibit a relatively cool-burning flame, while producing suitable quantities of red-light-emitting atomic lithium. While further optimization is still needed to enhance the luminosity of Li-based red-light-emitting flares, this represents the first known example of a successful red-light-emitting formulation of high color quality and purity based on lithium that does not contain any perchlorates, halogenated materials or strontium-based materials.

Historically, the formulations for red-light-emitting pyrotechnic formulations included powdered metal fuels like magnesium and aluminum, strontium nitrate and perchlorate oxidizers, as well as carbon-based chlorinated organic materials such as polyvinyl chloride. The authors cited a recent EPA report that found strontium as potentially harmful to human health, specifically that it replaces calcium in the bone, interferes with bone

strength, and that is why affects the skeletal development of children and adolescents.

An environmentally-friendly red light flare is popular in fireworks
source - iStock.com

In 2014, the EPA made a preliminary decision to start regulating the amount of strontium in drinking water. Whereas U.S. military training grounds were not included in the study, these facilities can demonstrate elevated concentrations of strontium as well, given the presence of strontium in the used red-light-illuminating signaling pyrotechnic compositions.

The next step in this research is to make the strontium- and halogen-free red flare the team developed brighter. The efforts now need to be made to increase the luminous intensity of the formulation or a close derivative thereof. This can be done in parallel with doing what is called prototype experiments, in which the new flare formulations can be tested on larger scales. The improvements in luminosity and the large scale prototype tests will be needed in order to push the technology forward.

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Regions:	United States, Germany
Industries:	Aerospace, Defence and Marine
Source links:	U.S. Army Research Laboratory

NEW WAY TO RECYCLE PHONE WASTE

A novel process to efficiently separate fibreglass and resin - two of the most commonly discarded parts of a cellphone - bringing them closer to their goal of a zero-waste cellphone, has been perfected by the researchers at the University of British Columbia. It's one of the first processes to use simple techniques like gravity separation to cleanly lift organic resins from inorganic fibreglass. Discarded cellphones are a huge, growing source of electronic waste, with close to two billion new cellphones sold every year around the world and people replacing their phones every few years.

The main issue is to break down models that can no longer be reused into useful materials - in a way that doesn't harm the environment. Most e-waste recycling firms focus on recovering useful metals like gold, silver, copper and palladium, which can be used to manufacture other products. But nonmetal parts like fibreglass and resins, which create bulk of cellphones' printed circuit boards, are generally discarded because they're less valuable and more complicated to process. They're either fed to incinerators or become landfill, where they can leach hazardous chemicals into soil, groundwater, and air.

The team of researchers was led by Maria Holuszko, who co-founded UBC's urban mining innovation centre - a unit focused on reclaiming valuable metals and other materials from electronic waste. They were determined to find a better recycling solution. The researchers developed a process that uses gravity separation and other simple physical techniques to process cellphone fibreglass and resins in an environmentally neutral fashion.

The key here is gravity separation, which effectively separates the fibreglass from the resin by using the differences in their densities. The separated fibreglass can be used after that as a raw material for construction and insulation. In the future, if the researchers can find a way to nhance the quality of the recycled fibreglass, it can even be suitable for manufacturing new circuit boards.

The researchers are now looking into develлping a large-scale commercial model of the process, in partnership with Ronin8, a Richmond, B.C. recycling company that separates the different plastics, fibres and metals in electronic waste streams without using toxic chemicals or losing precious metals. Ronin8 has developed an innovative e-waste process for electronic waste that aims to address the intrinsic faults in traditional e-waste processes today. The researchers' vision is to achieve a zero-waste end-of-life solution for electronics, and collaborated work has moved the researchers closer to this reality.

The researchers report their task has taken on a new urgency in light of China's waste import ban. The team of researchers needs a better way to manage the electronic hardware recycling, and a cost-effective, environmentally responsible method of mining e-waste for valuable materials would be a good step in that direction.

Circuit board materials prior to processing
source - ubc.ca

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On market since:	-
Regions:	Canada
Industries:	Environment
Source links:	University of British Columbia

NOVEL WAY TO FIGHT AGAINST POLLUTION IN LAKES AND COASTLINES

A new efficient method for treating toxins found in sewage, fertilizer runoff and other forms of water pollution has been developed by the researchers at Princeton University. Sewage plants rely on bacteria to remove environmental toxins from waste so that the processed water can be safely discharged into oceans and rivers. The bacterium Acidimicrobiaceae bacterium A6 is capable of breaking down ammonium, a pollutant found in sewage and fertilizer runoff. A6 is able to perform this chemical conversion in the absence of oxygen, an ability that could be helpful for providing alternative methods to costly oxygen-dependent methods in sewage treatment.

Most sewer plants that discharge into oceans or rivers already use bacteria to remove ammonium from waste, but doing so requires transforming lots of air into the sludge to feed the bacteria oxygen. The bacteria use the oxygen in a chemical reaction that turns ammonium into nitrite and after that other bacteria convert the nitrite to harmless nitrogen gas.

Researchers identified the bacterium in a New Jersey wetland
source - princeton.edu

Removing ammonium is significant to prevent depletion of oxygen in streams and to prevent eutrophication, the growth of excessive algae and other plants triggered by nitrogen components from sewage and agricultural runoff. An alternative chemical process for breaking down ammonium, known as Feammox, occurs in acidic, iron-rich, wetland environments and soils, and has been found to take place in riparian wetland soils in New Jersey, in tropical rainforest soils in Puerto Rice, in wetland soils in South Carolina, and at various forested and wetland locations in Southern China. It was not clear, however, what enabled the Feammox reaction.

Isolating the bacterium and definitively confirming its role took years of painstaking research. In their new study, the Princeton team mixed soil samples collected from the New Jersey wetland with water and a material containing iron oxide and ammonium and allowed the mixture to incubate in vials for nearly a year. Mixing the soil samples and the metal medium in the vials was done in an oxygen-free chamber and the vials were sealed

airtight to mimic the anaerobic conditions of the wetland soil from which the bacteria originated.

New type of bacteria will help to stop water pollution
source - princeton.edu

About every two weeks over the course of the year, the scientists removed a small sample from each of the vials to see whether the iron oxide and ammonium were being degraded. When they found out a sample where this reaction was taking place, they used genetic sequencing to identify the bacterial species present, and definitively discovered that A6 was carrying out the Feammox reaction.

The Princeton team is exploring how to build a reactor where A6 could be used to process ammonium at industrial scales. They are working with the Chinese environmental ministry to develop a prototype reactor to decrease ammonium and heavy metals in wastewater. The researchers are exploring whether the technology could help counter eutrophication, where excessive nutrients in runoff damage rivers, lakes and coastlines.

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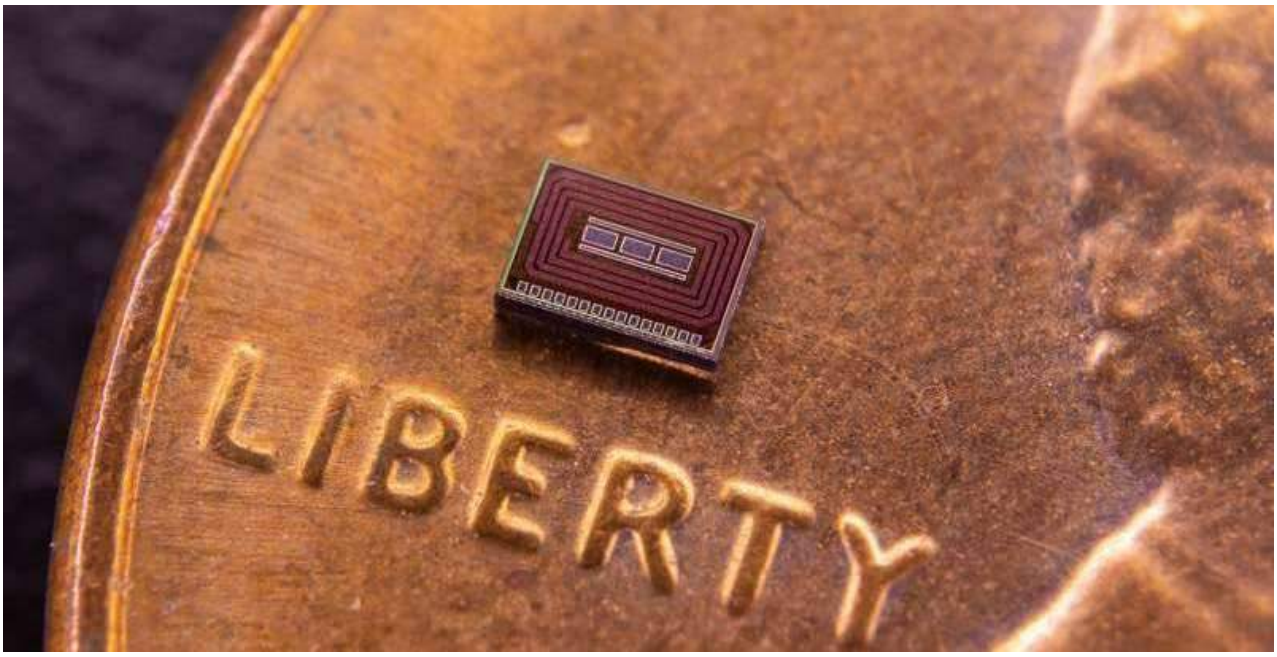
Regions:	United States
Industries:	Environment
Source links:	Princeton News

TINY INJECTABLE SENSOR PROVIDES LONG-TERM ALCOHOL MONITORING

A miniature, ultra-low power injectable biosensor that could be used for continuous, long-term alcohol monitoring has been developed by the engineers at University of California San Diego. The chip is small enough to be implanted in the body just beneath the surface of the skin and is powered wirelessly by a wearable device, such as a smartwatch or patch. The ultimate goal of this work is to develop a routine, unobtrusive alcohol and drug monitoring device for patients in substance abuse treatment programs.

One of the challenges for patients in treatment programs is the lack of convenient tools for routine monitoring. Breathalyzers, at the moment the most common way to estimate blood alcohol levels, are clunky devices that require patient initiation and are not that accurate. A blood test is the most accurate method, but it needs to be performed by a trained technician. Tattoo-based alcohol sensors that can be worn on the skin are a perspective novel alternative, but they are only single-use and can be easily removed.



Alcohol monitoring chip is small enough to be implanted just under the surface of the skin
source - ucsd.edu

A tiny injectable sensor, that can be administered in a clinic without surgery, could make it easier for patients to follow a prescribed course of monitoring for extended periods of time. The biosensor chip measures roughly one cubic millimeter in size and can be injected under the skin in interstitial fluid - the fluid that surrounds the body's cells. It consists of a sensor that is coated with the alcohol oxidase, an enzyme that selectively interacts with alcohol to generate a byproduct that can be electrochemically detected. The electrical signals are transmitted wirelessly to a nearby wearable device such as a smartwatch, that also wirelessly powers the chip. Two extra-sensors on the chip measure pH levels and background signals. These get canceled out to make the alcohol reading more accurate.

The researchers developed the chip to consume as little power as possible - 970 nanowatts total, that is about one million times less power than a smartphone consumes

during a phone call. The team doesn't want the chip to have an important impact on the battery life of the wearable device. And since the researchers are implanting this, they don't require a lot of heat being locally generated inside the body or a battery that is potentially toxic.

The chip is compared to the thickness of a penny
source - ucsd.edu

One of the methods in which the chip operates on such ultra-low power is by transmitting data via a technique called backscattering. This occurs when a nearby device like a smartwatch sends radio frequency signals to the chip, and the chip sends data by modifying and reflecting those signals back to the smartwatch. The researchers also developed ultra-low power sensor readout circuits for the chip and minimized its measurement time to just three seconds, the result is less power consumption. The researchers verified the chip in real conditions with a setup that mimicked an implanted environment. This involved mixtures of ethanol in diluted human serum underneath layers of pigskin. This is a proof-of-concept platform technology. For the future approach, the researchers are going to test the chip in live animals.

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Industries:	Electronics, Healthcare
Source links:	UC San Diego News Center

SHRIMP-INSPIRED CAMERA MAY ENABLE UNDERWATER NAVIGATION

A bio-inspired camera that mimics the eyes of a mantis shrimp has been developed by the researchers at the University of Illinois. The underwater environment may appear to the human eye as a dull-blue, featureless space. However, a vast landscape of polarization patterns appear when viewed through a camera that is designed to see the world through the eyes of many of the animals that inhabit the water. The findings are the first to demonstrate passive underwater GPS using the polarization properties of underwater light.

The camera, a variation of a polarization imager named Mantis Cam after the shrimp that inspired it, takes advantage of how light refracts, or bends, when it passes through the surface of water and bounces from particles and water molecules. The researchers collected underwater polarization data from all over the world in work with marine biologists and noticed that the polarization patterns of the water were constantly changing. This was in stark contrast to what biologists thought about underwater polarization information.

Viktor Gruev, the lead researcher, with the shrimp-inspired camera
source - illinois.edu

The team determined that the underwater polarization patterns are a result of the sun's position relative to the location where the recordings were collected. They found they can use the underwater polarization patterns to estimate the sun's heading and elevation angle, allowing them to figure out their GPS coordinates by knowing the date and time of the filming.

They tested the underwater GPS method by pairing their bio-inspired camera with an electronic compass and tilt sensor to measure the underwater polarization data at a variety of sites around the globe, depths, wind conditions and times of day. The researchers found that they can locate their position on the planet within an accuracy of 32,9 Miles. The researchers could use the underwater GPS method to help locate missing aircraft, or even create a detailed map of the seafloor.

This research could also lead to new insights into the migratory behavior of many marine species. Animals like turtles and eels, for example, probably use a slew of sensors to navigate their annual migration routes that take them thousands of miles across oceans. Those sensors may include a combination of magnetic, olfactory and possibly visual cues based on polarization information. Another aspect of this technology is its potential to help researchers understand how pollution may alter the migratory paths of animals sensitive to polarized light.

It is very likely that increased pollutants in the air and water alter underwater polarization patterns, causing the undersea environment to appear different from what many animals have learned. The underwater GPS method may provide insights into how some long-distance migratory animals, such as whales, might get confused and end up in the wrong places. For instance, more whales are becoming stranded close to the California shore, where they have never been observed before. Perhaps pollutions is the indirect culprit for this reason, as it affects the underwater polarization patterns necessary for migratory behavior.

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Industries:	Electronics, Environment
Source links:	Illinois News Bureau

A TRANSPARENT PATCH TO DETECT DANGEROUS FOOD THREATS

A test to bring certainty to the delicate but critical question of whether meat and other foods are safe to eat or need to be thrown out has been developed by the team of researchers at McMaster University. Mechanical and chemical engineers at McMaster, working closely with biochemists from across campus, have collaborated to develop a transparent test patch, printed with harmless molecules, that can signal contamination as it happens. The patch can be incorporated directly into food packaging, where it can monitor the contents for harmful pathogens.

The new technology has the potential to replace the traditional 'best before' date on food and drinks alike with a definitive indication that it's time to chuck that roast or pour out that milk. In the future, if you go to a store and you want to be sure the meat you're buying is safe at any point before you use it, you'll have a much more reliable way than the expiration date.

Researchers examine a transparent patch
source - mcmaster.ca

Unsafe food creates a vicious cycle of diarrhea and malnutrition, threatening the nutritional status of the most vulnerable. Where food supplies are insecure, people tend to shift to less healthy diets and consume more ‘unsafe foods’ - in which chemical, microbiological and other hazards pose health risks.

Food can become contaminated at any point of production and distribution, and the primary responsibility lies with food producers. Yet a large proportion of foodborne disease incidents are caused by foods improperly prepared or mishandled at home, in food service establishments or markets. Not all food handlers and consumers understand the roles they must play, such as adopting basic hygienic practices when buying, selling and preparing food to protect their health and that of the wider community.

A new patch can be used to detect pathogens on food source - iStock.com

If a pathogen is present in the food or drink inside the package, it would trigger a signal in the packaging that could be read by a smartphone or other simple device. The test itself does not affect the contents of the package. According to the World Health Organization, foodborne pathogens result in approximately 600 million illnesses and 420,000 deaths per year. About 30 percent of those cases involve children five years old and younger. The researchers are naming the new material 'Sentinel Wrap' in tribute to the McMaster-based Sentinel Bioactive Paper Network, an interdisciplinary research network that worked on paper-based detection systems. That network's research ultimately gave rise to the new food-testing technology.

Mass producing such a patch would be fairly cheap and simple, as the DNA molecules that detect food pathogens can be printed onto the test material. A food manufacturer could easily incorporate this into its production process. Getting the invention to market would need a commercial partner and regulatory approvals. The team of researchers point out that the same technology could also be used in other applications, such as bandages to indicate if wounds are infected, or for wrapping surgical instruments to assure they are sterile.

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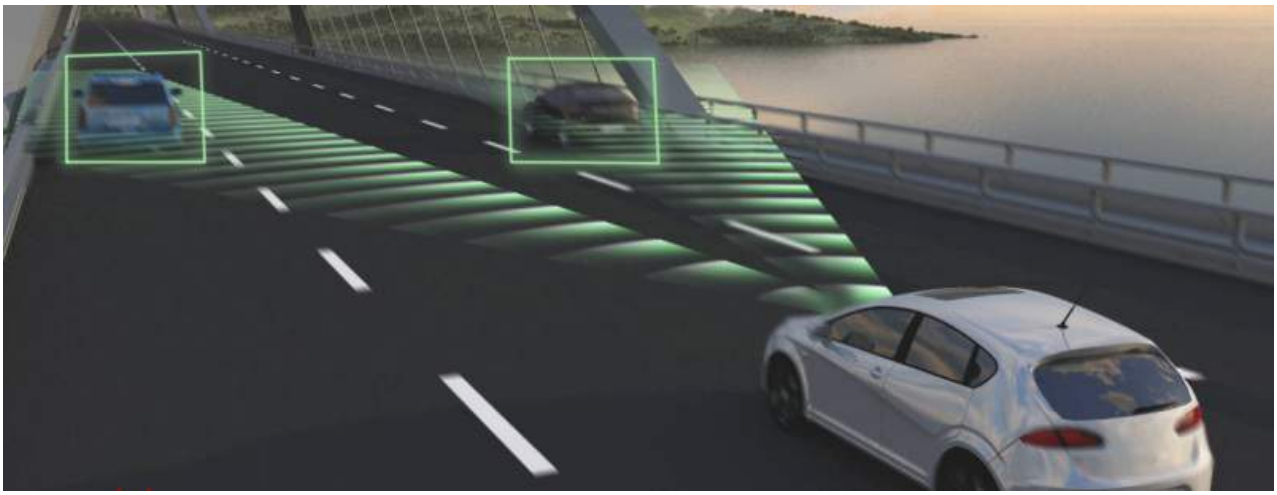
On market since:	-
Regions:	Canada
Industries:	Food and Drink
Source links:	McMaster Daily News

NEW ULTRAFAST LASER BEAM FOR AUTONOMOUS CARS

A novel laser light sensing technology that is more robust and less expensive than currently available with a wide range of uses, including a way to guide fully autonomous vehicles has been developed by the team of researchers at Purdue University and Stanford University. They believe heir innovation is orders of magnitude faster than conventional leading-edge laser beam steering devices that use phased antenna-array technology. The laser beam steering is based on light-matter interaction between a silicon-based metasurface and short light pulses produced for example by a mode-locked laser with a frequency-comb spectrum.

Such a beam-steering device can scan a large angle of view in nanoseconds or picoseconds compared with the microseconds current technology takes. This technology is far less oomplex and uses less power than existing technologies. The technology merges two different fields of nanophotonic metasurfaces and ultrafast optics. Laser beam steering is a vital technology that can be used in a wide variety of areas including navigation, space flights, radar applications, imaging, tag-scanners, robotics, archaeology, mapping and atmospheric physics. Faster laser scanning is directly related to higher frame rates as well as enhanced imaging resolution.

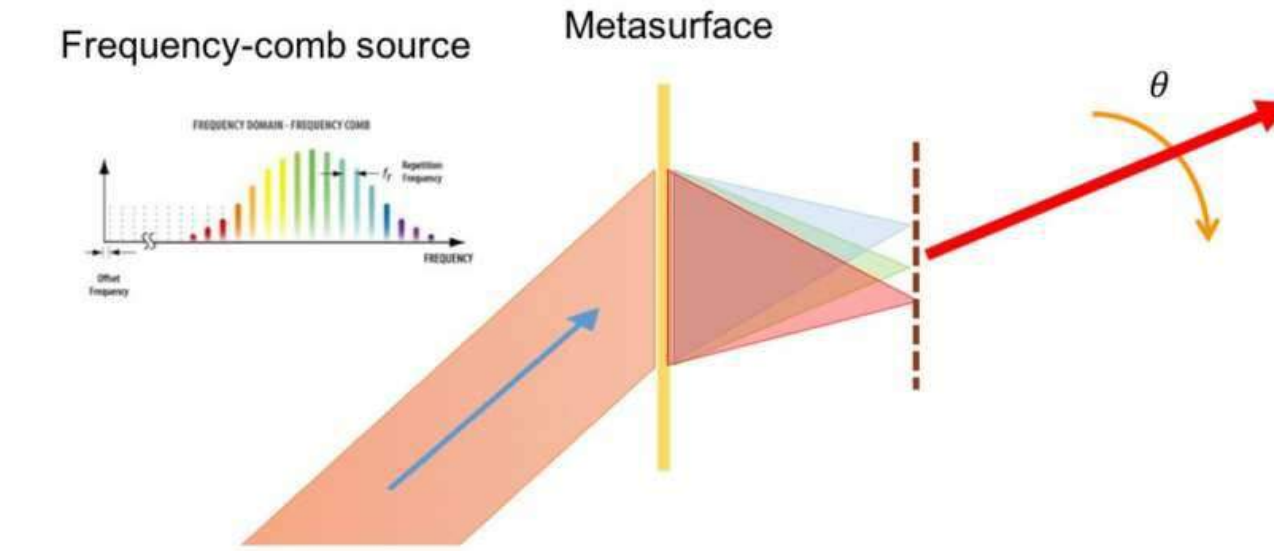


The technology uses a novel concept of optical frequency-arrayed technique that is more robust
source - purdue.edu

The researchers belive their innovation is chip-compatible technology that doesn't require additional sources of energy. It is based on light-matter interaction between metasurfaces and short pulses from mode-locked lasers with equally spaced phased-lock frequency lines. Another key element is using a metasurface based on patterned silicon film. That's the basis for all of the electronic circuitry at the nanoscale to give this exciting functionality that allows the beam steering to happen.

Autonomous cars depend on light detection and ranging, or lidar, which is similar to radar only instead emits infrared or visible light that measures how long it takes for the pulses to reflect back off objects and take their images. It would replace the spinning device frequently seen atop roofs of autonomous cars. But that existing technology remains expensive as businesses look for ways to transform the burgeoning autonomous car industry. The use of photonic metasurfaces was key to the new advancement. Metasurfaces provide simple, compact and power efficient solutions to photonics design.

The combination of those two technologies provide a much simpler approach.



The metasurface focuses these frequency components to an array of adjacent locations in space
source - stanford.edu

The challenge for the researchers now is to scale up the innovation and move it from the laboratory to the real world. They are looking for investors, partners or possibly licensing agreements as they work to move forward scaling up the technology. The first developments might be in areas such as scanning devices at stores, airports or in many other areas before moving on to autonomous cars. This seems to be a disruptive solution which could make a big difference in this huge, emerging industry.

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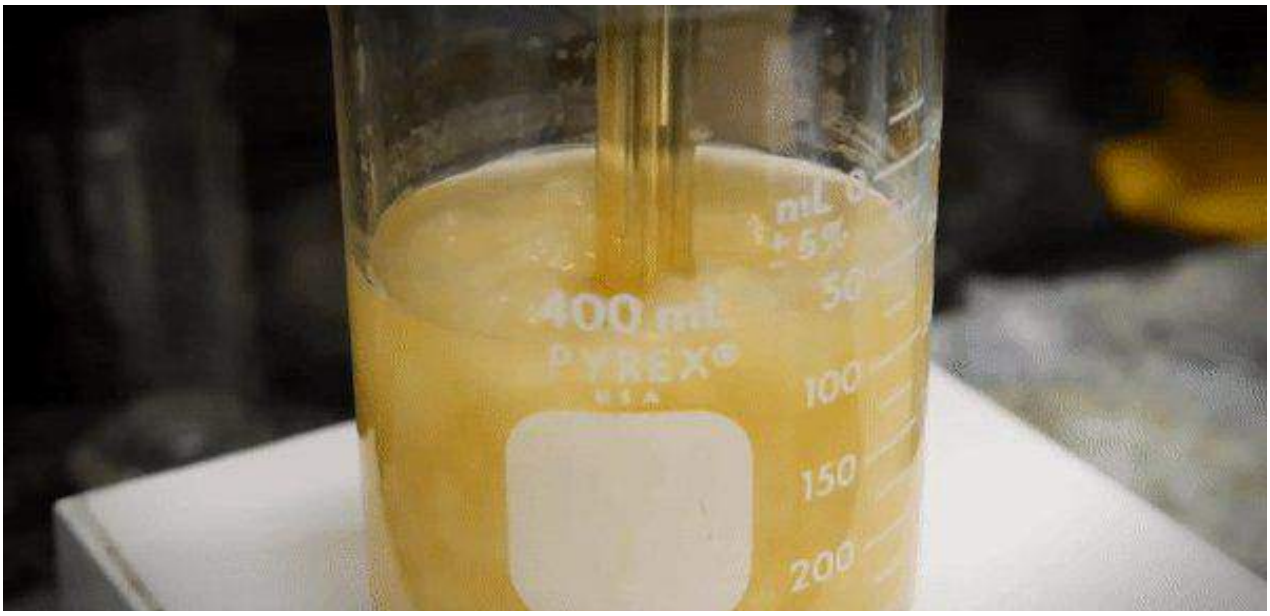
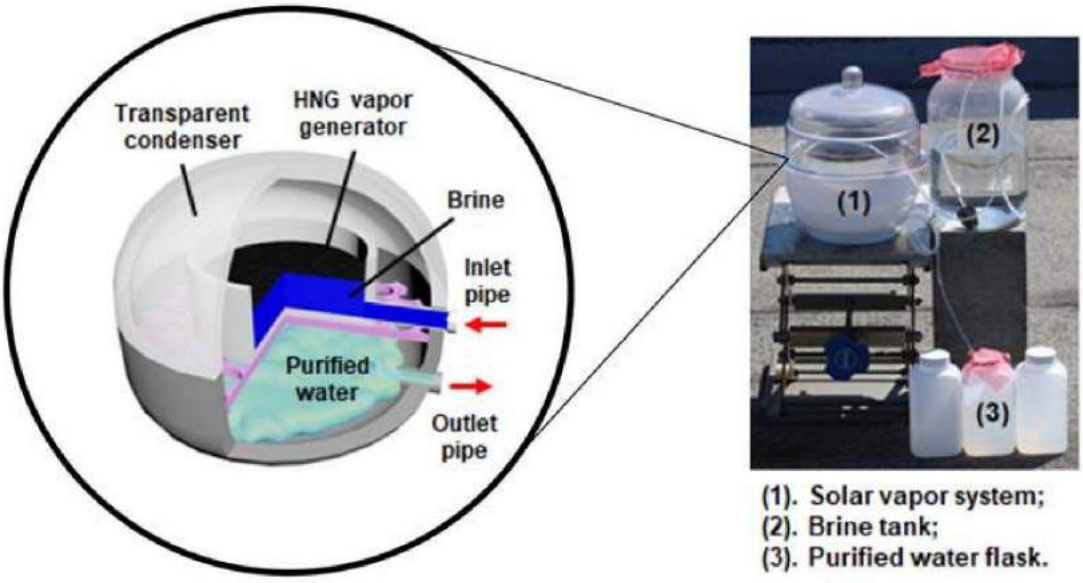
On market since:	-
Regions:	United States
Industries:	Transport Systems and Vehicles
Source links:	Stanford News



WATER PURIFICATION BREAKTHROUGH

A cost-effective and compact technology using combined gel-polymer hybrid materials has been developed by the researchers at the University of Texas at Austin. The ability to create clean, safe drinking water using only natural levels of sunlight and inexpensive gel technology could be at hand, thanks to an innovation in water purification. According to the United Nations, 30,000 people die each week from the consumption and use of unsanitary water. Although the vast majority of these fatalities occur in developing nations, the U.S. is no stranger to unanticipated water shortages, especially after hurricanes, tropical storms and other natural disasters that can disrupt supplies without warning.

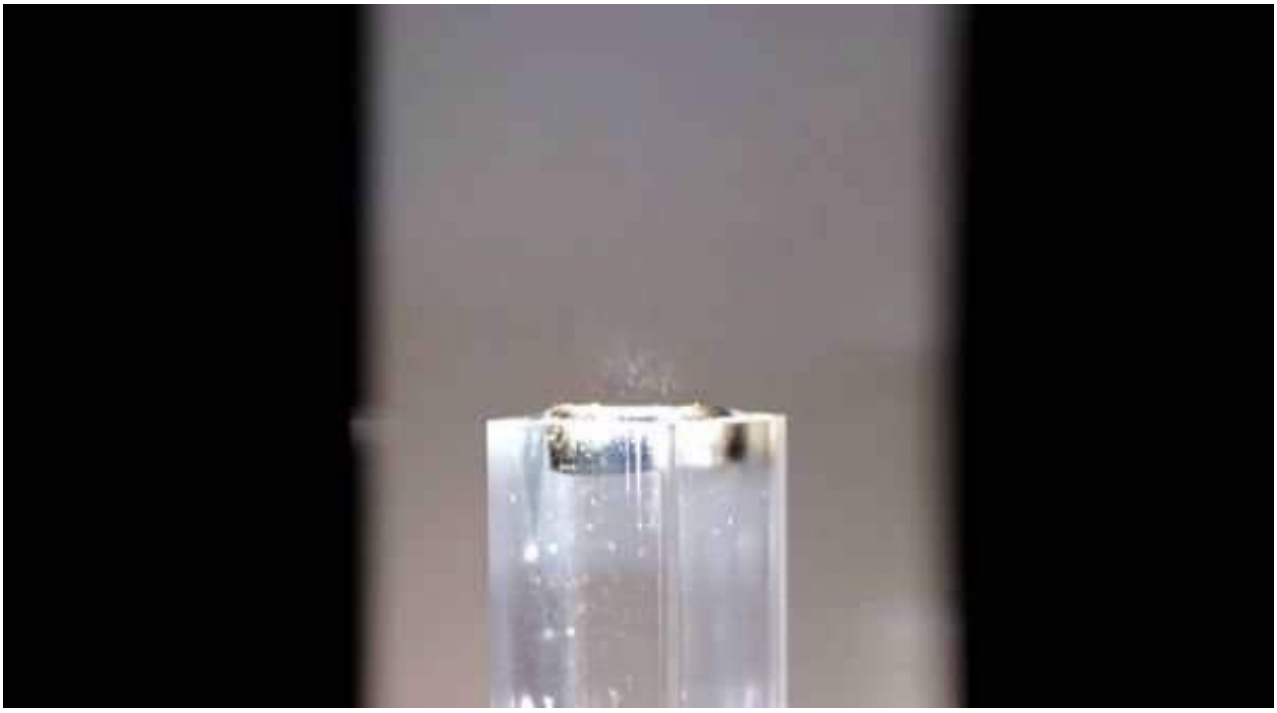
Possessing both hydrophilic (attraction to water) qualities and semiconducting (solar-adsorbing) properties, these 'hydrogels' (networks of polymer chains known for their high water absorbency) enable the production of clean, safe drinking water from any source, whether it's from the oceans or contaminated supplies. The researchers have developed a new hydrogel-based solar vapor generator that uses ambient solar energy to power the evaporation of water for efficient desalination.



Inside a 'Hierarchically-Nanostructured Gel' Vapor Generator
source - utexas.edu

Current solar steaming technologies used to treat saltwater involve a very costly process that relies on optical instruments to concentrate sunlight. The team developed nanostructured gels that require far less energy, only needing naturally occurring levels of ambient sunlight to run while also being capable of significantly increasing the volume of water that can be evaporated.

Water desalination through distillation is a common method for mass production of freshwater. However, current distillation technologies, such as multi-stage flash and multi-effect distillation, require significant infrastructures and are quite energy-intensive. Solar energy, as the most sustainable heat source to potentially power distillation, is widely considered to be a great alternative for water desalination.



Water purification breakthrough uses sunlight and 'hydrogels'
source - utexas.edu

The hydrogels allow for water vapor to be generated under direct sunlight and after that pumped to a condenser for freshwater delivery. The desalinating properties of these hydrogels were even tested on water samples from the salt-rich Dead Sea and passed with flying colors. Using water samples from one of the saltiest bodies of water on Earth, UT engineers were able to decrease salinity from Dead Sea samples significantly after putting them through the hydrogel process. In fact, they achieved levels that met accepted drinking water standards as outlined by the World Health Organization and the U.S. Environmental Protection Agency.

The tests demonstrated daily distilled water production up to 25 liters per square meter, enough for household needs and even disaster areas. Better still, the hydrogels can easily be retrofitted to replace the core components in most existing solar desalination systems, thereby eliminating the need for a complete overhaul of desalinations systems already in use. The potential impact of this technology could be far-reaching, as global demand for fresh, clean water outpaces existing natural supplies.

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Industries:	Water
Source links:	UT News

A NEW TECHNIQUE COULD PREVENT OVERHEATING OF ELECTRONICS

A polymer thermal conductor - a plastic material that, however counterintuitively, works as a heat conductor, dissipating heat instead of insulating it has been developed by the researchers at MIT. Plastics are excellent insulators, meaning they can effectively trap heat - a quality that can be an advantage in something like a coffee cup sleeve. But this insulating property is less desirable in products such as plastic casings for laptops and mobile phones, which can overheat, in part because the coverings trap the heat that the devices produce.

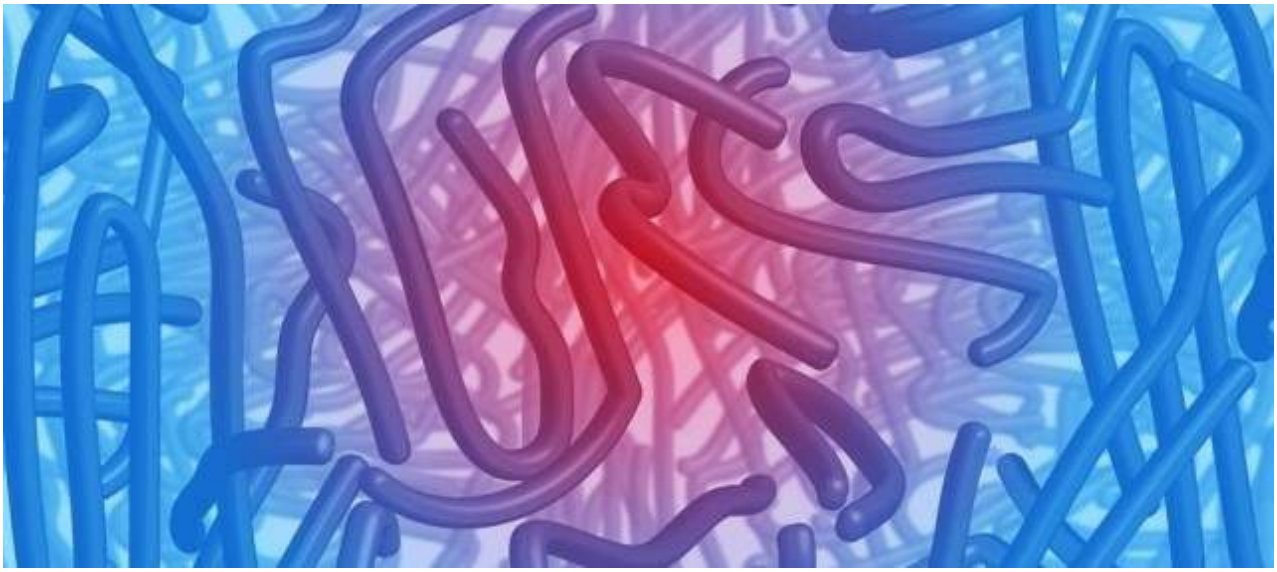
The new polymers, which are lightweight and flexible, can conduct 10 times as much heat as most commercially used polymers. Traditional polymers are both electrically and thermally insulating. The discovery and development of electrically conductive polymers has led to novel electronic applications such as flexible displays and wearable biosensors.

New polymers can have success in such applications, as a self-cooling alternative to existing electronics
source - mit.edu

This polymer can thermally conduct and remove heat much more efficiently. The researchers believe polymers could be made into next-generation heat conductors for advanced thermal management applications, such as a self-cooling alternative to current electronics casings. The team has attempted to turn natural thermal insulators into conductors. For electronics, polymers would offer a unique combination of properties, as they are lightweight, flexible, and chemically inert. Polymers are also electrically insulating, meaning they do not conduct electricity, and can therefore be used to prevent devices such as laptops and mobile phones from short-circuiting in their users' hands.

The technique stretched the messy, disordered polymers into ultrathin, ordered chains - much like untangling a string of holiday lights. The researchers found that the resulting chains enabled heat to skip easily along and through the material, and that the polymer conducted 300 times as much heat compared with ordinary plastics. But the insulator-turned-conductor could only dissipate heat in one direction, along the length of each polymer chain. Heat couldn't travel between polymer chains, due to weak Van der Waals

forces - a phenomenon that essentially attracts two or more molecules close to each other. The team ultimately produced a heat-conducting polymer known as polythiophene, a type of conjugated polymer that is commonly used in many electronic devices.



Engineers turn plastic insulator into heat conductor
source - mit.edu

The researchers develop a new way to engineer a polymer conductor using oxidative chemical vapor deposition (oCVD), whereby two vapors are directed into a chamber and onto a substrate, where they interact and form a film. They flowed the oxidant into a chamber, along with a vapor of monomers - individual molecular units that, when oxidized, form into the chains known as polymers. Going forward, the team will continue exploring the fundamental physics behind polymer conductivity, as well as ways to enable the material to be used in electronics and other products, such as casings for batteries, and films for printed circuit boards.

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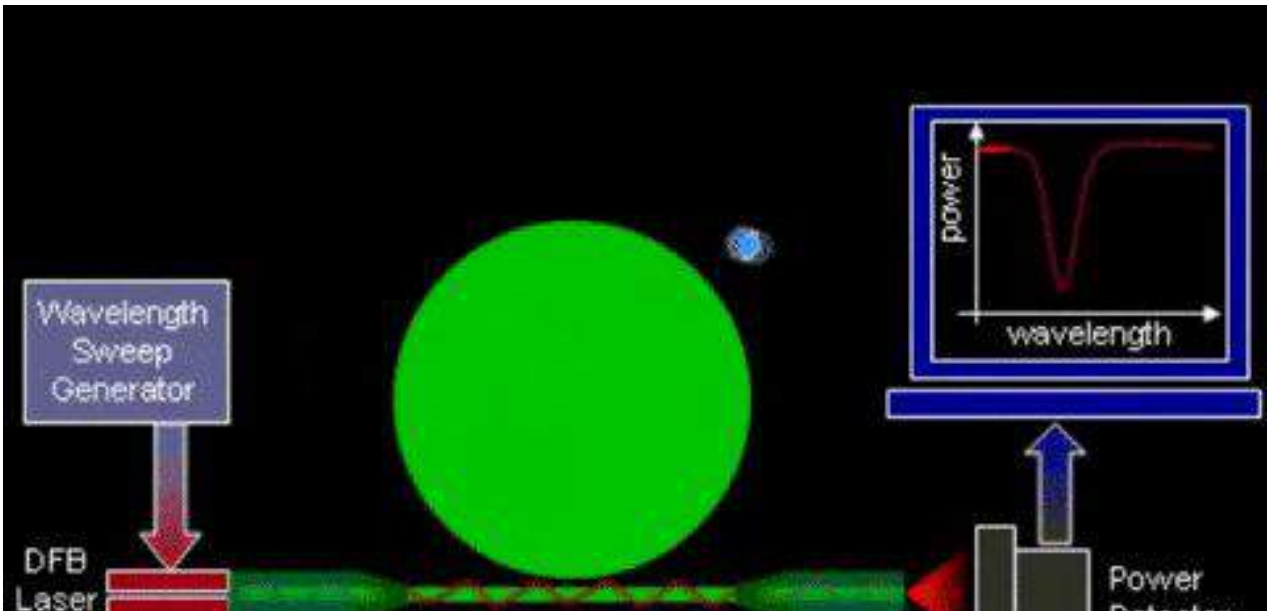
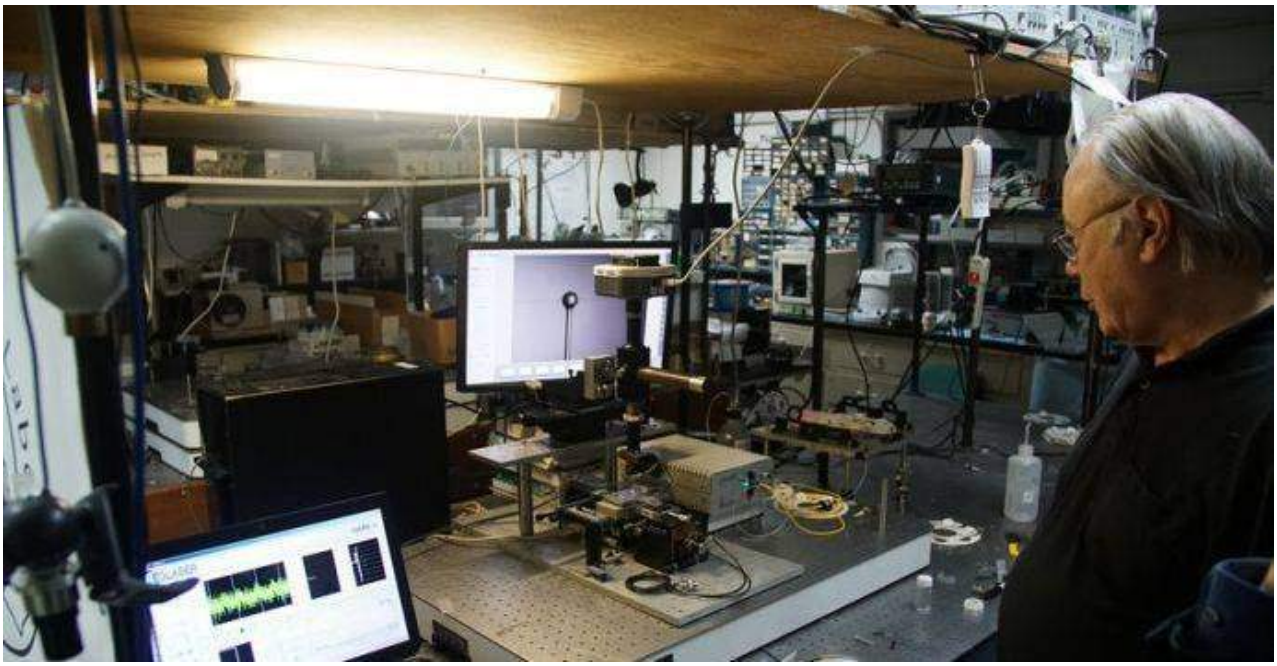
Regions:	United States
Industries:	Electronics
Source links:	MIT News



PHOTONIC BIOSENSORS COULD LEAD TO SUPER-ACCURATE DIAGNOSTICS AND DETECTION

A novel type of sensor that is able to find cancer in blood has been developed by the researchers at New York University. The researchers devised a way to make Whispering Gallery Mode (WGM) biosensors sensitive enough to identify even the smallest individual bio-particles from the RNA virus MS2 to single molecules down to 6 zepto-grams (6×10-21 grams), below the mass of all known cancer markers. Many companies, including Genalyte, employ WGM biosensors in diagnostic products that can perform dozens of bioassays in minutes.

Now, the team of researchers is the first to find a way to determine the density of charges on an area of a WGM micro-bead's surface, as well as the charge of an ensnared nanoparticle or virus, by measuring how light frequency fluctuates as the tiny particle follows its wobbly course around the sphere. This discovery could allow researchers and manufacturers not just to identify nanoparticles, but to manipulate them.



Researcher Stephen Arnold observes a whispering gallery mode biosensor setup
source - nyu.edu

The WGM biosensor, which was named for the famous Whispering Gallery in tee dome of St. Paul's Cathedral in London, is a device the size of a small smartphone comprising a tunable laser guided down a specially treated fiber optic filament with a detector at the far end of the filament measuring the light's intensity and resonance. A tiny silica bead next to the filament diverts a portion of the light beam, which begins to resonate within the bead the way sound resonates under the dome of the church gallery for which the phenomenon is named.

While the WGM biosensor's ability to identify individual nanoparticles led to highly sensitive measuring capabilities, the researchers's latest discovery could make possible biosensors tailored to very specific applications, from wearable sensors for soldiers and rescuers designed to detect extremely low concentrations of a suspected airborne nerve agent, to ways of increasing the efficiency of nanoparticle drug uptake and redistribution. Charge controls the ability to transport particles that are interacting with cells and other

objects that possess electric fields. By determining the charge of a virus, for instance, the researchers can understand how it can be transported to the cell surface.

The researchers were able to extract the electrostatic force between the orbiting nanoparticle and the surface of the glass bead through experiments based on the observation that the nano-orbital phenomenon requires a near balance between the electrostatic force and the known optical tractor beam force, just as a weighing scale balances the force of a spring against your body's weight. The difference in the strength of the force being measured is extraordinarily small.

With this force in hand both the charge on the nanoparticle and the microcavity charge density could be calculated through a series of experiments. The team next plans to use the discovery to develop technology for 'photonic printing,' the ability to quickly create numerous task-specific WGM biosensors, with specific molecules attached to specific areas of the micro-bead.

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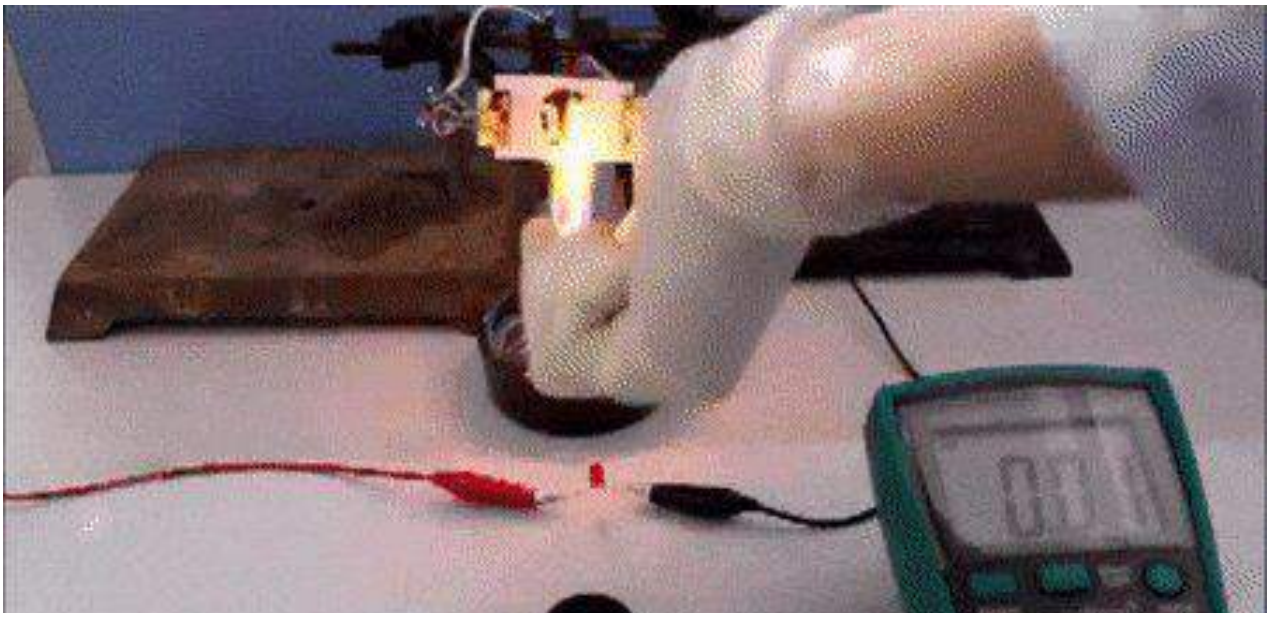
Regions:	United States
Industries:	Electronics, Healthcare
Source links:	NYU News



FIRE ALARM WALLPAPER DETECTS, RESISTS, AND WARNS OF HOUSE FIRES

A 'fire alarm wallpaper' made of environmentally friendly, nonflammable materials - including some of the materials found in bone, teeth, and hormones - that can detect a fire, prevent the fire from spreading, and give off an alarm when a fire occurs has been developed by the researchers at Chinese Academy of Sciences. When exposed to heat, the wallpaper is transformed from an electrically insulating state into an electrically conductive one, causing it to automatically trigger an alarm that generates loud sounds and warning lights.

Compared with flammable commercial wallpaper, the fire-resistant wallpaper is superior owing to its excellent high-temperature resistance, nonflammability, and automatic fire alarm function. The fire-resistant wallpaper has a white color, mechanical robustness, and high flexibility, it can be processed into different shapes, dyed with various colors, and printed with a commercial printer.

Whenever a fire occurs, the wallpaper often causes the fire to spread
source - shutterstock.com

Therefore, the fire alarm fire-resistant wallpaper has perspective applications in high-safety interior decoration to save human lives and decrease the loss of property in a fire disaster. The new wallpaper is based on hydroxyapatite, which is the primary inorganic component of bone and teeth. Although hydroxyapatite is typically brittle and inflexible, in previous work, the researchers found that forming ultralong nanowires made of hydroxyapatite gives the material a high flexibility suitable for making wallpaper.

In order to make the nonflammable wallpaper a 'smart material' capable of automatically sounding an alarm in response to a fire, the researchers incorporated an ink-based thermosensitive sensor onto the wallpaper. The thermosensitive sensor is fabricated on the surface of the wallpaper by a simple drop-casting process using an ink containing graphene oxide. The tiny sensor is placed on the backside of the fire-resistant wallpaper so that it is out of sight and protected by the fireproof wallpaper.

The sensor is composed primarily of graphene oxide, which is electrically insulating at room temperature. However, when exposed to heat, the oxygen-containing groups are

removed, making the material highly conductive. The sensor is connected to an alarm, so when a fire occurs and the sensor begins to conduct electricity, it causes the alarm to go off.

Initially, one problem with the graphene oxide sensor was that it burned out very quickly, so that the alarm only lasted for about three seconds. To enhance this, the researchers modified the graphene oxide with polydopamine - a material based on the hormone and neurotransmitter dopamine, found in living organisms. The polydopamine-modified graphene oxide has a much lower thermal responsive temperature than graphene oxide by itself, meaning that it not only responds to fire more quickly (in about two seconds), but also has a prolonged alarm time of more than five minutes. In the future, the researchers plan to scale up production of the wallpaper, as well as investigate other applications of the new fire-resistant material.

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On market since:	-
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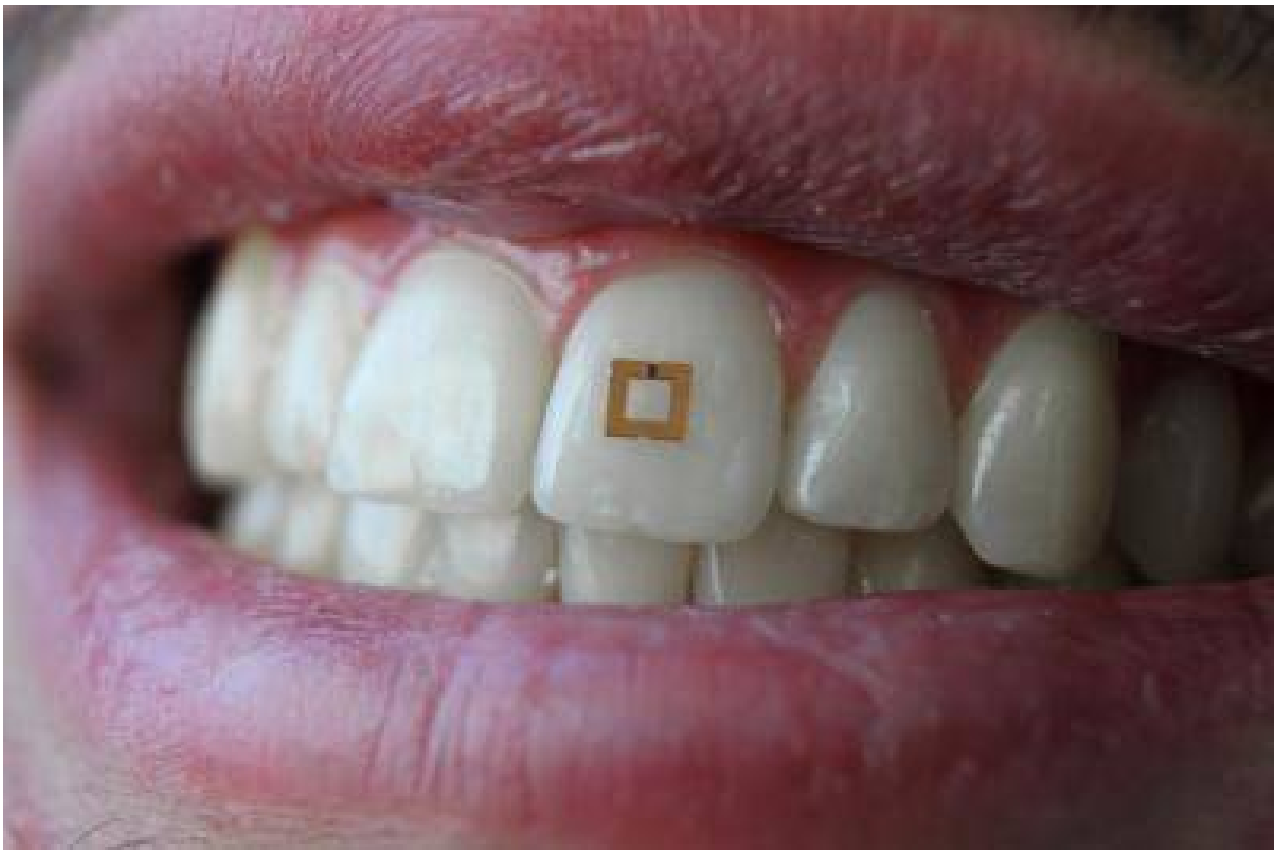
Industries:	Manufacturing

THE TINY TOOTH-MOUNTED SENSORS THAT CAN TRACK WHAT YOU EAT

The miniaturized sensors that, when mounted directly on a tooth and communicating wirelessly with a mobile device, can transmit information on glucose, salt and alcohol intake have been developed by researchers at the Tufts University School of Engineering. The researchers note that future adaptations of these sensors could enable the detection and recording of a wide range of nutrients, chemicals, and physiological states.

You are what you eat. In today's society many people seem to ignore this fact, with obesity and related welfare diseases all around them. While physical activity can obviously solve parts of the problem food intake and food quality aro very important factors to tackle unhealthy habits. Tracking food intake is not easy though, since it often is boring, tiring and offers lots of chances to lie to yourself by entering 'wrong' data (on purpose) into the thousands of apps that you can find on the market right now. Not even speaking of keeping track of what you eat in a manual food diary. That's why people looked for new devices tracking food intake automatically without you having to worry about numbers, quantities, and meals.



Tooth sensor
source - tufts.edu

Monitoring in real time what happens in and around human bodies can be invaluable in the context of health care or clinical studies, but not so easy to do. Previous wearable devices for monitoring dietary intake suffered from limitations such as requiring the use of a mouth guard, bulky wiring, or necessitating frequent replacement as the sensors rapidly degraded.

Tufts engineers sought a more adoptable technology and developed a sensor with a mere

2mm x 2mm footprint that can flexibly conform and bond to the irregular surface of a tooth. In a similar fashion to the way a toll is collected on a highway, the sensors transmit their data wirelessly in response to an incoming radiofrequency signal. The sensors are made up of three sandwiched layers: a central 'bioresponsive' layer that absorbs the nutrient or other chemicals to be detected, and outer layers consisting of two square-shaped gold rings. Together, the three layers act like a tiny antenna, collecting and transmitting waves in the radiofrequency spectrum. As an incoming wave hits the sensor, some of it is cancelled out and the rest transmitted back, just like a patch of blue paint absorbs redder wavelengths and reflects the blue back to the eyes.

Wireless real-time monitoring could add precision to the linkage between diet and health
source - shutterstock.com

The sensor, however, can change its 'color.' For instance, if the central layer takes on salt, or ethanol, its electrical properties will shift, causing the sensor to absorb and transmit a different spectrum of radiofrequency waves, with varying intensity. That is how nutrients and other analytes can be detected and measured. In theory the team of researchers can modify the bioresponsive layer in these sensors to target other chemicals - the scientists are really limited only by their creativity. The researchers have extended common RFID (radiofrequency ID) technology to a sensor package that can dynamically read and transmit information on its environment, whether it is affixed to a tooth, to skin, or any other surface.

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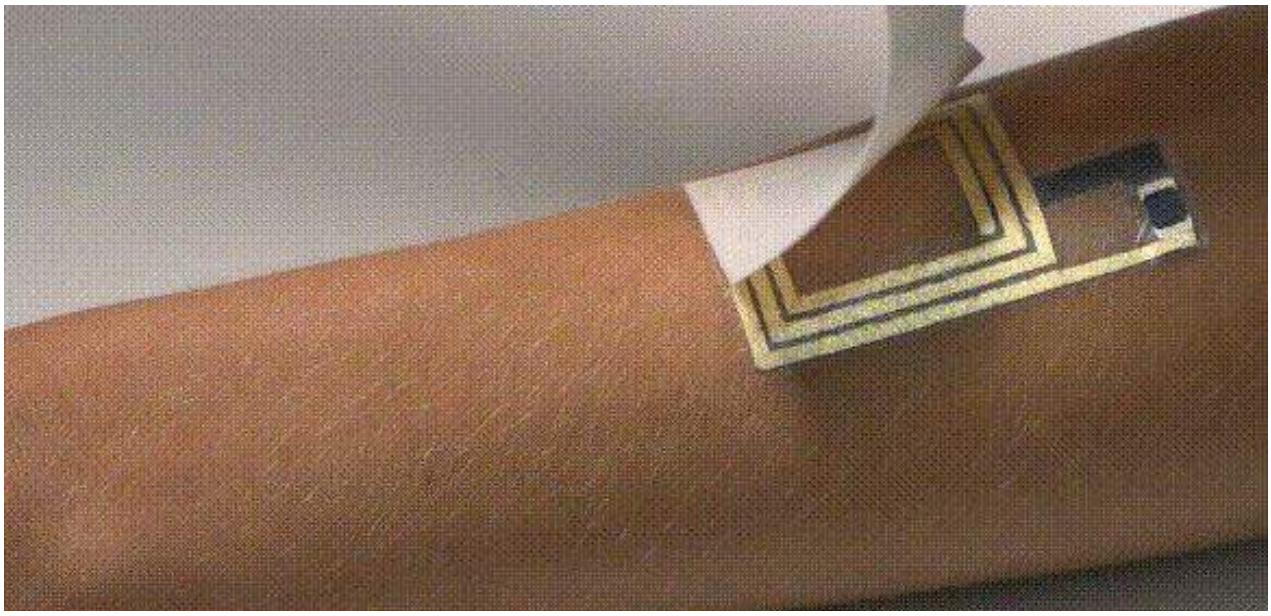
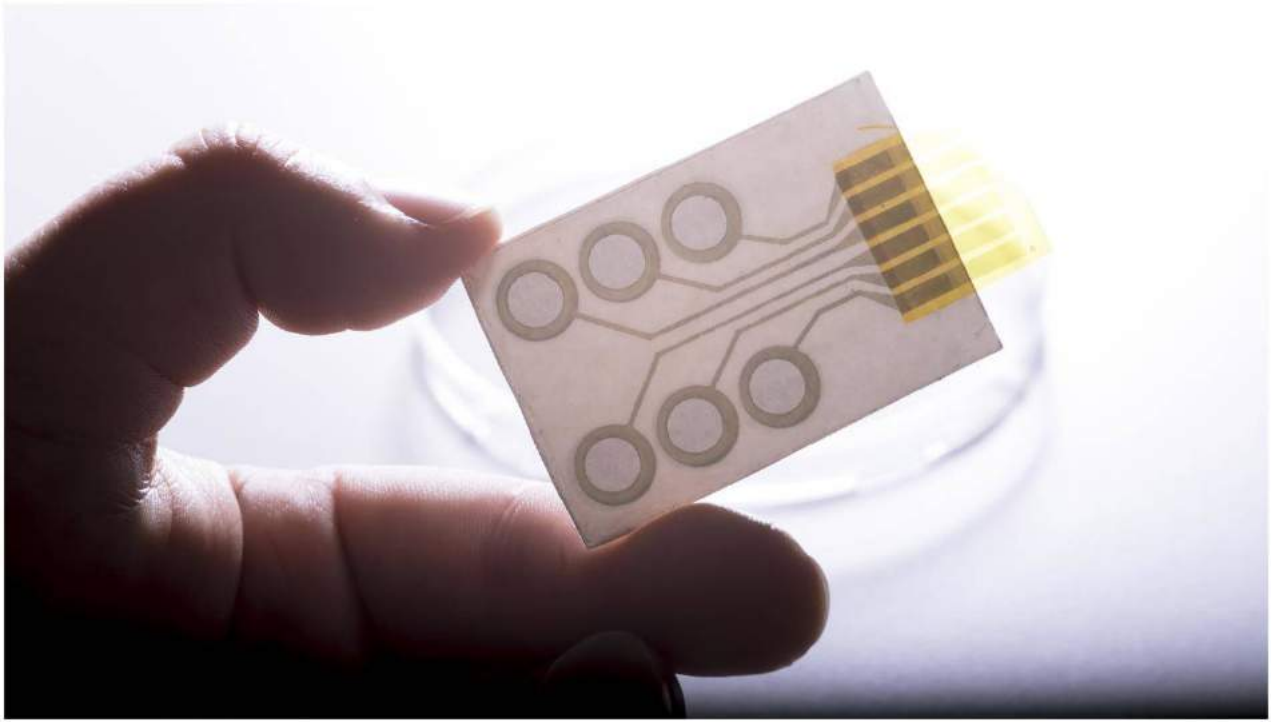
Regions:	United States
Industries:	Electronics, Healthcare
Source links:	Tufts Now



TATTOO ELECTRODES WHICH ARE ATTRACTIVE FOR LONG-TERM MEDICAL DIAGNOSTICS

A novel method which raises the transmission of electrical impulses from human to machine to the next level using printed tattoo electrodes has been developed by the team of researchers at the Graz University of Technology and their colleagues from from Instituto Italiano di Tecnologia (IIT) Pontedera. In the case of diagnostic methods such as electrocardiogram (ECG) and electromyography (EMG), gel electrodes are the preferred method of transmitting electric impulses from the heart or muscle.

In clinical practice, the frequently stiff and cumbersome electrodes noticeably restrict the mobility of patients and are not very comfortable. Because the gel on the electrodes dries out after a short time, the possibilities of taking measurements over a longer period using this kind of electrode are limited. In the presented method, conducting polymers are printed on commercial temporary tattoo paper, that is why producing single or multiple electrode arrangements.



Conductive polymers printed on a standard decal paper form the tattoo electrodes
source - tugraz.at

The external connections necessary for transmitting the signals are integrated directly in the tattoo. The tattoo electrodes are applied after that to the skin like temporary transfer pictures and can hardly be felt by the wearer. Due to their extreme thinness of under one micrometre, the electrodes can be adapted perfectly to the uneven human skin, and can even be applied to parts of the body where traditional electrodes are not suitable, for instance the face. With this method, the scientists have managed to take a big step forward in further developing epidermal electronics. The team of researchers is on a direct road to making an extremely economical and simple as well as versatile applicable system which has enormous market potential. There is already concrete interest from international biomedical companies in the shared development of marketable products.

Another feature of the printer-created tattoo electrodes is that even a perforation of the

tattoo, for instance through the growth of a hair, does not impair the conductivity of the electrode and the signal transmission. This is particularly relevant in the case of long-term applications because hair growth leads to inaccuracies in the results using traditional measuring methods. Flawless transmissions of up to three days were trialled in the tests of the team of researchers.

This is Francesco Greco, the researcher at TU Graz in Austria, with a temporary tattoo electrode
source - tugraz.at

This facilitates the measurement of electrophysiological signals of patients and athletes over a longer period without restricting or influencing their normal activities. Electrodes of different sizes and arrangements could also be produced using the printer and individually adapted to the respective body part on which the measurement is to be carried out. The team of researchers is working on the development of wireless tattoo electrodes with integrated transistor which would make it possible to both send and receive signals. They could not only measure impulses using this method, but also stimulate body regions in a targeted way.

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On market since:	-
Regions:	Austria, Italy
Industries:	Electronics, Healthcare
Source links:	TU Graz Current News

LASER-BASED SENSING SYSTEM CAN DETECT METHANE LEAKS FROM MILES AWAY

A novel field instrument that is able to detect and quantify methane leaks as tiny as one-quarter of a human exhalation from nearly a mile away has been developed by a collaborative team of CU Boulder researchers. The revamped and 'ruggedized' laser technology turns a complex, room-sized collection of instruments into a sleek, 19-inch portable unit to tote into the field near oil and gas operations. The instrument collects precise, nonstop data, providing game-changing information critical for safe industry operations and controlling harmful greenhouse gas emissions.

Detecting methane and other gas leaks from oil and gas operations has traditionally been hampered by high costs and technological constraints, which have limited efforts to provide continuous monitoring. The new technology, which relies on a laser system called a dual frequency comb spectrometer, provides a much-needed solution: extremely effective, accurate data collection at a fraction of the cost of previous technologies.

A new field instrument can quantify very tiny methane leaks
source - iStock.com

This instrument is particularly special because it's precise, autonomous, and continuous. Other technologies like aircraft flybys or physically traveling to sampling sites pose a problem - if a leak occurs between sampling events, the researchers missed it. Continuous monitoring could help industry operators catch not only frequent, small leaks, but large, infrequent ones. Such 'super emitters' are thought to comprise only 20 percent of leaks, but cause 80 percent of emissions.

When it came to applying this technology to real-world methane leak detection, a team scaled down what was originally a room brimming with instrumentation to a 19-inch box that could be carried into the field. The researchers figured out how to use wind patterns to investigate possible leak points, enabling their frequency-comb based observing system to pinpoint the source of a methane leak. The researchers ended up creating an instrument that was mobile, portable, and robust - it works better than the original, at a

tenth of the cost.

The instrument sits on a mobile platform that can be placed out in field sites surrounded by oil and gas operations. It swivels 360 degrees, sending out carefully-tuned, invisible beams of light to reflect off small mirrors placed a mile or more away. If the beam, composed of over 100,000 wavelengths, passes through part of a gas plume blowing like a ribbon through the air, gases in the plume absorb some of the light in the beam before it returns to the detector. This lets researchers identify the unique absorption 'fingerprints' of gases like methane and carbon dioxide. And with atmospheric models, researchers can track back to an actual leak location. As part of an effort to provide a service that can give oil and gas operators more effective and cheaper leak detection, the researchers are launching a spin-off called Longpath Technologies. They will continue to grow this alongside the emerging technology it relies on.

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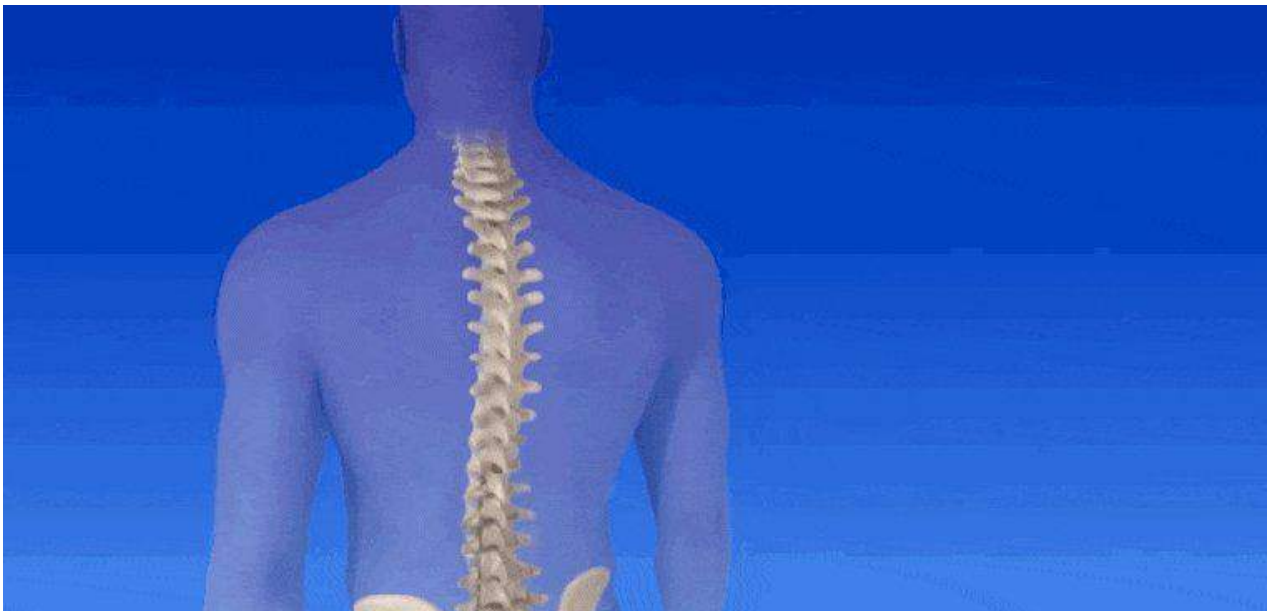
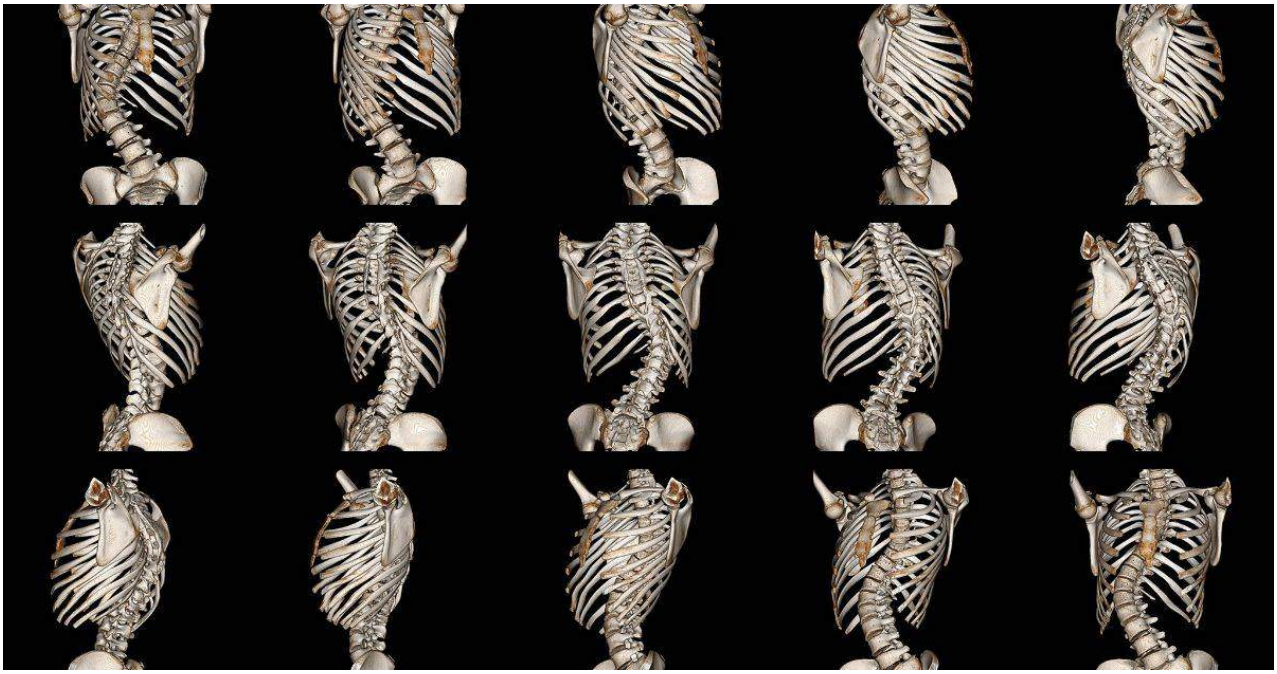
On market since:	-
Regions:	United States
Industries:	Environment
Source links:	CU Boulder Today



ELASTIC METAL RODS TO TREAT SCOLIOSIS

A novel combination of alloy processing that produces solid and durable implants that are fully compatible with the human body has been developed by the researchers at Ecole de Technologie Superiore. This new generation of alloys made on the basis of Ti-Zr-Nb (titanium-zirconium-niobium) which possesses a high functional complex and so-called 'superelasticity' (able to restore the original shape against large and repeated deformation) are the working material.

Scoliosis is a sideways curvature of the spine that occurs most often during the growth spurt just before puberty. While scoliosis can be caused by conditions such as cerebral palsy and muscular dystrophy, the cause of most scoliosis is unknown. Most cases of scoliosis are mild, but some children develop spine deformities that continue to get more severe as they grow. Severe scoliosis can be disabling. An especially severe spinal curve can decrease the amount of space within the chest, making it complicated for the lungs to function properly.



Scoliosis
source - iStock.com

Children who have mild scoliosis are monitored closely, usually with X-rays, to see if the curve is getting worse. In many cases, no treatment is necessary. Some children will need to wear a brace to stop the curve from worsening. Others may need surgery to keep the scoliosis from worsening and to straighten severe cases of scoliosis. If a scoliosis curve gets worse, the spine will also rotate or twist, in addition to curving side to side. This causes the ribs on one side of the body to stick out farther than on the other side.

The team of researchers sought to develop an industrial technology for the production of metal rod stocks which are used in the production of modern bone implants, and in particular, for treatment of spinal problems. These alloys are the most perspective class of metallic biomaterials. This is due to the unique combination of their biochemical and biomechanical properties: Ti-Zr-Nb differs from the complete biocompatibility of

composition and high corrosion resistance, while at the same time exhibiting hyperelastic behavior - very similar to 'normal' bone behavior.

These are elastic metal rods
source - etsmtl.ca

This method of combined thermomechanical processing of alloys - particularly, radial-displacement rolling and rotary forging - allows researchers to get the highest quality blanks for biocompatible implants by controlling their structure and properties. Such processing of blanks gives them an outstanding resistance to fatigue and overall functional stability. According to the team of researchers, the high-quality rod stocks have already found a potential customer. The scientists are now developing a technology to obtain beams for spinal transpedicular fixation, which should enhance the therapy quality in severe cases of scoliosis. In addition, scientists are now aimed at developing the thermomechanical processing and optimizing technology modes to obtain materials of the necessary form and sizes with the best complexity of properties.

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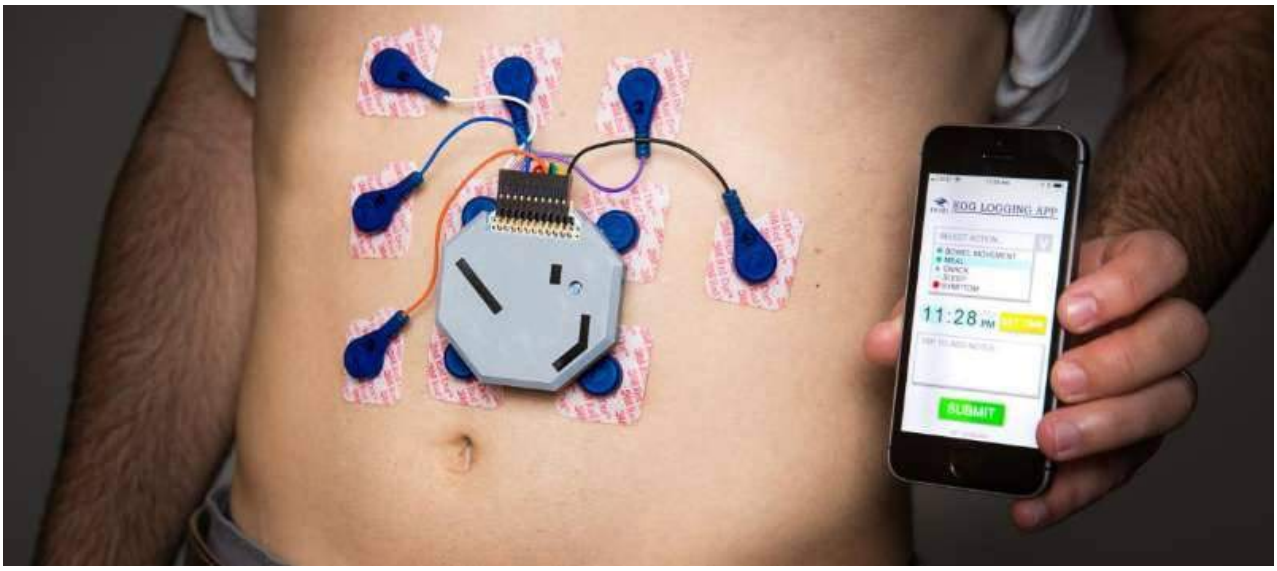
On market since:	-
Regions:	United States, Canada
Source links:	Ecole de Technologie Superieure

A NEW SYSTEM TO MONITOR THE STOMACH'S ACTIVITY THROUGHOUT THE DAY

A wearable, non-invasive system to monitor electrical activity in the stomach over 24 hours, essentially an electrocardiogram but for the gastro-intestinal (GI) tract, has been developed by researchers at the University of California, San Diego. Applications include monitoring GI activity for patients outside of a clinical setting, which cuts down costs. Monitoring for longer periods of time also increases the likelihood of capturing abnormal events.

The researchers tested the device, a 3D printed portable box connected to 10 small wearable electrodes, on 11 children and one adult volunteer. They found that data collected with the wearable system were comparable to data collected in the clinic with state-of-the-art methods, which are invasive, including a catheter inserted through the patient's nose. They also found that the stomach's electrical activity changes not only around meals, but also during sleep, following its own circadian rhythm.

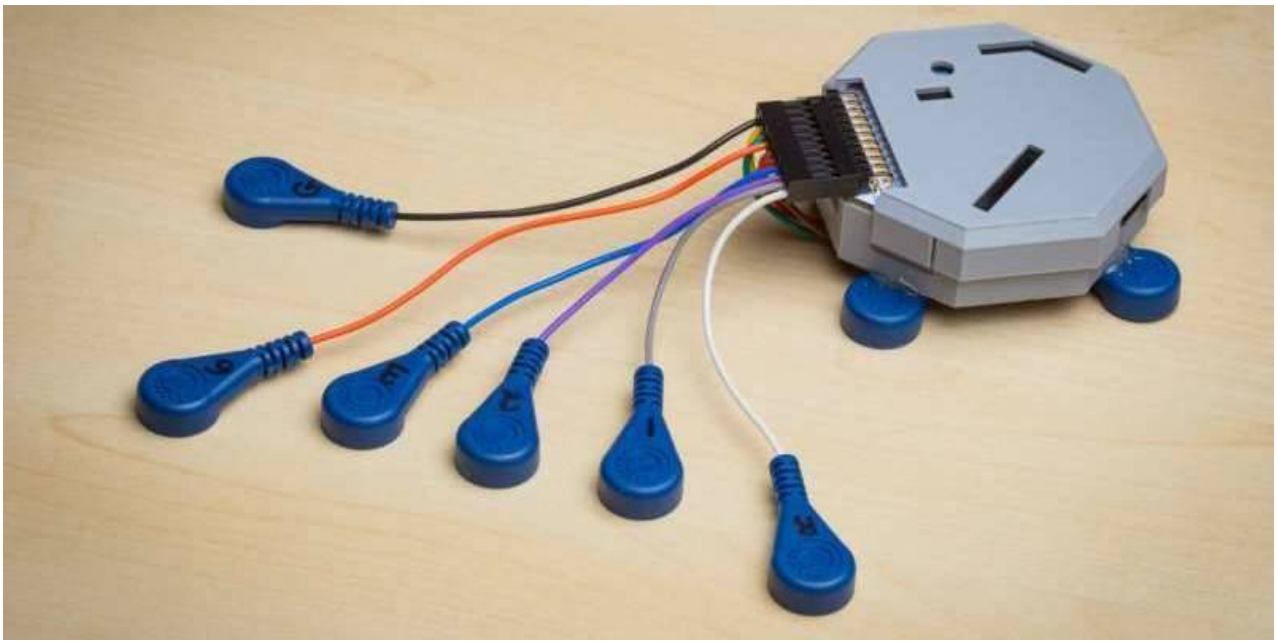


A new wearable system
source - ucsd.edu

The researchers believe their system will spark a new kind of medicine, where a gastroenterologist can quickly see where and when a part of the GI tract is showing abnormal rhythms and as a result make more accurate, faster and personalized diagnoses. This work opens the door accurately monitoring the dynamic activity of the GI system. Until now, it was quite challenging to accurately measure the electrical patterns of stomach activity in a continuous manner, outside of a clinical setting. But from now, the researchers will be able to observe patterns and analyze them in both healthy and unwell people as they go about their daily lives.

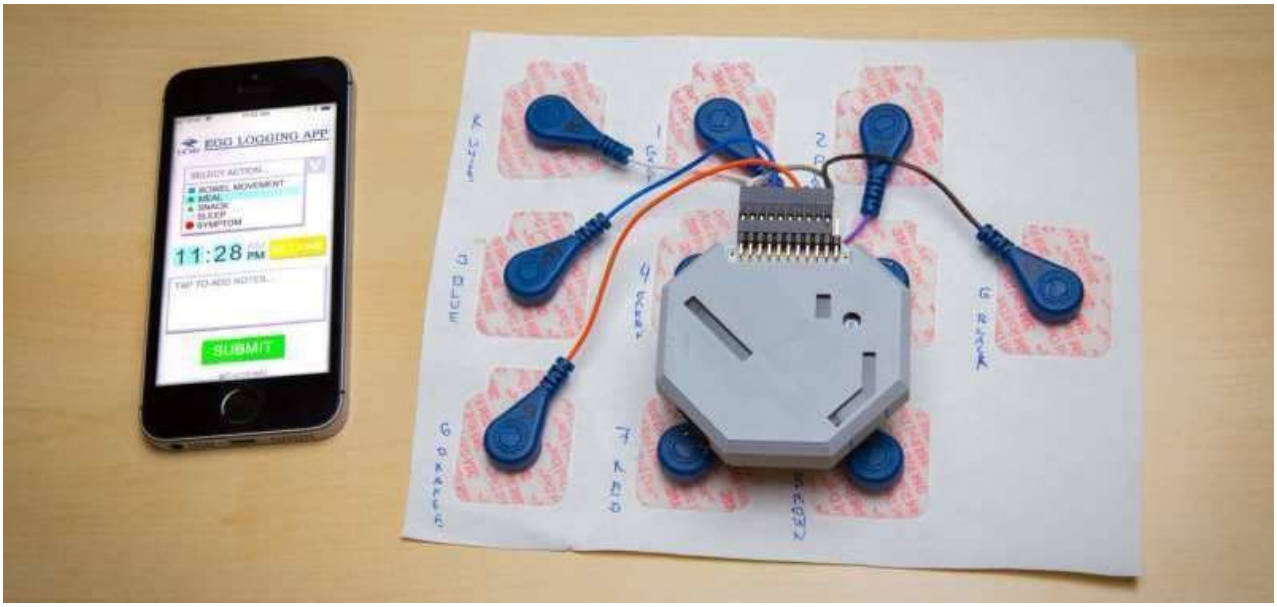
The device meets an unmet clinical need. This will help the reseerchers determine if the stomach is functioning properly during meals and, most significantly, when patients are experiencing symptoms such as nausea and belly pain. The breakthrough was made possible because engineers and physicians came together to work on the problem. The device itself uses off-the-shelf electrodes used in electrocardiograms. The electronics and battery are encased in a 3D printed box and connected to the electrodes, which fit on a

person's abdomen just over the stomach. The team of researchers verified the device on 11 pediatric patients at Rady Children's Hospital in San Diego. These patients had been undergoing an invasive procedure called manometry, one of a couple clinical gold standards for objectively monitoring GI tract activity. The procedure requires using a catheter inserted through the nose to measure pressure at several points inside the stomach. Comparing the two methods demonstrated that data collected by the wearable device was robust and reliable.



The system is made up of a custom circuit board, a battery and off-the-shelf electrodes
source - ucsd.edu

The system is currently paired with a smart phone app that allows patients to log their meals, sleep and other activities. The long-term goal is to design an app that would allow patients and physicians to see the data collected by the device in real time. This is analogous to going from switchboard operators straight to smart phones for gastroenterology.



The system and its accompanying app, which allows patients to log meals, sleep and other activities
source - ucsd.edu

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On market since:	-
Regions:	United States
Industries:	Healthcare
Source links:	UCSD News

NEW VALVE TECHNOLOGY PROMISES CHEAPER, GREENER ENGINES

A new technology that reliably and affordably increases the efficiency of internal combustion engines by more than 10 per cent has been developed by the team of researchers at the University of Waterloo. The product of a decade of research, this patented system for opening and closing valves could significantly reduce fuel consumption in everything from ocean-going ships to compact cars.

The internal combustion engine is an engine in which the burning of a fuel occurs in a confined space called a combustion chamber. This exothermic reaction of a fuel with an oxidizer creates gases of high temperature and preasure which are permitted to expand. The defining feature of an internal combustion engine is that useful work is performed by the expanding hot gases acting directly to cause movement, for instance by acting on pistons, rotors, or even by pressing on and moving the entire engine itself. Modern engines have a maximum thermal efficiency of about 25% to 50% when used to power a car. The most efficient internal combustion engines are the behemoths installed in large ships which can reach a bit over 50% efficiency, but again, they are so big that the surface area to volume ratios are much smaller in every way and so the friction and heat rejection is tiny.

The team of researchers
source - uwaterloo.ca

This method has the potential to bring the well-established benefits of a fully variable valve system out of the lab and into production engines because cost and complexity aren't issues. The research was led by Amir Khajepour, a professor of mechanical and mechatronics engineering at Waterloo. He is also a Canada Research Chair and director of Waterloo's Mechatronic Vehicle Systems Lab. Intake and exhaust valves in internal combustion engines are typically controlled by cam mechanisms that do not allow the timing of their opening and closing to be varied.

The technology developed by Waterloo team of researchers replaces cams with hydraulic

cylinders and rotary hydraulic valves that enable fully variable timing as the speed and torque of an engine change. This ability to specifically time the opening and closing of valves according to engine operation is a key to increasing fuel efficiency, reducing both costs and greenhouse gas emissions. The ideal solution is to make the motion of the valve completely controllable. Although other systems to vary valve timing already exist, they are limited to use in experimental engines in laboratories due to their high cost and complexity.

This technology increases the efficiency of internal combustion engines by more than 10 percent
source - iStock.com

The technology developed and tested at Waterloo is much simpler and far less expensive, paving the way for its use in engines for power generation, mining vehicles, the trucking industry and a host of other applications, including the consumer automotive market. The team of researchers believes that an affordable, reliable method to vary valve timing in internal combustion engines could substantially decrease the carbon footprint during the transition to cleaner electric powertrains over the next few decades. The researchers should be able to easily enhance efficiency by over 10 per cent, which is significant.

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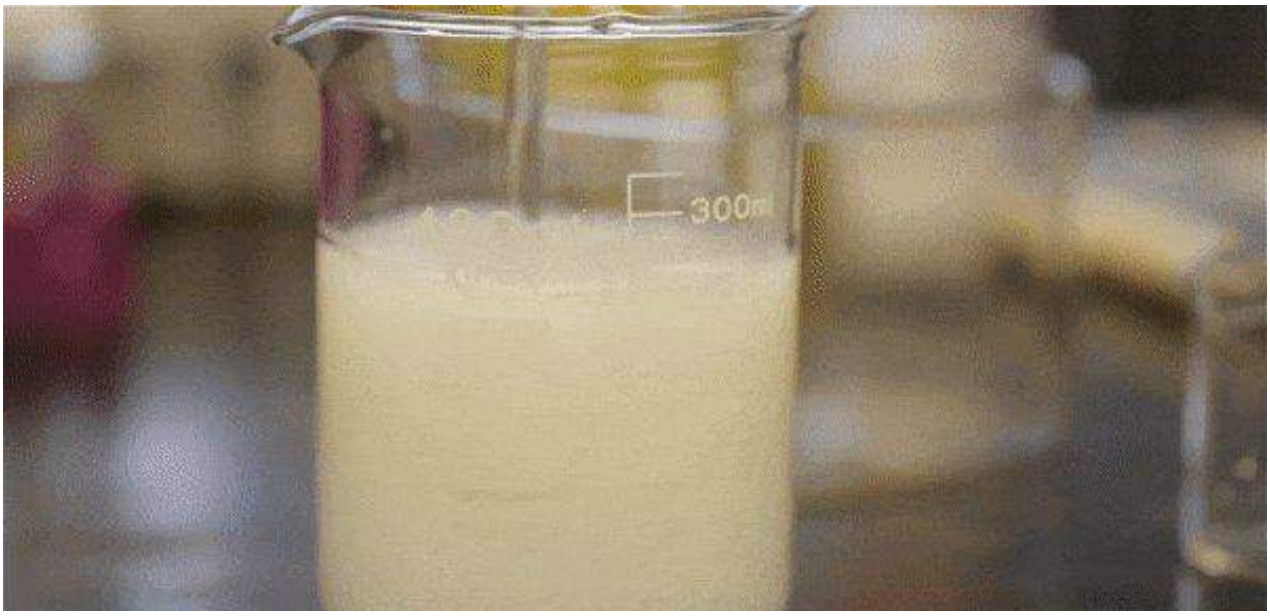
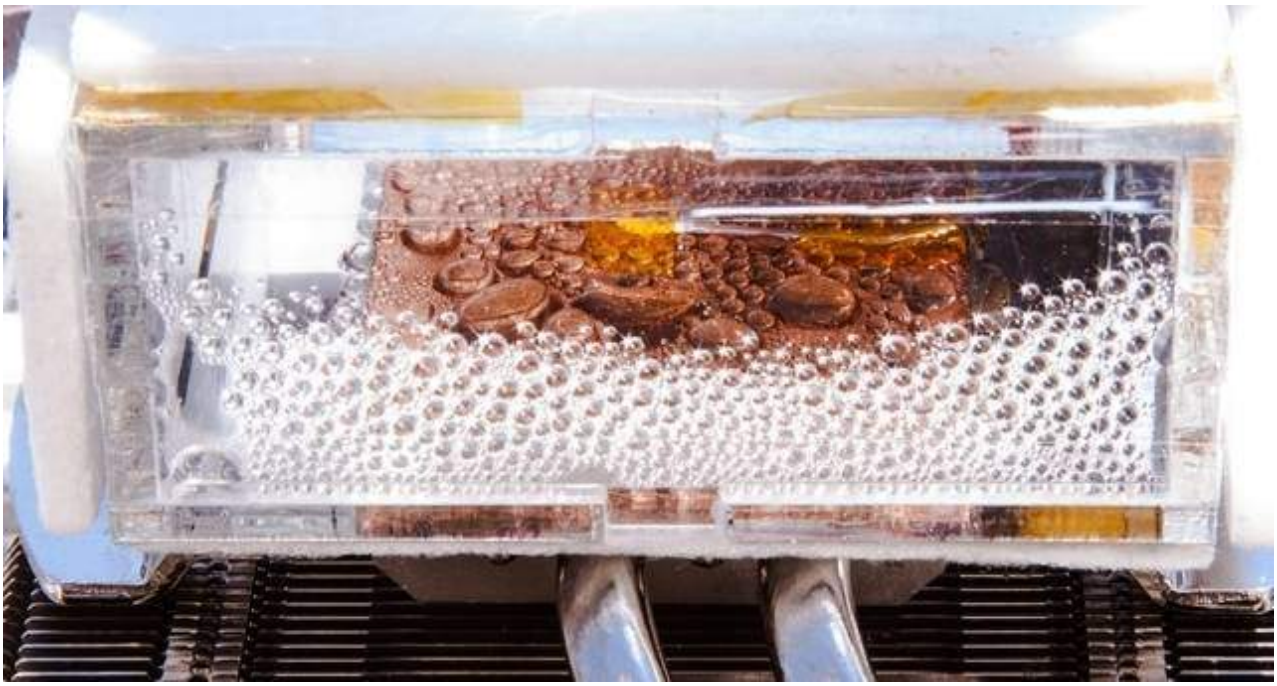
On market since:	-
Regions:	Canada
Industries:	Transport Systems and Vehicles
Source links:	University of Waterloo News



A NEW SYSTEM THAT COULD PROVIDE DRINKING WATER EVEN IN EXTREMELY ARID LOCATIONS

A new device that is able to extract moisture from very dry air has been developed by the researchers at MIT. It seems like getting something for nothing, but you really can get drinkable water right out of the driest of desert air. Even in the most arid places on Earth, there is some moisture in the air, and a practical way to extract that moisture could be a key to survival in such bone-dry locations. Now, researchers at MIT have proved that such an extraction system can work.

The new device has now been field-tested in the very dry air of Tempe, Arizona, confirming the potential of the new method, though much work remains to scale up the process. The system, based on relatively new high-surface-area materials called metal-organic frameworks (MOFs), can extract potable water from even the driest of desert air with relative humidities as low as 10 percent. The existing methods for extracting water from air require much higher levels – 100 percent humidity for fog-harvesting methods, and above 50 percent for dew-harvesting refrigeration-based systems, which also require large amounts of energy for cooling. So the new system could potentially fill an unmet need for water even in the world's driest regions.



A new device harvests water from desert air
source - mit.edu

The test device was powered solely by sunlight, and although it was a small proof-of-concept device, if scaled up its output would be equivalent to more than a quarter-liter of water per day per kilogram of MOF. With an optimal material choice, the output can be as high as three times that of the current version.

Not only does this system work at lower humidities than dew harvesting does, but those systems require pumps and compressors that can wear out, whereas this has no moving parts. It can be operated in a completely passive manner, in places with low humidity but large amounts of sunlight. The current version can only operate over a single night-and-day cycle with sunlight, but continous operation is also possible by utilizing abundant low-

grade heat sources such as biomass and waste heat. The next step is to work on scaling up the system and boosting its efficiency. The researchers hope to have a system that's able to produce liters of water. These small, initial test systems were only designed to produce a few milliliters, to prove the concept worked in real-world conditions. The idea would be to produce units
sufficient to supply water for individual households.

A new system could provide drinking water even in extremely arid locations
source - iStock.com

The team verified the water produced by the system and found no traces of impurities. Mass-spectrometer testing demonstrated there's nothing from the MOF that leaches into the water. It shows the material is indeed very stable, and the researchers can get high-quality water. This technology is fantastic, because of the practical demonstration of an air-cooled water harvesting system based on MOFs operating in a real desert climate. This provides a new approach to solving the problem of water scarcity in arid climates. This technology, if one can further increase its production capacity, can have a real impact in areas where water is scarce, such as southern California.

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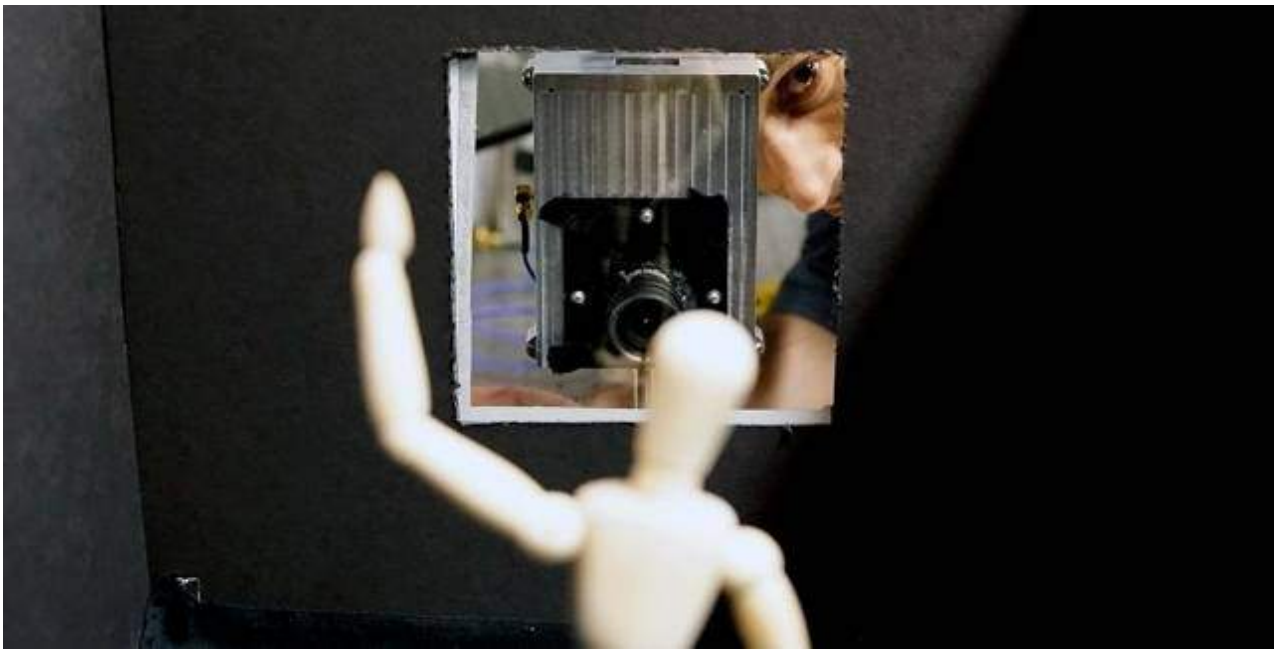
Industries:	Environment
Source links:	MIT News

DEPTH-SENSING IMAGING SYSTEM CAN PEER THROUGH THE FOG

A novel system that can produce images of objects shrouded by fog so thick that human vision can't penetrate it has been developed by the researchers at MIT. It can also gauge the objects' distance. An inability to handle misty driving conditions has been one of the chief obstacles to the development of autonomous vehicular navigation systems that use visible light, which are preferable to radar-based systems for their high resolution and ability to read road signs and track lane markers. So, the MIT system could be a crucial step toward new cars.

The researchers verified the system using a small tank of water with the vibrating motor from a humidifier immersed in it. In fog so dense that human vision could penetrate only 36 centimeters, the system was able to resolve images of objects and gauge their depth at a range of 57 centimeters. Fifty-seven centimeters is not a great distance, but the fog produced for the study is far denser than any that a human driver would have to contend with. In the real world, a typical fog might afford a visibility of about 30 to 50 meters. The vital point is that the system performed better than human vision, whereas most imaging systems perform far worse. A navigation system that was even as good as a human driver at driving in fog would be a significant breakthrough.



The system was able to resolve images of objects and gauge their depth at a range of 57 centimeters
source - mit.edu

The researchers are dealing with realistic fog, which is dynamic, dense and heterogeneous. It is constantly moving and changing, with patches of denser or less-dense fog. Other methods are not designed to cope with such realistic scenarios. The new system uses a time-of-flight camera, which fires ultrashort bursts of laser light into a scene and measures the time it takes their reflections to return.

On a clear day, the light's return time faithfully indicates the distances of the objects that reflected it. But fog causes light to 'scatter,' or bounce around in random ways. In foggy weather, most of the light that reaches the camera's sensor will have been reflected by airborne water droplets, not by the types of objects that autonomous vehicles need to avoid. And even the light that does reflect from potential obstacles will arrive at different

times, having been deflected by water droplets on both the way out and the way back. The MIT system gets around this problem. The patterns produced by fog-reflected light vary according to the fog's density. On average, light penetrates less deeply into a thick fog than it does into a light fog. But the MIT researchers were able to show that, no matter how thick the fog, the arrival times of the reflected light adhere to a statistical pattern known as a gamma distribution.

Guy Satat, a graduate student in the MIT Media Lab, who led the new study
source - mit.edu

The team tested the system using a fog chamber a meter long. Inside the chamber, they mounted regularly spaced distance markers, which provided a rough measure of visibility. They also placed a series of small objects, wooden blocks, a wooden figurine, silhouettes of letters, that the system was able to image even when they were indiscernible to the naked eye. This system was developed by Guy Satat, a graduate student.

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On market since:	-
Regions:	United States
Industries:	Transport Systems and Vehicles
Source links:	MIT News

NEXT-GEN SMOKE GRENADES COULD CLOAK SOLDIERS FROM INFRARED DETECTION

A novel kind of smoke that obscures both visible and infrared (IR) detection has been developed by the researchers at American Chemical Society. The military uses smoke grenades in dangerous situations to provide cover for people and tanks on the move. But the smoke arms race is on. Increasingly, sensors can now go beyond the visible range into the infrared (IR) region of the spectrum.

Because of the advancement of sensors beyond the visible region, the researchers need new, high-performing obscurants in the infrared region. Each obscurant can absorb or scatter light at a given frequency. Most of the smokes that the researchers use do well in either the visible or IR range. The objective of this program is to create what they call a bispectral obscurant, which works to block visible, as well as infrared detection.

A new type of smoke grenade that can obscure sensors in the visible and infrared ranges burns during a test
source - acs.org

To build a better puff of smoke, the team of researchers and their colleagues in the Smoke & Obscurants, Pyrotechnics, and Chemical Biological Filtration Branches started thinking about using a metal organic framework (MOF). Other scientists working at the institute, the U.S. Army's Edgewood Chemical Biological Center, have been studying these stable porous structures, and were working with one called UiO-66 that was made up of terephthalic acid, a known visible obscurant.

The traditional army smoke grenade is made with a toxic material, called hexachloroethane, but terephthalic acid grenades are emerging as a safer alternative. The rest of UiO-66 consists of large pores and a zirconium node that researchers proposed could absorb in the IR range. The question was whether UiO-66 would burn in such a way as to liberate the terephthalic acid from the framework, creating a smoke with both an IR-absorbing agent and a visible light obscurant. If the UiO-66 molecule didn't break apart, the terephthalic acid wouldn't be free to block the visible light. In a proof-of-principle experiment, the researchers packed UiO-66 into a grenade along with the pyrotechnic

agents that generate the burn. They placed it in a 249-cubic-yard chamber lined with sensors and set off the smoke grenade.

Smokescreens are used by armies to cover their tracks and hide them from enemies
source - acs.org

The team of researchers monitored visible and IR wavelengths. The researchers got some blockage in the visible range, though it wasn't as good as a true terephthalic acid grenade. In their opinion, they can enhance their performance by changing the recipe of the pyrotechnic portion and thereby better liberate the terephthalic acid from the framework. In the long term, the researchers plan to continue incorporating additional obscurants to the smoke, creating a kind of ‘Swiss army knife’ of smoke grenades. Ideally, the researchers would like one smoke device that hits multiple spectra, instead of multiple devices to hit each spectrum individually. The reason this is important to the army is that they want to minimize the amount of stuff a soldier has to carry. One grenade is definitely easier to haul than five. Bispectral screening smokes are of interest to the U.S. Army due to the proliferation of thermal imaging, night vision, and thermal guided threats.

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On market since:	-
Regions:	United States
Industries:	Aerospace, Defence and Marine
Source links:	American Chemical Society News

LIVING SENSOR CAN PREVENT ENVIRONMENTAL DISASTERS FROM FUEL SPILLS

A new technology that would alert pipeline managers about leaks as soon as failure begins, avoiding the environmental disasters and fuel distribution disruptions resulting from pipeline leaks, has been developed by the researchers at Mississippi State University. The advantage with this sensor is that it can detect very small leaks, and operators can take quick action to repair them. The researchers no longer have to wait until the leak is out of hand. In addition, if they are able to develop this system on a larger scale, the same unit would be able to treat the waste and to remediate the soil and water that has been contaminated.

Currently, the pipelines are inspected by a device called a smart pig, an electronic sensor that travels through the pipe detecting cracks or welding defects. In spite of regular inspection, leaks still occur. The team of researchers is developing a sensor that would complement this process by providing additional information about the integrity of the pipes. This sensor adheres to the outside of the pipe, and takes advantage of the metabolic process of bacteria to detect gas leaks in real time.

A new sensor is able to prevent environmental disasters from fuel spills
source - shutterstock.com

In previous approach, the researchers discovered the use of microorganisms in wastewater treatment, and they have recently turned their focus to building biosensors from similar species. In the current study, they are testing bacteria that will elicit an adequately measurable cathode voltage while also being able to survive in a marine environment for the application of offshore oil spill detection. For this to work, the bacteria have to remain robust through a range of alkalinity, pressure and pH conditions.

One type of bacteria the researchers are testing is referred to as ‘electrogenic,’ which means that it releases electrons to its environment through metabolic processes. The team developed an organic sensor composed of an electrogenic anode made up of bacteria that consume carbon-based material (gas or oil) and expel electrons. The electrons then travel across a resistor to a cathode. A different set of bacteria, hungry for electrons, resides at the cathode encouraging electron flow. An increase in the metabolic processes of the anode bacteria will correspond to a voltage increase in the sensor, which could alert a technician to a potential leak. The sensor is not complicated to implement. Placing the sensor onto a pipe is not a big challenge. It is a very versatile technique.

The Colonial Pipeline, which carries fuel from Texas to New York, ruptured last fall, dumping a quarter-million gallons of gas in rural Alabama
source - shutterstock.com

At the moment, the team of researchers is looking for a medium in which to immobilize the bacteria. They are testing high-porosity plastics and bio-based films that optimize the surface area that the electrogenic bacteria can cover. Once rugged bacteria are identified and immobilized, they can be utilized as leak detectors in a range of oil transport and drilling applications, including fracking. It is possible that at some point in the future the sensor could be sprayed as a coating on the exterior of pipes insuring that the entire length is continuously monitored.

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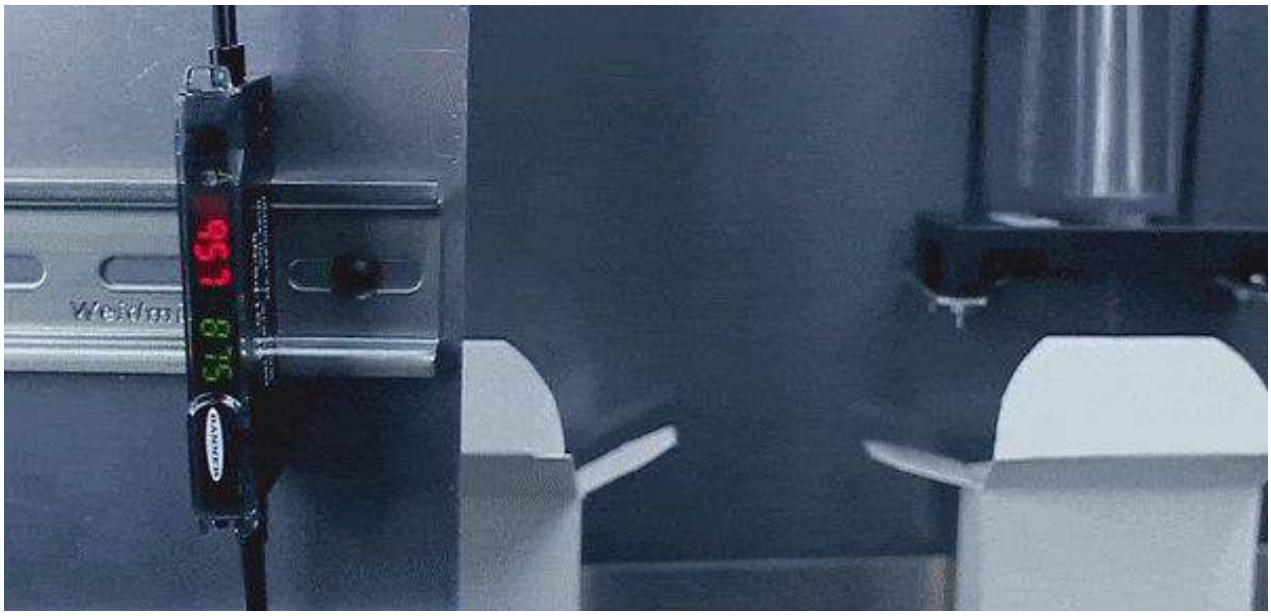
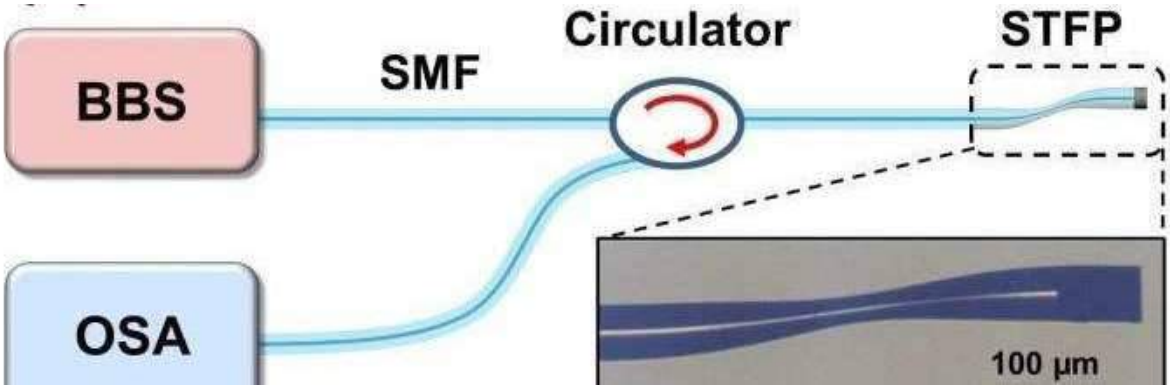
On market since:	-
Regions:	United States
Industries:	Environment
Source links:	Mississippi State University News



A NEW FIBER OPTIC SENSOR OFFERS SENSITIVE ANALYSIS IN NARROW SPACES

A new flexible sensor with high sensitivity that is designed to perform variety of chemical and biological analyses in very small spaces has been developed by the researchers at Optical Society of America. The sensor is small size means that it could potentially be used inside blood vessels. With additional development, the sensor might be used to detect specific chemicals, DNA molecules or viruses. This new fiber sensor has a simple structure and is inexpensive to make while being small enough for highly sensitive measurement in narrow areas. In the future, it could be used for chemical and biological sensing in a variety of applications.

The new sensor consists of a 1-millimeter long portion of the end of an optical fiber that narrows and is bent into a configuration called an S taper. By detecting changes in an optical property known as refractive index, the device can sense concentration, pH and other chemical parameters.



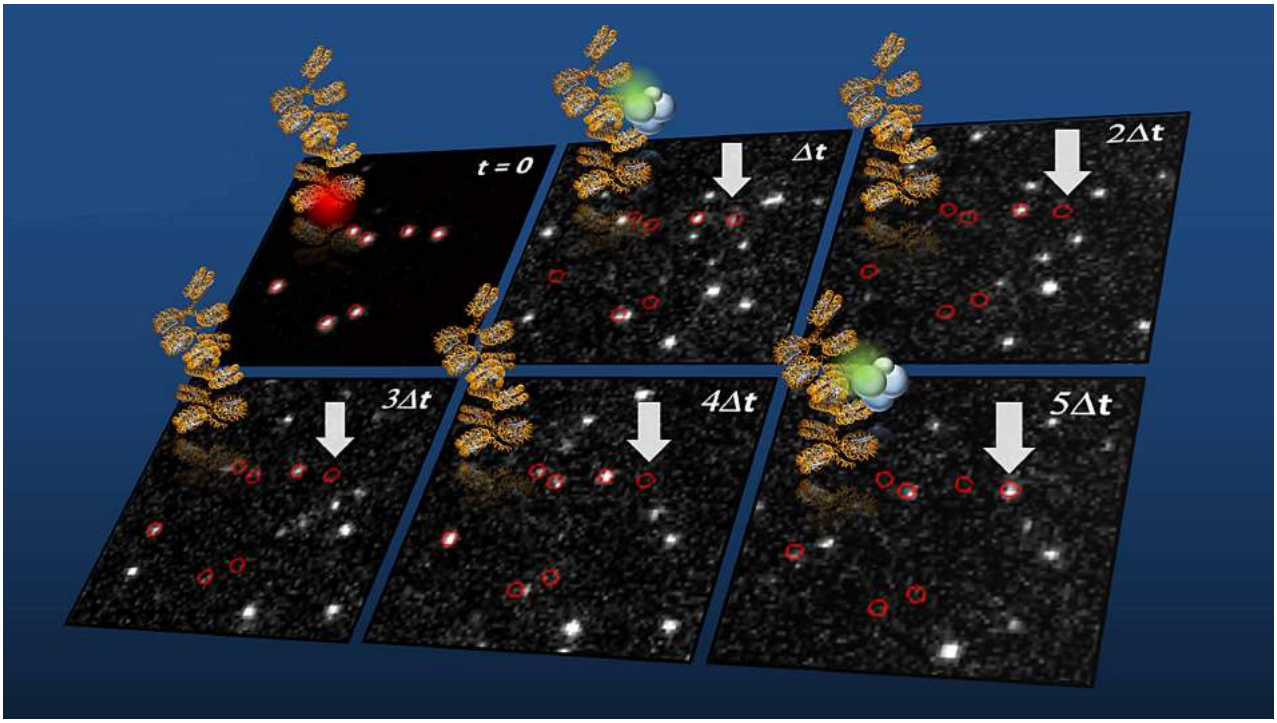
A new sensor, based on an S-tapered fiber probe
source - osa.org

To operate the sensor, the team of researchers sends white light from a special supercontinuum source through the fiber. When the light enters the fiber's tapered area, a portion of it escapes and interacts with the surrounding sample in a way that shifts the light's spectrum. This altered light hits a silver mirror at the end of the fiber and is reflected back through the fiber to an optical spectrum analyzer that monitors and records the change in spectrum. The spectral shifts can be utilized to determine the sample's chemical properties.

The novel sensor enhances upon one the researchers previously developed that also featured an S taper for refractive index sensing. To make it more helpful for narrow or limited spaces, they designed the new sensor to use reflected light rather than light that transmits through the sample. This change made the device's measurements less sensitive to small bends that the fiber might experience when inserted into a sample. The S-shaped taper also makes the sensing portion of the fiber smaller than other reflection refractive index sensors based on tapered fibers, which are too long to form a compact probe.

To verify the new sensor design, the team of researchers immersed it in different concentrations of glycerin-water solutions at room temperature. By monitoring the shift of the reflection spectra, the researchers demonstrated that the sensor was highly sensitive to refractive index changes in the surrounding solution. When they heated the sensor from

room temperature to 100 degrees Celsius in increments of 10 degrees, the reflection spectrum of the sensor changed very little. This demonstrated that temperature changes do not affect the accuracy of the sensor.



The sensor might be used to detect specific chemicals, DNA molecules or viruses
source - shutterstock.com

After that, the team of researchers plans to test whether making the fiber taper even narrower might further increase the sensor's sensitivity. They also want to make a version of the sensor with functionalized material on the fiber surface that would bind to specific molecules, allowing the sensor to detect the presence of DNA or viruses.

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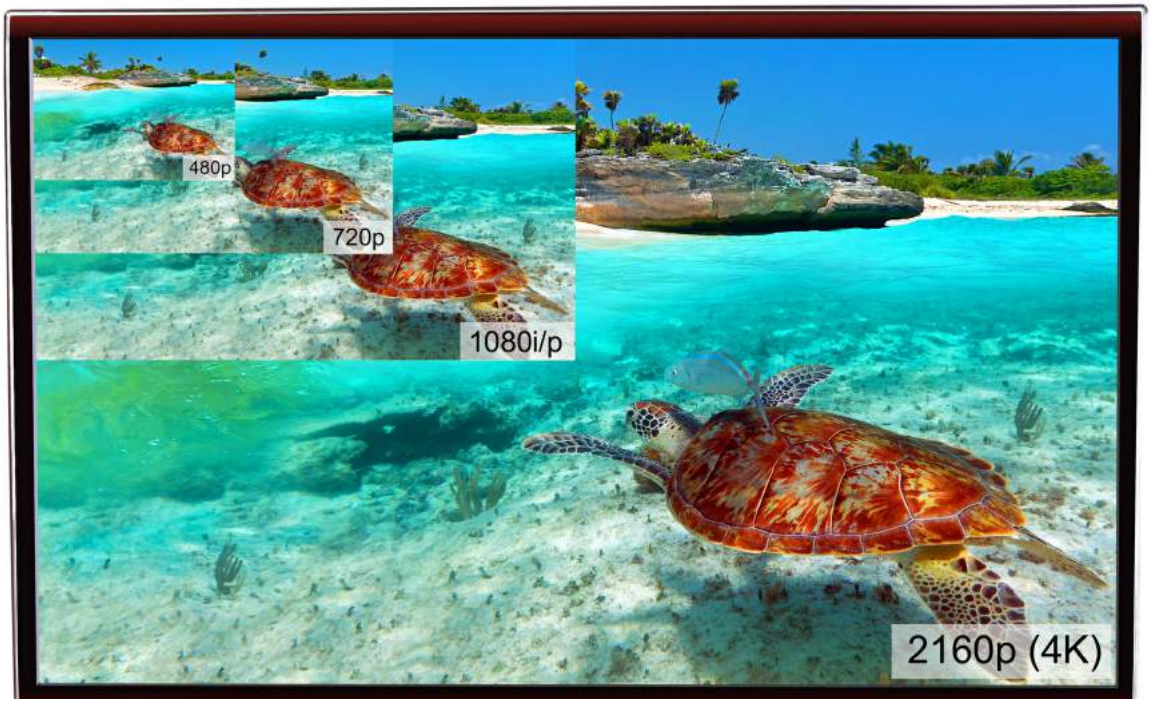
On market since:	-
Regions:	United States
Industries:	Healthcare
Source links:	OSA News

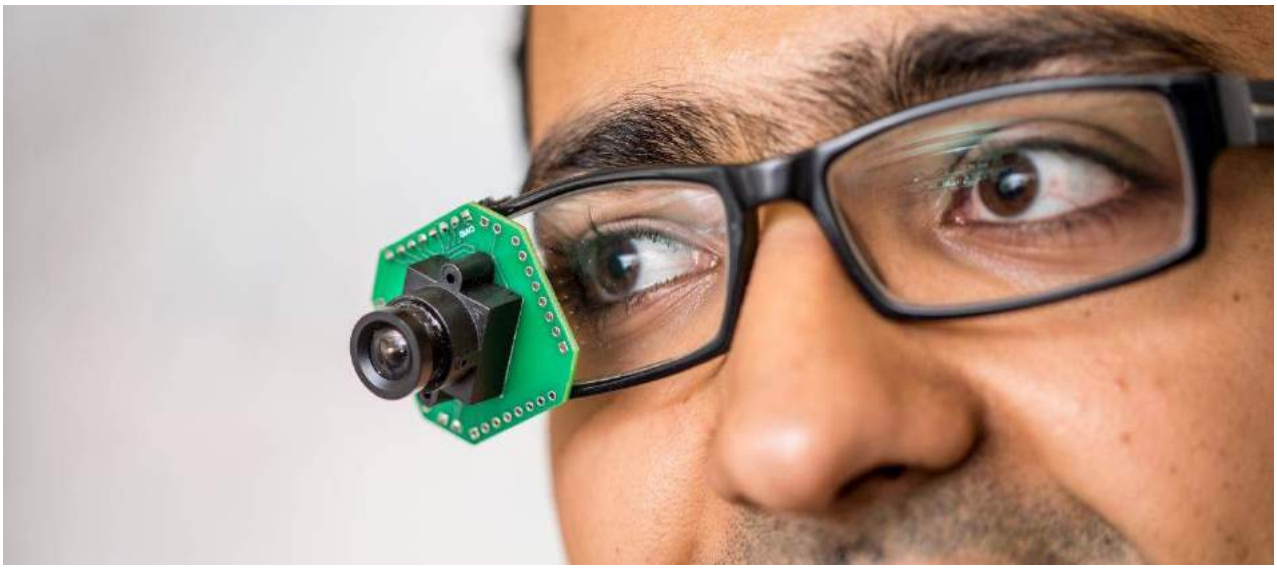
PROTOTYPES



WIRELESS CAMERA FOR HD VIDEO

A new HD video streaming method that doesn't need to be plugged in has been developed by the engineers at the University of Washington. Wearable cameras such as Snap Spectacles promise to share videos of live concerts or surgeries instantaneously with the world. But because these cameras must use smaller batteries to stay lightweight and functional, these devices can't perform high-definition video streaming. A new prototype skips the power-hungry parts and has something else, like a smartphone, process the video instead.

They do this using a technique called backscatter, through which a device can share information by reflecting signals that have been transmitted to it. The fundamental assumption people have made so far is that backscatter can be used only for low-data rate sensors such as temperature sensors. This work breaks that assumption and demonstrates that backscatter can indeed support even full HD video.



This low-power, video-streaming prototype could be used in next-generation wearable cameras
source - washington.edu

In today's streaming cameras, the camera first processes and compresses the video before it is transmitted via Wi-Fi. These processing and communication compounds eat a lot of power, especially with HD videos. As a result, a lightweight streaming camera that doesn't need large batteries or a power source has been out of reach. The UW team developed a new system that eliminates all of these components. Instead, the pixels in the camera are directly connected to the antenna, and it sends intensity values via backscatter to a nearby smartphone. The phone, which doesn't have the same size and weight restrictions as a small streaming camera, can process the video instead.

For the video transmission, the system translates the pixel information from each frame into a series of pulses where the width of each pulse represents a pixel value. The time duration of the pulse is proportional to the brightness of the pixel. The team verified their idea using a prototype that converted HD YouTube videos into raw pixel data. After that they fed the pixels into their backscatter system. Their design could stream 720p HD videos at 10 frames per second to a device up to 14 feet away.

The group's system uses 1,000 to 10,000 times less power than current streaming technology. But it still has a small battery that supports continuous operation. The next step is to make wireless video cameras that are completely battery-free. The team has also created a low-resolution, low-power security camera, which can stream at 13 frames per second. This falls in line with the range of functions the group predicts for this technology. The group also envisions a world where these cameras are smart enough to only turn on when they are needed for their specific purpose, which could save even more energy.

Right now home security cameras have to be plugged in all the time. But with this technology, the researchers can effectively cut the cord for wireless streaming cameras. This video technology has the potential to transform the industry. Cameras are critical for a number of internet-connected applications, but so far they have been constrained by their power consumption.

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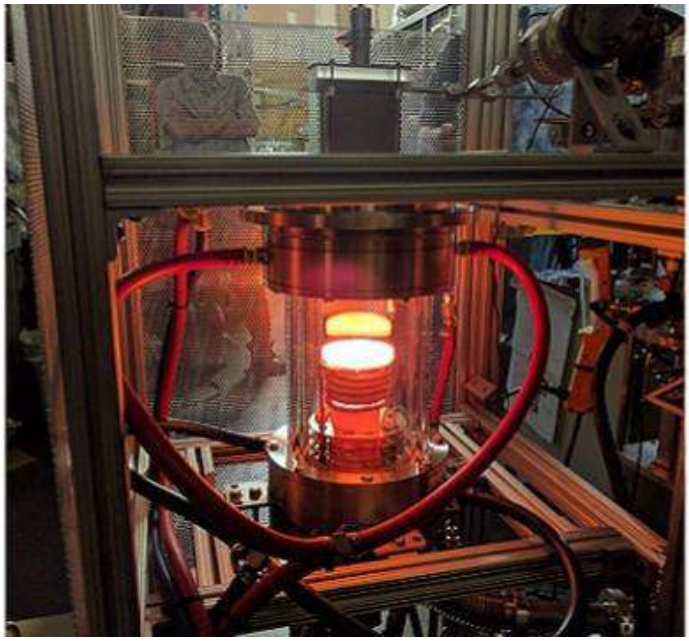
On market since:	-
Regions:	United States
Industries:	Electronics
Source links:	UW News

BUILDING CRYSTALS ON A VERY HOT SURFACE

A chemical reactor that operates at extremely high temperatures has been developed by the researchers at KAUST. It could enhance the efficiency and economy of a commonly used process in the semiconductor industry, with flow-on benefits for Saudi Arabia's chemical industry. The production of semiconductors relies on epitaxy: a process that creates high-quality single-crystal materials by depositing atoms on to a wafer layer by layer, controlling thickness with atomic precision. The most common method of epitaxy is metalorganic chemical vapor deposition, or MOCVD.

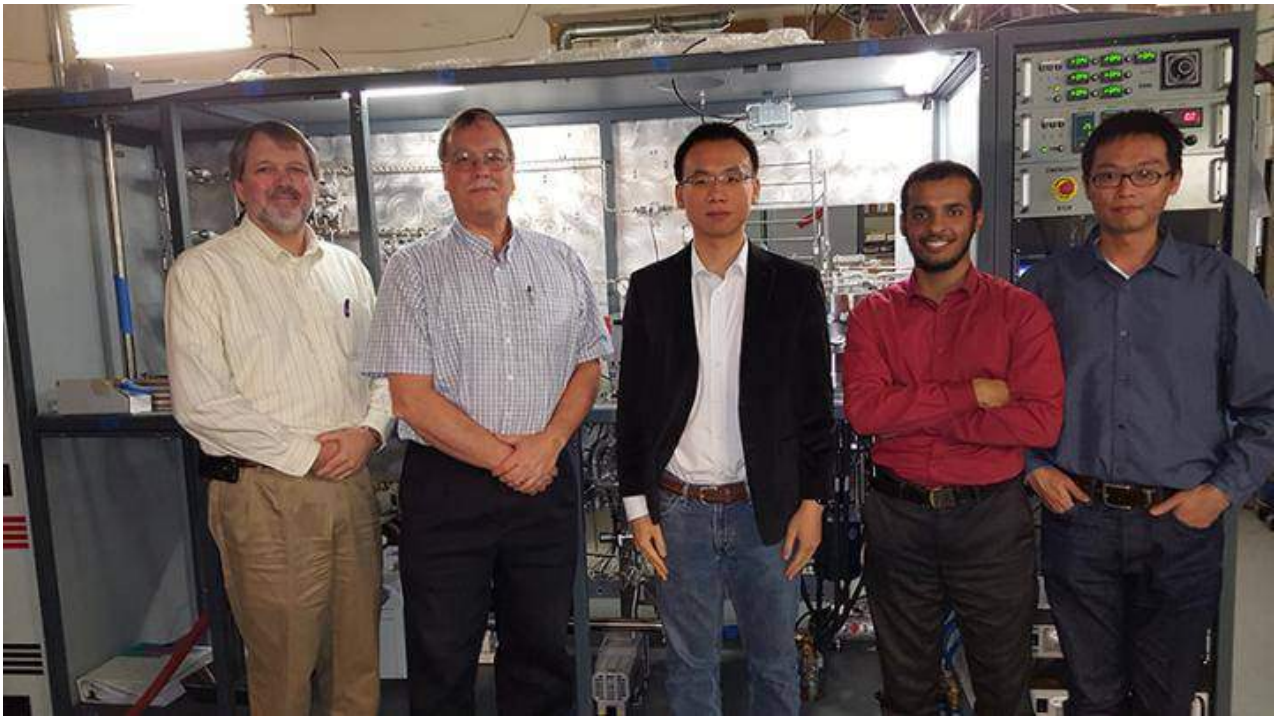
In a conventional induction-heating III-nitride metalorganic chemical vapor deposition (MOCVD) reactor, the induction coil is outside the chamber. Therefore, the magnetic field does not couple with the susceptor well, leading to compromised heating efficiency and detrimental coupling with the gas inlet and thus possible overheating.



A MOCVD reactor that uses induction heating
source - kaust.edu.sa

Pure vapors of organic molecules containing the desired atoms - for instance, boron and nitrogen in the case of boron nitride - are injected into a reaction chamber. The molecules decompose on a heated wafer to leave the semiconductor's atoms behind on the surface, which bond both to each other and the wafer to form a crystal layer. The researchers are developing an MOCVD reactor that can efficiently operate at extremely high temperatures to create high-quality boron nitride and aluminum nitride materials and devices particularly perspective for flexible electronics, ultraviolet optoelectronics, and power electronics.

The epitaxy of high-quality boron nitride and aluminum nitride have been a huge challenge for the conventional MOCVD process, which usually operates below 1200 degrees Celsius. Epitaxy of these materials responds best to temperatures over 1600 degrees Celsius. However, the most common resistant heaters are not reliable at these temperatures.



A MOCVD reactor that uses induction heating
source - kaust.edu.sa

Although induction heaters can reach these temperatures, the heating efficiency of the conventional design is low. Because the wasted energy can overheat the gas inlet, it must be placed far away from the wafer, which is problematic for high-quality boron nitride and aluminum nitride due to particle generation and low utilization of organic molecules.

The KAUST team has developed an innovative and low-cost induction heating structure to solve these problems. This design can help greatly enhance uniformity for up to 12-inch wafers and decrease particle generation, which is crucial for high-quality material and device fabrication. It also allows the researchers to discover novel materials. The results demonstrate important increase in heating efficiency and reduction in wasted energy. This equipment research involves many disciplines and is highly complex. However, history has shown that equipment innovation is the key to scientific breakthroughs and industrial revolution. A goal of the research is to set up MOCVD manufacturing activities that can be integrated into the huge chemical industry of Saudi Arabia.

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On market since:	-
Regions:	Saudi Arabia
Industries:	Chemicals, Construction
Source links:	KAUST News

A NEW WAY TO MAKE DIAMONDS FLEXIBLE

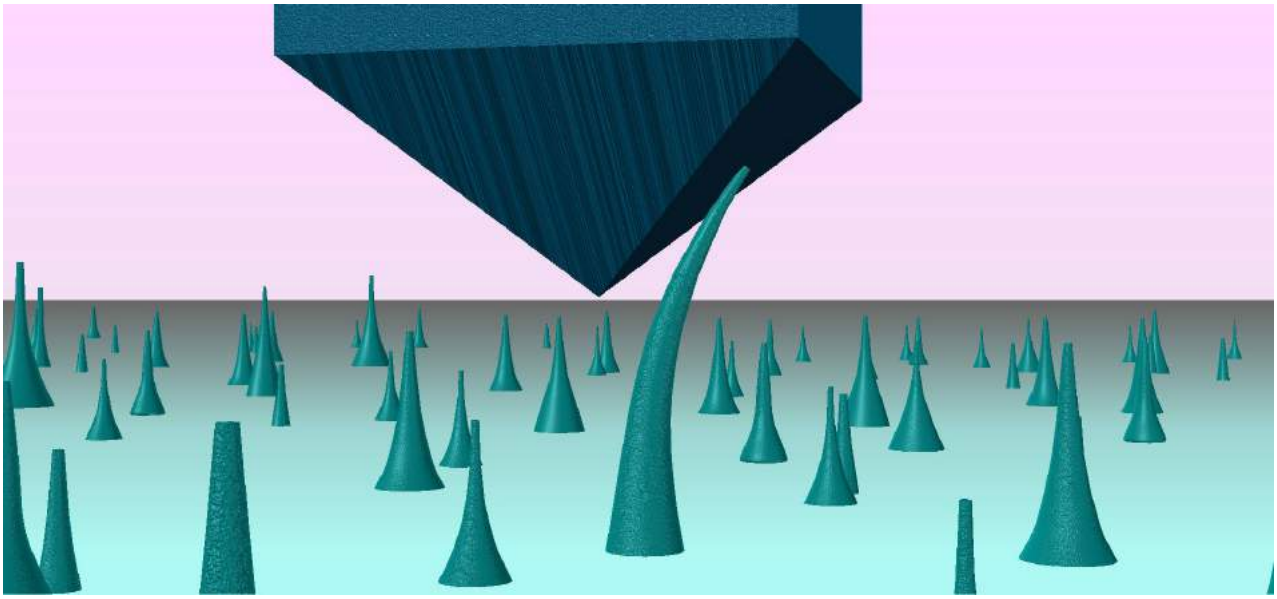
A novel method to bend and strench a diamond has been developed by the researchers at MIT. Diamond is well-known as the strongest of all natural materials, and with that strength comes another tightly linked property - its brittleness. Recently, the team has discovered that when grown in extremely tiny, needle-like shapes, diamond can bend and stretch, much like rubber, and snap back to its original shape. These results could open the door to a variety of diamond-based devices for applications such as sensing, data storage, actuation, biocompatible in vivo imaging, optoelectronics, and drug delivery.

For instance, diamond has been explored as a possible biocompatible carrier for delivering drugs into cancer cells. The researchers demonstrated that the narrow diamond needles, similar in shape to the rubber tips on the end of some toothbrushes but just a few hundred nanometers (billionths of a meter) across, could flex and stretch by as much as 9 percent without breaking, then return to their original configuration. The researchers developed a unique nanomechanical approach to precisely control and quantify the ultralarge elastic strain distributed in the nanodiamond samples.

A diamond can turn flexible when made into ultrafine needles
source - mit.edu

The team measured the bending of the diamond needles, which were grown through a chemical vapor deposition process and after that etched to their final shape, by observing them in a scanning electron microscope while pressing down on the needles with a standard nanoindenter diamond tip (essentially the corner of a cube). Following the experimental tests using this system, the team performed many detailed simulations to interpret the results and was able to determine precisely how much stress and strain the diamond needles could accommodate without breaking.

The researchers also devised a computer model of the nonlinear elastic deformation for the actual geometry of the diamond needle, and discovered that the maximum tensile strain of the nanoscale diamond was as high as 9 percent. The computer model also predicted that the corresponding maximum local stress was close to the known ideal tensile strength of diamond - for example, the theoretical limit achievable by defect-free diamond.



The diamond needles can bend as much as 9 percent and still return to their original shape
source - mit.edu

When the entire diamond needle was made of one crystal, failure occurred at a tensile strain as high as 9 percent. Until this critical level was reached, the deformation could be completely reversed if the probe was retracted from the needle and the specimen was unloaded. If the small needle was made of many grains of diamond, the team demonstrated that they could still achieve unusually large strains. However, the maximum strain achieved by the polycrystalline diamond needle was less than one-half that of the single crystalline diamond needle.

The surprise finding of ultralarge elastic deformation in a hard and brittle material, diamond, opens up unprecedented possibilities for tuning its optical, optomechanical, magnetic, phononic, and catalytic properties through elastic strain engineering.

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On market since:	-
Regions:	United States
Industries:	Manufacturing
Source links:	MIT News

A NEW DEVICE FOR COMMUNICATION

A novel smartwatch has been developed by the team of researchers at Dartmouth College. WrisText allows a user to compose text messages on a smartwatch without physically typing on the touchscreen interface. This enables easy text entry with the watch-wearing hand in instances when the other hand is occupied. By simply moving the wrist in different directions, a user can answer a question with a quick 'yes' or 'no' or even type out a more complex sentence. Watches are becoming more commonly used for text entry, but the process can still be awkward. WrisText provides an alternative for text entry that is quick, convenient and effcient.

WrisText is a one-handed text entry technique for smartwatches using the joystick-like motion of the wrist. A user enters text by whirling the wrist of the watch hand, towards six directions which each represent a key in a circular keyboard, and where the letters are distributed in an alphabetical order. The design of WrisText was an iterative process, where the researchers first conducted a study to investigate optimal key size, and found that keys needed to be 55o or wider to achieve over 90% striking accuracy.

After that the team of researchers computed an optimal keyboard layout, considering a joint optimization problem of striking accuracy, striking comfort, word disambiguation. They evaluated the performance of WrisText through a five-day study with 10 participants in two text entry scenarios: hand-up and hand-down. On average, participants achieved a text entry speed of 9.9 WPM across all sessions, and were able to type as fast as 15.2 WPM by the end of the last day.

The Dartmouth College team of researchers will unveil developmental smartwatch technology at the ACM CHI Conference on Human Factors. The watch innovations will be demonstrated during the event in Montreal, Canada running from April 21 through April 26. The research is the latest on a long list of technical designs from Dartmouth's XDiscovery Lab that seek to increase the functionality of wearables while also adding to the overall user experience.

Smartwatches help people access info 'on the fly,' but they are far from perfect. The researchers' aim is to eliminate the technical and practical barriers that keep people from using wearable devices. The researchers look forward to presenting the future of this technology at CHI2018. The watch features a round face with an alphabetical keyboard that was found to be the most comfortable and accurate layout for wrist movement. An augmented wristband uses proximity and vibration sensors to transfer natural wrist motions into text entry. While entering text was complicated for users to learn at first, participants in a study became proficient with the system after only a few days.

The WrisText research paper earned honorable mention from CHI2018 and builds on an earlier innovation from the XD Lab that allows users to input non-textual gestures with the watch-wearing hand. While in an early stage of development, this technical achievement provides lateral force feedback that allows wearers to experience forces that impact the sides of a watch.

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On market since:	-
Regions:	United States
Industries:	Electronics
Source links:	Dartmouth College

FOOT EXERCISER FOR OFFICE AND HOME USE

Exclusive interview for SPINOFF.COM with Peter Wahib, the Inventor of FootROK, a new system that allows the foot to sit comfortably and improve blood circulation. Utilizing pressure points and a 360-degree rotating system, users can rest, tilt or rotate their foot in any direction. FootROK can also relieve stress from the heels and toes. The device is lightweight and fits easily in any backpack or bag for travel or storage. Unfortunately, most of the jobs nowadays force us to sit for several consecutive hours. This could result in many physical problems, such as blood clots which could affect the joints and the body organs. FootROK allows the user to stay active during a workday. It also elevates the leg to a comfortable position. It is intended to improve blood circulation in the leg which would reduce complications in the body due to blood clots.

Moreover, the repetitive circular motion performed with the user's leg would increase focus during a long work session.

FootROK can be used by people of different ages
source - pirodesigngroup.com

SOC: Dear Mr. Wahib, we are so grateful for your generosity this day in spending time speaking with us and sharing your insights about your foot exerciser. Our investors and we would like to learn your professional background.

Mr. Wahib: I started as a technologist. I did the technical program in mechanical engineering and I received my B.S in mechanical engineering. Besides, I worked during school, so it's been more than 8 years from now as I am a mechanical engineering designer. In addition, I worked in the field of product design for many companies here, in Canada.

SOC: Could you please share the story of FootROK creation?

Mr. Wahib: During school, I was a very active person. But when I started working full time, there appeared some problems with my knee and foot due to long sitting hours. I wanted to find in the market some products which could help to solve this problem. I didn't find something that I was looking for exactly. Basically, I found only some big heavy machines

which you need to put on the desk. They required a lot of movement like small bicycles or stuff like this. They were complex and made a lot of noise, too. If you were outside, such machines would disturb everybody around you. The other ones were very simple and inefficient. These machines allowed movement only in one direction. I've found that many athletes put like a ball on their foot to improve the blood circulation. But the ball is not very stable. That is why I decided to develop a product of my own that would allow movement in all directions. My product is also very small, it fits in average size work bag and I can take it with me when I'm going at work or when I'm leaving the office. Besides, the foot exerciser is lightweight - it's only 0.25 kg.

FootROK is designed to fit any shoe size and type
source - pirodesigngroup.com

SOC: Did you have some other projects before?

Mr. Wahib: I worked on many mechanical engineering projects and all of them had a great success. Now, I'm working for one big international company, which develops products on a high level. I know how to bring a product in a professional way and how to make a good design manner. But FootROK is my first personal one.

SOC: Was your project funded by any state financing or grants? Has it already

received any honors or awards?

Mr. Wahib: No, I'm still in the trial phase. Basically, I was creating FootROK for myself, but then one person from TV has contacted me with the offer to make marketing on TV. There is an interest in my product, but I haven't promoted it yet.

SOC: Could you please share some information about the team members who supported you and the project?

Mr. Wahib: I've created the FootROK design by myself. In my team, I have people who helped me with the illustrations and pictures to know how the product would look like in the real life. My brother is a financial adviser in a large company, so he is my financial side. But I need some assistance to help me with marketing because I don't have much experience in this field.

SOC: What are the unique selling points of your product?

Mr. Wahib: In my opinion, the most important things are the size and the weight of my product. It is the lightest thing in the market right now. You could take the foot exerciser anywhere with you. Besides, people can stand on it and it wouldn't break. It can also be fitted on any shelf without any problem. The features are designed specifically to relieve stress from the foot. The foot exerciser allows you to move in all directions. It is designed to fit any shoe size and type. It is very efficient. I believe that the combination of these features makes it very unique.

You can take FootROK anywhere because it's very lightweight
source - pirodesigngroup.com

SOC: Are there any competitors in the market?

Mr. Wahib: I haven't found any competitors in this specific category in the market. Of course, there are companies which produce different leg exercisers but nothing similar to FootROK. My idea was to simulate the ball that you can put on your foot in the professional environment.

SOC: Could you tell us all current industries and fields of your product application and where do you think it could be successfully applied in the future?

Mr. Wahib: As I work in the company, my job is to sit in front of the computer for 8 hours. Everything now is becoming automated. And there appear much more office jobs than the physical ones. In my opinion, the market of all office jobs may need such foot exerciser. Besides, many athletes, who have injuries, need something to keep moving all the time without putting a lot of effort on the foot. In addition, the old people who want to sit in front of the TV but at the same time, they also need to improve blood circulation in their legs while sitting down.

SOC: The potential investors will be curious whether you already have the first

clients and signed contracts? What was the feedback from the customers?

Mr. Wahib: No, I haven't entered the market yet because I need people who would help me with the marketing processes. But I tested FootROK at my job with my colleagues and I've got a really good feedback. I discovered that my foot exerciser really helped to solve some particular problems. To test it on myself, I've spent 8 hours with the exerciser on one leg and I didn't use anything for another leg for the whole day. When I stood up I felt a significant difference in the pain and the feeling in both legs. Basically, I tested it on myself, because personally, I have this problem. In my opinion, it helped me a lot.

The medical advantages of FootROK
source - pirodesigngroup.com

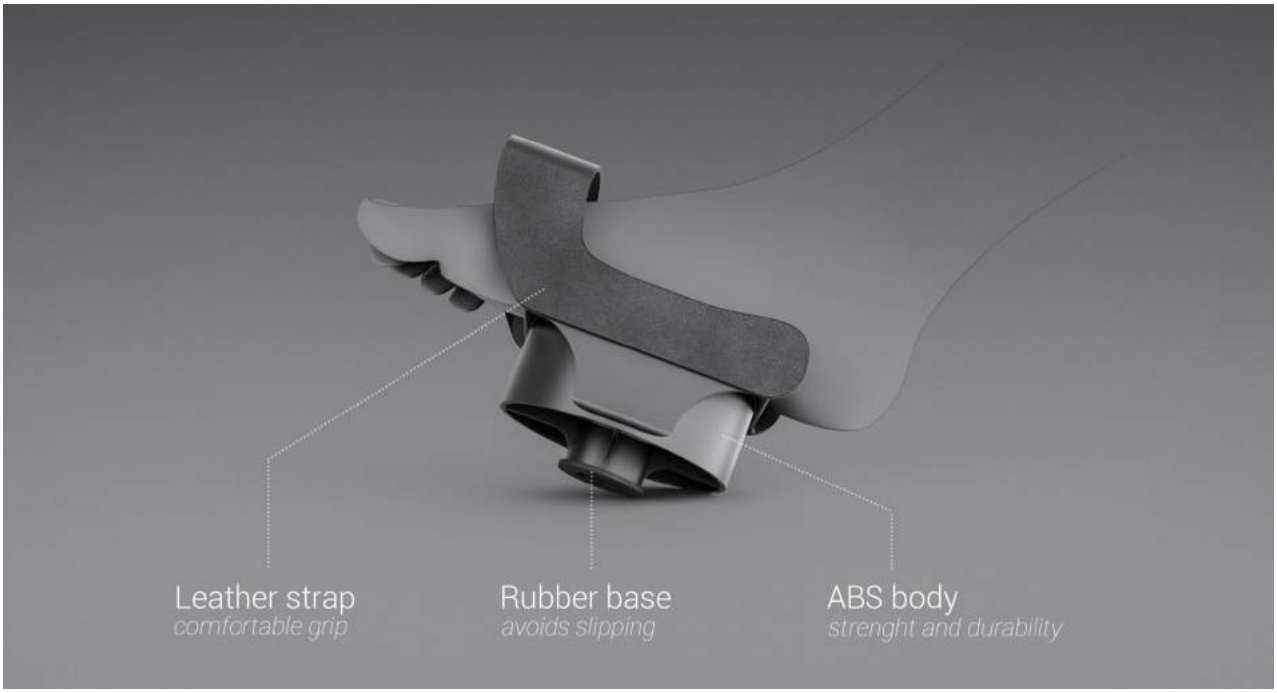
SOC: Please, tell us about your criteria for partners selection?

Mr. Wahib: First of all, I need the partners with a good experience in marketing. These are people who have links with appropriate stores and who will help me to enter the market. I would like my partners to guide me in the right way and to help me with the tooling cost because I need a certain amount of capital to be able to bring this product to life. In the design aspect, I have a good understanding of what I need. And my partner should be able to help me with sales, maybe even to do the TV commercial to promote the product.

Long sitting hours in the office may become less painful for your legs
source - pirodesigngroup.com

SOC: Why do you consider the major market players might be interested in investing in a promotion of your product on the addressable market?

Mr. Wahib: Product materials were chosen carefully to ensure rigidity and comfort. This product is available in 3 different leather colors to match your style. It offers optimal angles of movement and stability. This device allows a stable flat position if the user simply desires to elevate the leg without movement. It significantly improves the blood circulation. The size of the product allows the toes and the hills to be flying in the air. That reduces the pressure from the foot because while you are walking, the major amount of stress is on the front and on the back of the foot. When you put FootROK on, your toes and hills don't touch anything. FootROK allows the rotation in all possible directions. Another feature is that it has an independent foot. In other similar leg exercisers you have to put your legs very close to each other to be able to use them, and that is uncomfortable.



The uniqueness of FootROK
source - pirodesigngroup.com

SOC: When in opinion your product will reach the peak of its development?

Mr. Wahib: At this point, I need a mass feedback. I feel comfortable to test it with the big market. This might help to improve the design of my product if there is such possibility, and after that, it can reach the peak of its development. But at this moment, FootROK is as good as it can be.

SOC: Do you have your own unique strategy which you consider your product is strong at?

Mr. Wahib: FootROK is strong at R&D, design, and production. Once we go in the mass production, the cost of the foot exerciser will be very low which allows us to make a good profit on it.

Leather material choice
source - pirodesigngroup.com

SOC: What is the protection plan for your product?

Mr. Wahib: I have filed a patent, so I have a patent pending on the product, its design, and features. FootROK is completely protected.

SOC: What did you plan to use the invested funds for?

Mr. Wahib: In my opinion, the investment funds will be mostly used to pay the tooling. Besides, the funds will be also used to invest into marketing and promotional sides. These are two main aspects for which I need the investment.

Variety of colors to your liking
source - pirodesigngroup.com

SOC: Could you please describe your ideal investor? What aspects are important for you?

Mr. Wahib: The country doesn't really matter for me. I appreciate the mutual respect. The experience is a significant aspect. It will be great to work with someone who has already brought to life projects in the field of product design. In addition, the experience in marketing, sales, and promotional sides are also important for me.

SOC: And the last question, could you specify the most convenient way you would like to receive inquiries from potential investors? Should it be by e-mail or personal phone call?

Mr. Wahib: E-mail will be a great start. When we understand each other by e-mail, we can schedule a conference call.

FootROK is a great choice both for home and office use
source - pirodesigngroup.com

Dear Mr. Wahib, SPINOFF.COM would like to express gratitude for the time you have dedicated to this interview. We are pleased to forward the interview to all potential investors and partners and we will observe the development and success of your product with great pleasure and interest.

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On market since:	-
Regions:	Canada
Industries:	Creative Industries, Healthcare
Source links:	Personal web-site

A NEW TYPE OF DEFIBRILLATOR

A novel add-on for automated external defibrillators - aka AEDs - that punches through the skin to help deliver a jolt to a person in cardiac arrest has been developed by the researchers at Rice University. The skin presents a formidable barrier to life-saving defibrillators, but the new add-on could be a way around that problem. Or, more to the point, through. A team of senior bioengineering students developed a needle-laden pad capable of pressing through both a flexible AED pad and the skin to overcome the skin's typical impedance of around 500 kilo ohms per square centimeter.

In practice, AED users would apply AED pads to the exposed skin of a patient's chest and side, just as they are trained to do in thousands of AED and CPR classes taught in the US each year. After that, users would press the needles through a pad and the patient's skin to bloodlessly deliver a more efficient shock. By the team's measurements, the add-ons decrease the skin's impedance by 72 percent. That, in turn, should increase a patient's chance of survival and decrease the odds that the patient will need multiple shocks.

The researchers looked into other ways to break the skin impedance, and some of the things the researchers saw used chemicals or abrasion, like a sandpaper material. But in an emergency situation, you wouldn't want to mess around with chemicals or something very difficult. With needles, you just push straight down and it's pretty effective. The team reports they drew inspiration from insulin-delivery patches that break through the skin with microneedles.

The Zfib add-on is a 3D-printed plastic frame with a rubber backing that allows the user to press 180 tiny needles into a patient's chest without having to touch the needles. The needles collect current from the side of the pad that touches the skin and deliver it to the patient. Indicators on top of the device turn green when enough pressure is applied.

Tiny needles give defibrillators a big boost
source - rice.edu

These needles only go 1 to 2 millimeters into the skin, so it's not very far. They go just past the epidermis and into the dermis. There's no blood drawn. The needles have to do their job without interfering with the AED's ability to monitor the heart's rhythm and decide

whether a shock is necessary. The current also has to be kept low enough to prevent burns. There are papers and clinical studies from the past 10 or 20 years about how people have gotten second- and third-degree burns from AED pads.

The team of researchers had to calculate how many needles they needed based on surface area. The students ran into the problem of putting so many needles on that it distributed the force and wouldn't break the skin, like a bed of nails. Once they settled on 180 needles, the team evaluated their design with tests on artificial skin, an animal cadaver. The team worked with advisers Eric Richardson, a bioengineering lecturer, and Mehdi Razavi, a cardiologist at Texas Heart Institute. The team will demonstate their invention at the annual George R. Brown School of Engineering Design Showcase.

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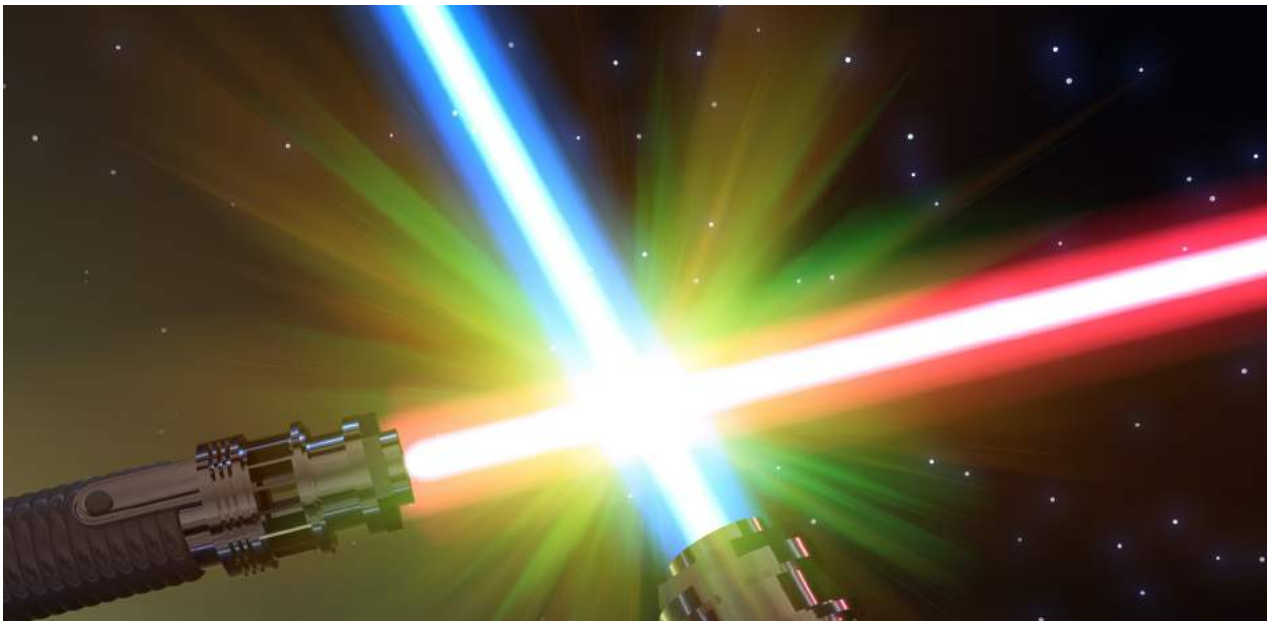
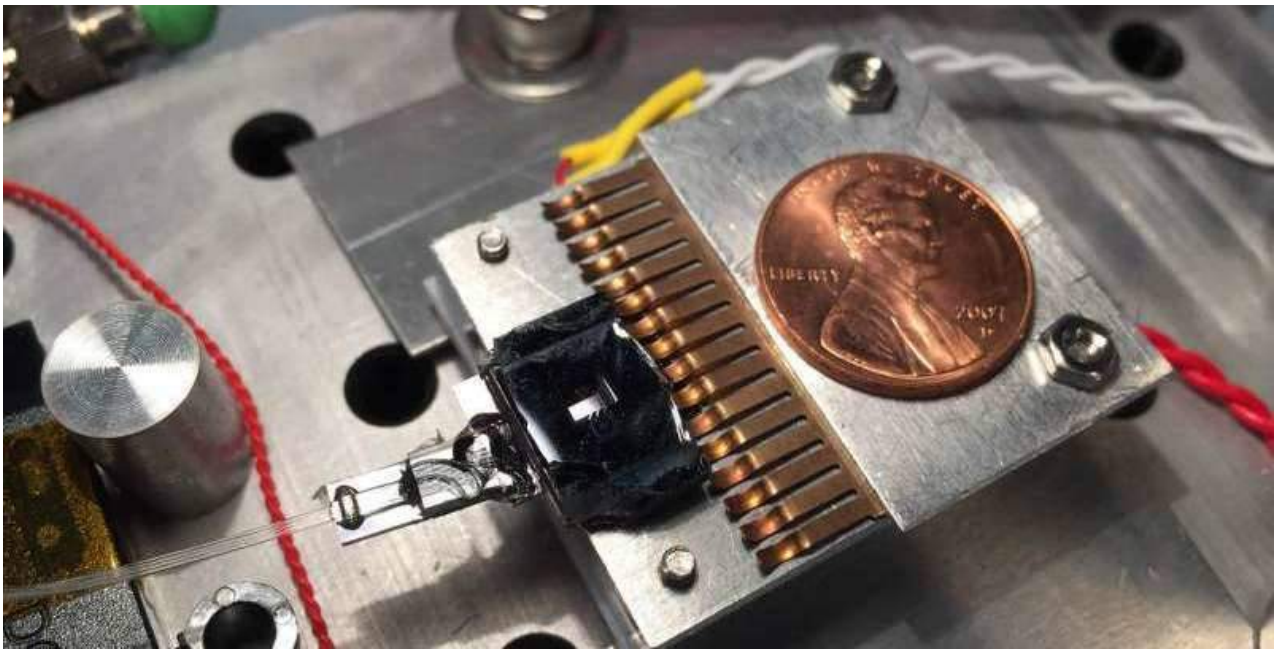
Regions:	United States
Industries:	Healthcare
Source links:	Rice University News



MINI LASER TOOLKIT FOR MEASUREMENTS

A chip on which laser light interacts with a tiny cloud of atoms to serve as a miniature toolkit for measuring significant quantities such as length with quantum precision has been developed by the researchers at NIST. The design could be mass-produced with existing technology. NIST's prototype chip was used to generate infrared light at a wavelength of 780 nanometers, precisely enough to be used as a length reference for calibrating other instruments. The NIST chip packs the atom cloud and structures for guiding light waves into less than 1 square centimeter, about one ten-thousandth of the volume of other compact devices offering similar measurement precision.

Compared to other devices that use chips for guiding light waves to probe atoms, this chip increases the measurement precision a hundredfold. The chip currently relies on a small external laser and optics table, but in future designs, the researchers hope to put everything on the chip. Many devices use light to probe the quantum states of atoms in a vapor confined in a small cell.



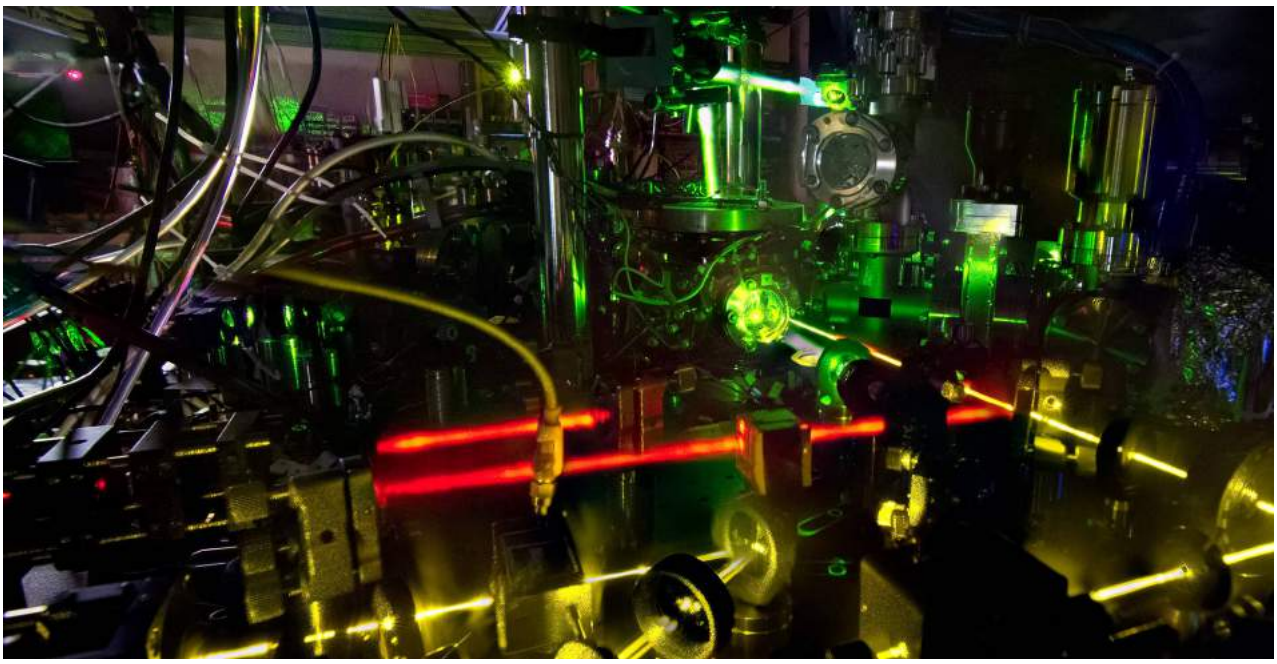
NIST's prototype chip
source - nist.gov

Atoms can be highly sensitive to external conditions, and therefore, make superb detectors. Devices based on light interactions with atomic vapors can measure quantities such as time, length and magnetic fields and have applications in navigation, communications, medicine and other fields. Such devices generally must be assembled by hand.

The new NIST chip transports light from the external laser through a novel waveguide and grating structure to expand the beam diameter to probe about 100 million atoms until they switch from one energy level to another. To determine the laser light frequency or wavelength that the atoms will absorb to undergo this energy transition, the system uses a photodetector to identify the laser tuning at which only about half the light passes through the vapor cell.

The demonstration used a gas of rubidium atoms, but the chip could work with a wide range of atomic and molecular vapors to generate specific frequencies across the entire

visible spectrum of light and some of the infrared band. Once the laser is properly tuned, some of the original laser light can be siphoned off as output to use as a reference standard. The NIST chip might be used, for example, to calibrate length measurement instruments.



The NIST chip packs a tiny cloud of atoms and structures for guiding light waves
source - nist.gov

The new chip shows that lasers and atomic vapor cells could potentially be mass-produced together like semiconductors, using silicon materials and traditional chip-manufacturing techniques, rather than the current manual assembly of bulky optics and blown-glass vapor cells. This advance could apply to many NIST instruments, from atomic clocks to magnetic sensors and gas spectrometers. The research is part of the NIST-on-a-chip program, aimed at creating prototypes for small, inexpensive, low-power and easily manufactured measurement tools that are quantum-based, and that is why, intrinsically accurate. These tools are intended to be usable virtually anywhere, such as in industrial settings for calibration of instruments. Under this program, NIST-pioneered technologies would be manufactured and distributed by the private sector.

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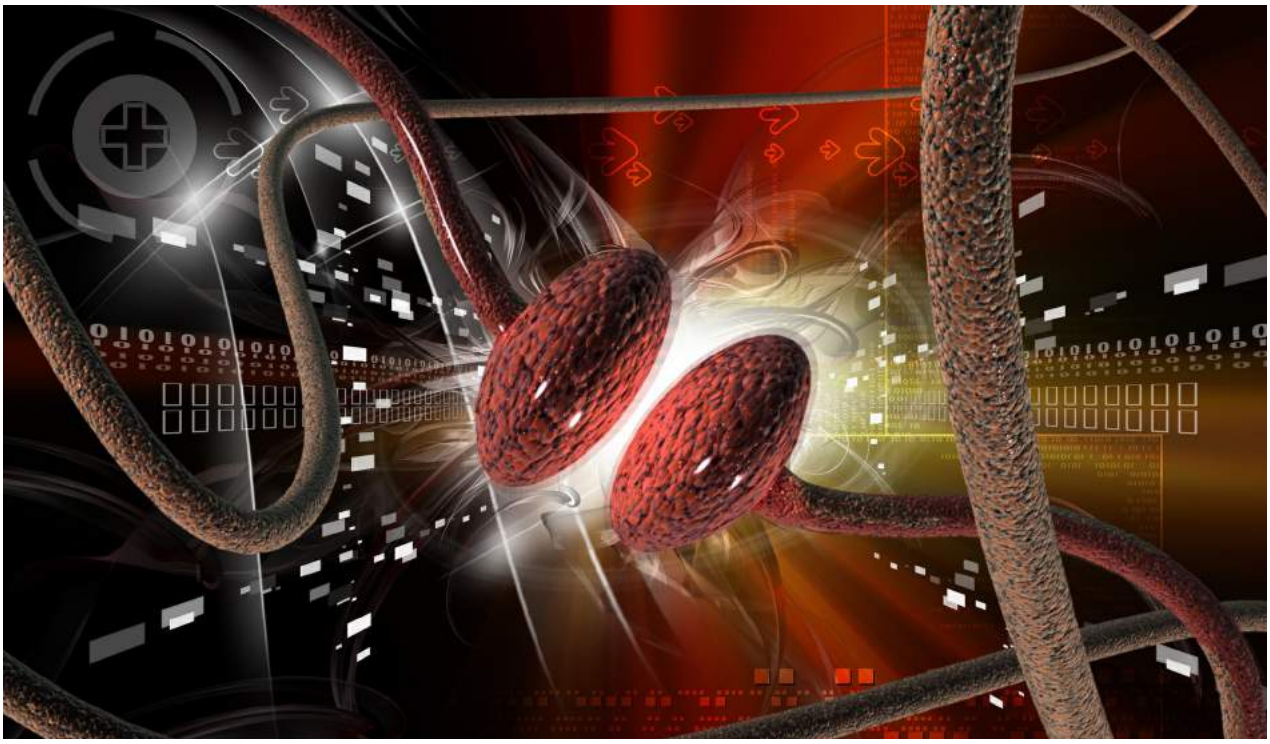
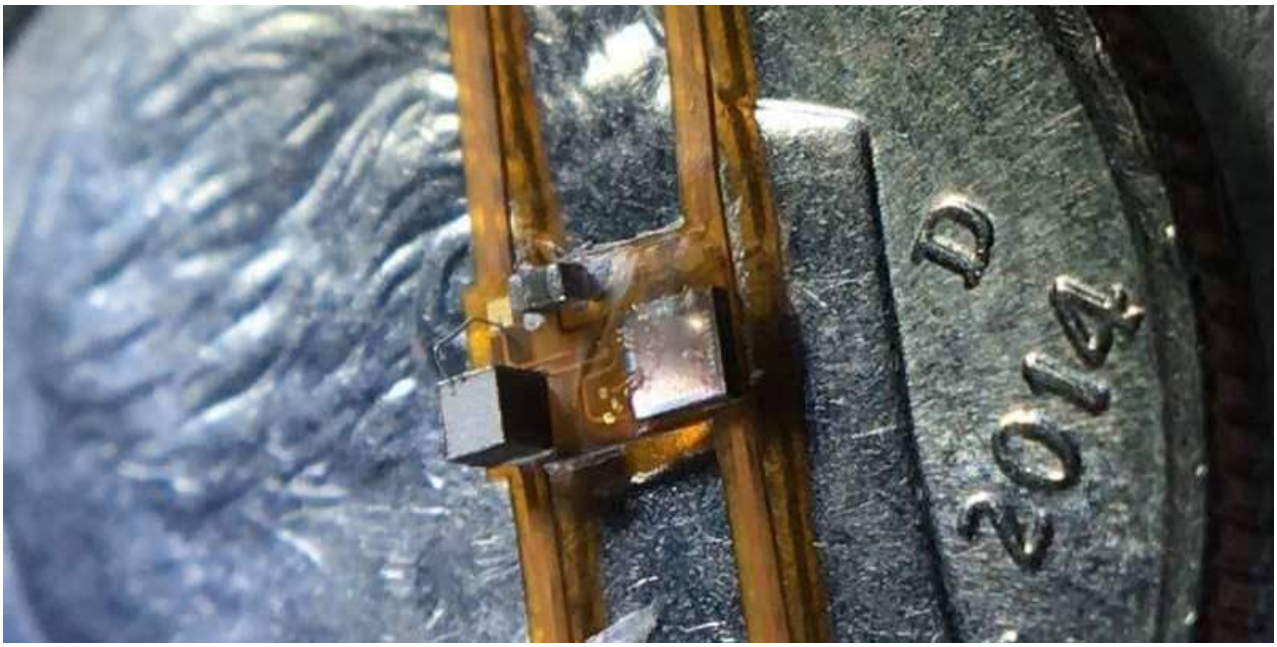
Patent status:	-
On market since:	-
Regions:	United States
Industries:	Electronics
Source links:	NIST News



NEW TYPE OF NERVE STIMULATOR

The smallest volume, most effective wireless nerve stimulator has been developed by the engineers at the University of California, Berkeley. In 2016 the researchers demonstrated the first implanted, ultrasonic neural dust sensors, bringing closer the day when a Fitbit-like device could monitor internal nerves, muscles or organs in real time. Now, Berkeley engineers have taken neural dust a step forward. The device, called StimDust, short for stimulating neural dust, adds more sophisticated electronics to neural dust without sacrificing the technology's tiny size or safety, greatly expanding the range of neural dust applications.

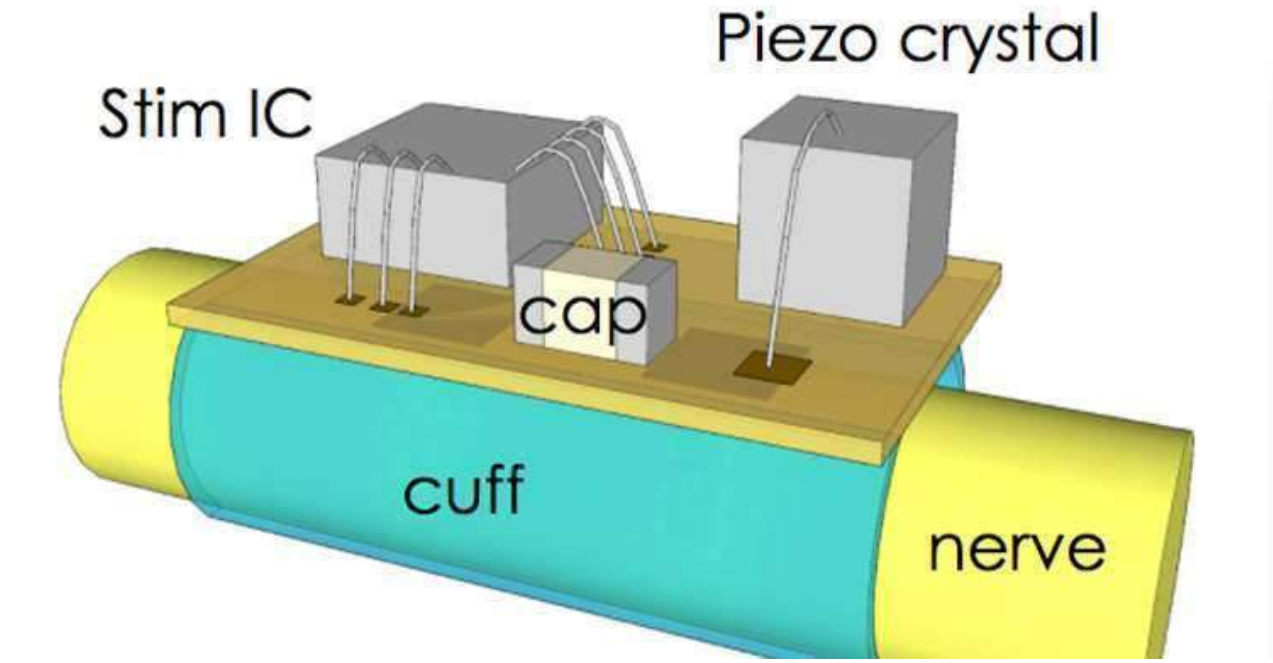
The researchers' goal is to have StimDust implanted in the body through minimally invasive procedures to monitor and treat disease in a real-time, patient-specific approach. StimDust is just 6.5 cubic millimeters in volume, about the size of a granule of sand, and is powered wirelessly by ultrasound, which the device uses after that to power nerve stimulation at an efficiency of 82 percent.



The small size of StimDust can be seen in comparison to a dime
source - berkeley.edu

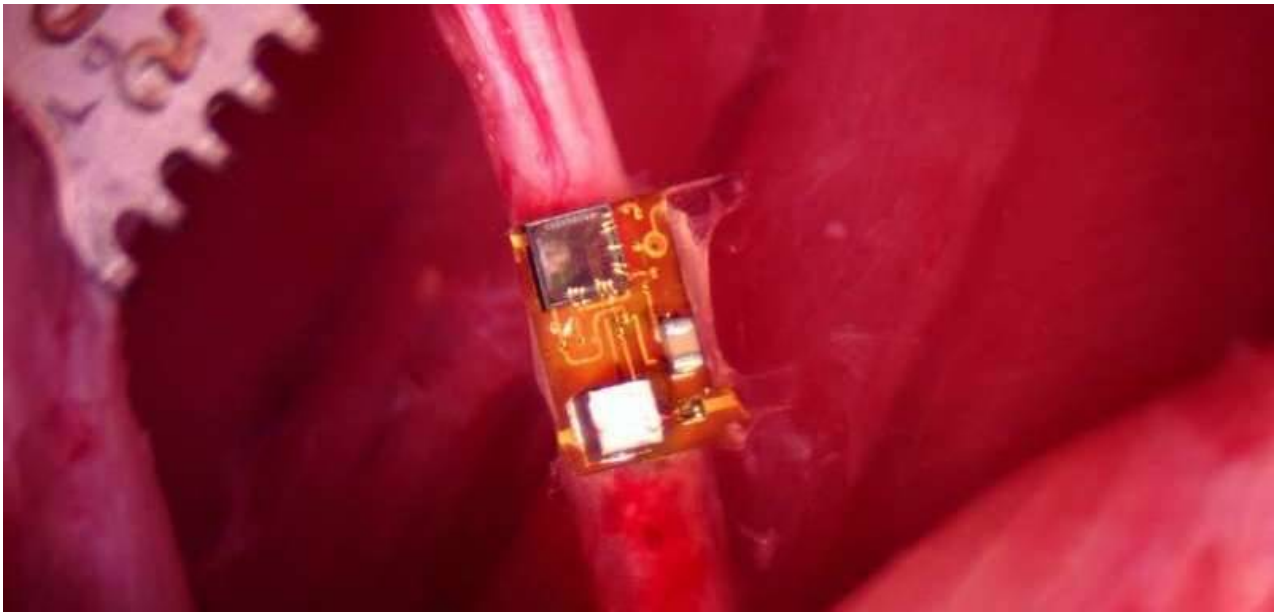
StimDust is the smallest deep-tissue stimulator that the researchers are aware of that's capable of stimulating almost all of the major therapeutic targets in the peripheral nervous system. This device represents the researchers vision of having tiny devices that can be implanted in minimally invasive ways to modulate or stimulate the peripheral nervous system, which has been shown to be efficient in treating a number of diseases.

StimDust is about an order of magnitude smaller than any active device with similar capabilities that the research team is aware of. The compounds of StimDust include a single piezocrystal, which is the antenna of the system, a 1-millimeter integrated circuit, and one charge storage capacitor. StimDust has electrodes on the bottom, that make contact with a nerve through a cuff that wraps around the nerve. In addition to the device, team of researchers created a custom wireless protocol that gives them a large range of programmability while maintaining efficiency. The entire device is powered by just 4 microwatts and has a mass of 10 milligrams.



This graphic details the simplicity of the StimDust design
source - berkeley.edu

After testing StimDust on the benchtop, the research team implanted it in a live mouse to test it in a realistic environment. Through a cuff around the sciatic nerve, the research team was able to control hind leg motion, record the stimulation activity and measure how much force was exerted on the hind leg muscle as it was stimulated. After that the researchers gradually increased stimulation and mapped the response of the hind leg muscle so they could know exactly how much stimulation was needed for a desired muscle recruitment, a kind of sophisticated analysis required of medical devices.



StimDust fitted onto a live mouse sciatic nerve via a cuff
source - berkeley.edu

The team of researchers hopes that their work can lead to applications of StimDust to treat diseases such as heart irregularities, chronic pain, asthma or epilepsy. There's an incredible opportunity for healthcare applications that can really be transformative.

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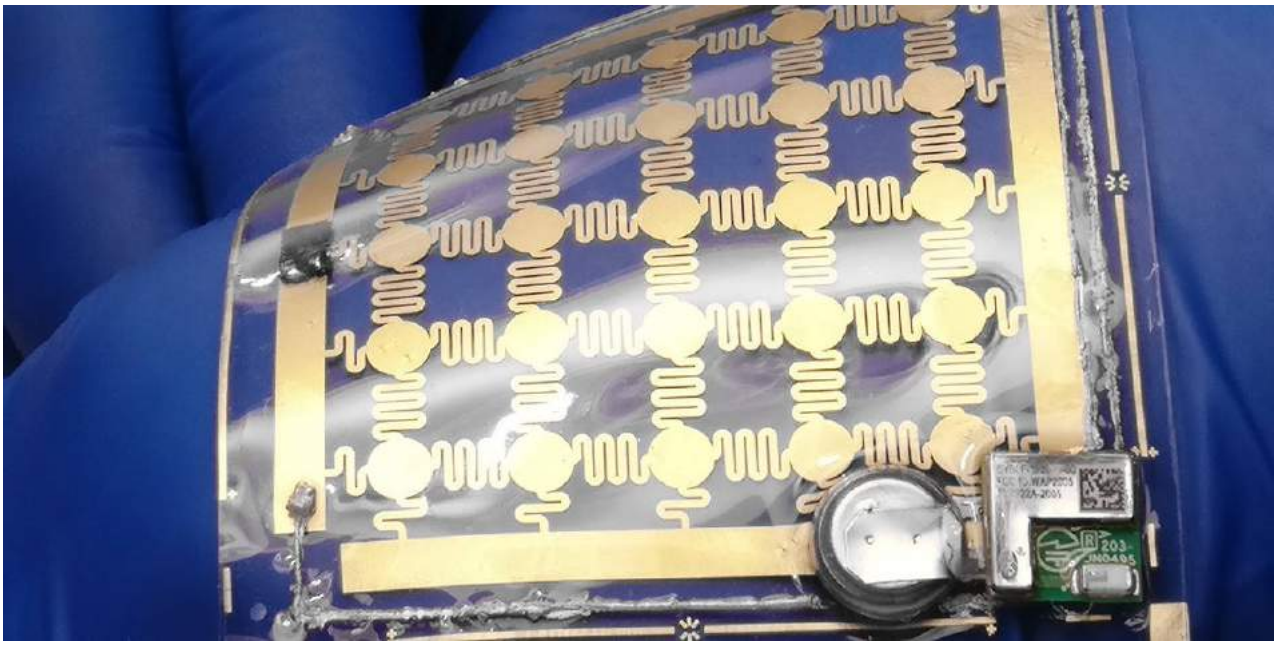
Regions:	United States
Industries:	Electronics
Source links:	Berkeley News

'MARINE SKIN' WEARABLE TRACKS ANIMALS UNDER THE SEA

A wearable that could eventually track ocean creatures such as dolphins and whale sharks has been developed by the researchers at KAUST. Humans aren't the only ones who deserve comfortable wearables that track physical activity. A crab unwittingly became the first test subject for a lightweight sensor tag that could track animal movements in deep ocean environments. The 'Marine Skin' tag can be glued to the outer shell or skin of an animal and weighs barely as much as a paper clip in water.

All of that means the lightweight skin could theoretically be worn by a wide variety of both large and small marine animals without much disruption to their bodies or underwater behavior. The research team at King Abdullah University of Science and Technology (KAUST) in Saudi Arabia aims to help tag as many as 200 marine species with the device by the summer of 2019.



'Marine Skin'
source - kaust.edu.sa

The researchers realized they could help marine species by developing comfortable and convenient wearables for them. Tagging and tracking marine animals has already come a long way. In the 1930s, researchers used shotguns to shoot stainless steel tubes - bearing an identification number and promise of reward for return - into whales that could be recovered after the marine leviathans had been killed and processed for their blubber. Modern electronics and radio tags have enabled more sophisticated tracking, even if researchers often still rely on invasive methods of darting or implanting marine animals with the tags. But the researchers at KAUST, working with scientists at the Red Sea Research Center, aimed to meet or beat the existing standard for marine animal tagging in terms of non-invasiveness, weight, operational lifetime, and speed of operation.

With a coin battery that could theoretically last up to a year, the prototype version of the tag can continuously track seawater salinity, temperature, and depth. A first swimming and diving trial with the blue swimmer crab - a creature captured on the east coast of the Red Sea - suggested a battery lifetime of five months without any optimization or changes to

data logging frequency. This wearable was tricky to build as it has to sustain saline water and pressure associated with depth. Therefore, the researchers resorted to materials which are low cost but mechanically compliant and can absorb the stress.

A crab as the first test object
source - kaust.edu.sa

The researchers primarily used copper, tungsten, and aluminum in the electronic components and a common silicone for the main body of the skin. Material ɲnd processing costs for the wearable system came to less than $12 per unit: much less expensive than existing marine tags. One limitation comes into play when researchers want to collect the data stored on the Marine Skin. The current prototype relies on Bluetooth technology to transmit the stored data to smartphones. A second generation version of the design could wirelessly transmit data whenever the animal host chooses to surface. Beyond that, the team suggested the possibility of using optical communication to gather data in underwater conditions.

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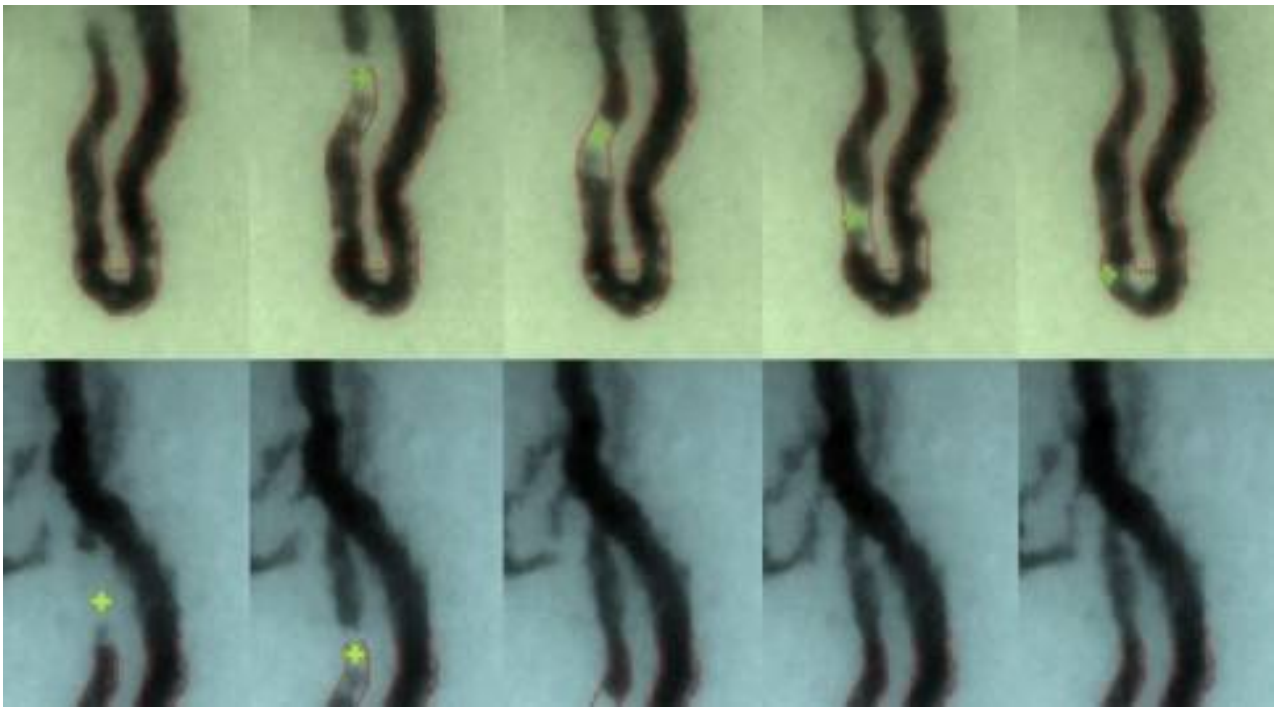
On market since:	-
Regions:	Saudi Arabia
Industries:	Electronics, Environment
Source links:	KAUST News

TECHNOLOGY THAT DETECTS DANGEROUSLY LOW WHITE BLOOD CELL LEVELS

A portable device that could be used to monitor patients' white blood cell levels at home, without taking blood samples has been developed by the researchers at MIT. Such a device could prevent thousands of infections every year among chemotherapy patients. The team's tabletop prototype records video of blood cells flowing through capillaries just below the surface of the skin at the base of the fingernail. The researchers' vision is that patients will have this portable device that they can take home, and they can monitor daily how they are reacting to the treatment. If they go below the threshold, then preventive treatment can be deployed.

Chemotherapy patients usually receive a dose every 21 days. After each dose, their white blood cell levels fall and after that gradually climb again. However, doctors usually only test patients' blood just before a new dose, so they have no way of knowing if white blood cell levels drop to dangerous levels following a treatment. In the U.S., one in six chemotherapy patients ends up hospitalized with one of these infections while their white cells are particularly low. Those infections cause long, expensive hospital stays and are fatal in about 7 percent of cases. The patients also have to miss their next chemotherapy dose, which sets back their cancer treatment.

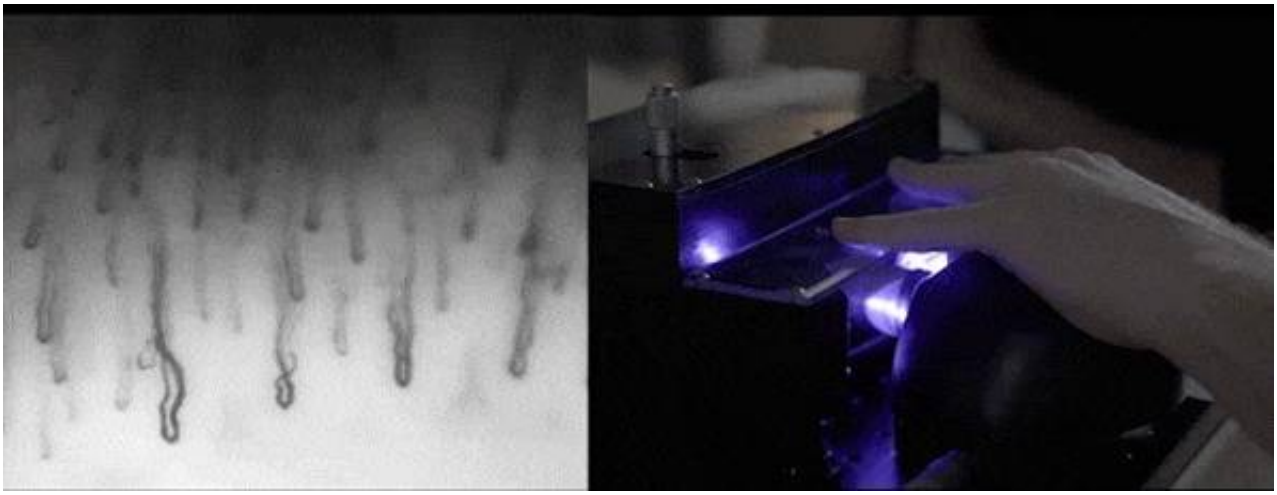


White blood cell levels
source - mit.edu

The MIT team estimated that if there were a way to detect when patients' white cell counts went below the threshold level, so they could be treated with prophylactic antibiotics and drugs that promote white blood cell growth, about half of the 110,000 infections that occur in chemotherapy patients in the United States every year could be prevented.

The technology the researchers used to solve this issue consists of a wide-field microscope that emits blue light, which penetrates about 50 to 150 microns below the skin and is reflected back to a video camera. The researchers decided to image the skin at the base of the nail, known as the nailfold, because the capillaries there are located very close to the surface of the skin. These capillaries are so narrow that white blood cells must squeeze through one at a time, making them easier to see. The technology does not

provide a precise count of white blood cells, but reveals whether patients are above or below the threshold considered dangerous - defined as 500 neutrophils (the most common type of white blood cell) per microliter of blood.



The researchers' prototype device can image through the skin at the base of the fingernail
source - mit.edu

To help move the technology further toward commercialization, the researchers are building a new automated prototype. Automating the measurement process is key to making a viable home-use device. The imaging needs to take place in the right spot on the patient's finger, and the operation of the device must be straightforward. The researchers also plan to adapt the technology so that it can generate more precise white blood cell counts, which would make it useful for monitoring bone marrow transplant recipients or people with certain infectious diseases. This could also make it possible to determine whether chemotherapy patients can receive their next dose before 21 days have passed.

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On market since:	-
Regions:	United States
Industries:	Healthcare
Source links:	MIT News

A NEW WAY TO REDUCE POTHOLES

Self-powered wireless sensors embedded in roads that could spot potholes and other hazards have been developed by the researchers at the University of Buffalo. Spring is here and the roads are a mess. Potholes form progressively from fatigue of the road surface which can lead to a precursor failure pattern known as crocodile (or alligator) cracking. But the days of motorists calling to report potholes may someday be a thing of the past. Instead, networks of self-powered wireless sensors would be laid under the road surface, providing regular updates on road conditions to transportation planners, drivers with connected cars and other parties.

That's the promise of ePave, a joint project involving the researchers at University of Buffalo and their colleagues from China's Chang'an University. The researchers want to detect road faults before they happen, and ultimately help motorists avoid traffic accidents due to damaged roads. The idea of embedding sensors in pavement is not new. An example of this is the buried sensors at intersections that prompt traffic lights to change if another vehicle is crossing the road. These systems are powered by wires that connect to traffic lights.

Potholes may someday be a thing of the past
source - iStock.com

Many researchers are trying to create more intelligent systems using wireless technology. This could allow entire roads to be monitored, including traffic and sub-surface conditions, such as pressure and moisture levels, that can be a sign that potholes or other road faults are developing. Many proposed wireless systems focus on batteries. The trouble with that idea is that transportation planners would need to tear up the road to replace the batteries. Other alternative power sources include solar, mechanical and thermal energy, or harvesting ambient radio signals. Yet each faces limitations with cost, installation, maintenance and other issues.

ePave attempts to work around these issues by harnessing piezoelectricity, the same type of electric charge used by electric cigarette lighters and acoustic guitar pickups, from the mechanical stress that vehicles put on roads. Each sensor is about the size of a key fob. Tests with a prototype suggest they can be placed as much as 500 feet apart. At two to three centimeters below the road, they can harvest and store enough energy to regularly detect moisture, pressure and other useful information. After that, it can send this data

every 10 minutes to relay stations as far as 1,000 feet away.

Self-powered wireless sensors
source - buffalo.edu

These relay stations could be built into street lights or similar structures, and the data could then be transmitted to a network via underground cables. In turn, that information could then be shared with transportation planners, connected cars and others. While promising, ePave is not yet ready for the roads. Researchers plan to continue studying the system, including the life of the piezoelectric module, which they hope will last at least five years and possibly as long as 20 years. They are also examining how to best embed the sensors, ways to reduce costs and other matters.

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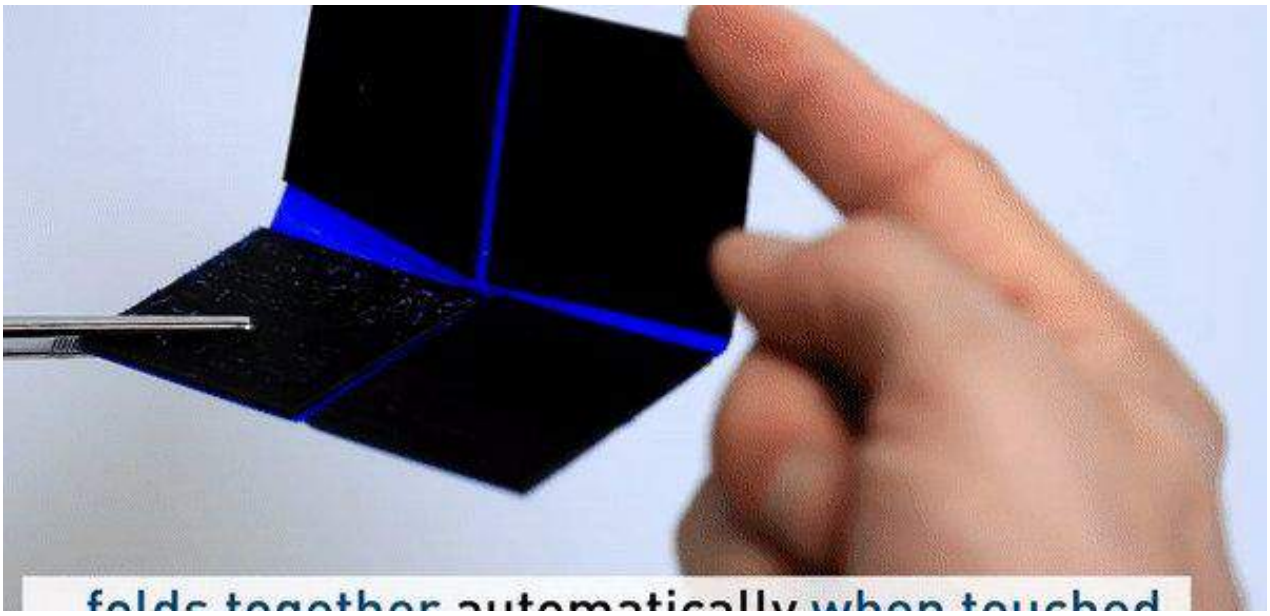
On market since:	-
Regions:	United States, China
Industries:	Electronics, Transport Systems and Vehicles
Source links:	Buffalo News Center



SELF-LOCKING BIOINSPIRED ORIGAMI STRUCTURES LIKE THE EARWIG

An artificial structure that functions on the same principle as the wing of earwigs has been developed by the researchers at ETH Zurich. The wing of an earwig is a lot like origami - but its elaborate design is far more ingenious than anything humans can make. When open, the earwig wing expands ten times larger than when closed - one of the highest folding ratios in the animal kingdom. The large wing area allows the insect to fly, while the compact way the wings retract enables the creature to tunnel underground without damaging its wings.

The wing design has another unique feature. However, in its open, locked state the wing remains stiff with no need for muscle power to provide stability. With just one 'click' the wing folds into itself completely, without the action of muscles. The researchers demonstrated that if the wing were to operate on the classical origami principle - using rigid, straight folds with an angular sum of 360 degrees at their intersections - the earwig would only be able to fold its wing down to a third of its size. The crucial factor in the design of the insect's wing is its elastic folds, which can operate either as an extensional or rotational spring.

Bioinspired origami structures like the earwig
source - ethz.ch

The wing joints are made from layers of a special elastic biopolymer, resilin, whose arrangement and thickness determines the spring type. In some instances, both extensional and rotational functions combine in the same joint. The team of researchers also examined the point in the earwig's wing that is responsible for stability in both the open and closed state: the central mid-wing joint. At this point, the folds intersect at angles that are incompatible with rigid origami theory. This point locks the wing in place in both its open and closed state.

The researchers transferred the findings to a multi-material printer. This allowed them to directly manufacture a so-called 4D object comprising four stiff plastic plates connected to

each other by a soft elastic joint. The spring functions of the connecting folds were proorammed into the material to enable them to perform extensional or rotational movements, mimicking the biological model.

The insect's wing is stable when open, but folds together automatically on even the lightest touch. In the next step, the researchers transferred the principle to larger elements and printed a spring origami gripper. This structure self-folds, locks, and cnn then grip objects without the need for external actuation. The self-folding origami elements are currently only available as prototypes. One potential application might be foldable electronics. Another area is space travel: solar sails for satellites or space probes that could travel within a very small space and then unfurl to their full size at their place of use.

Self-locking bioinspired origami structures like the earwig wing would save space, weight, and energy, as they do not require any actuators or additional stabilizers. The ETH researchers can also imagine more mundane uses, such as foldable tents, maps, or package inserts.

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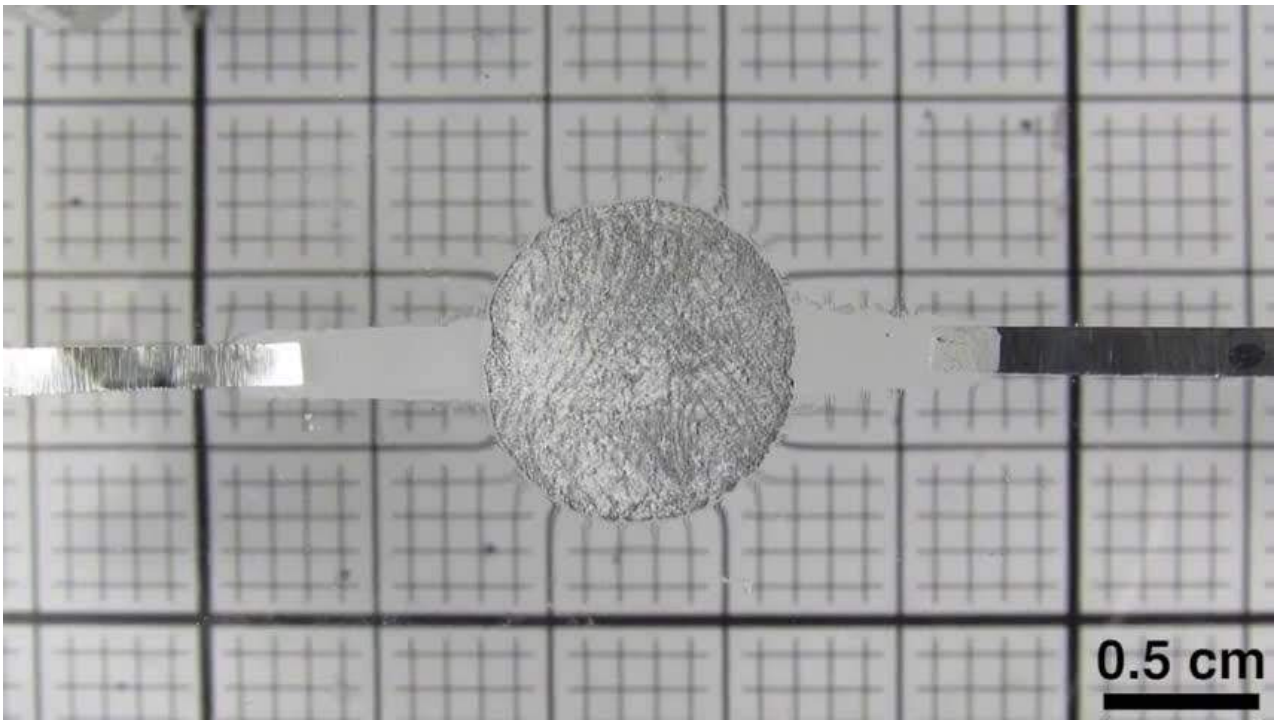
Patent status:	+
On market since:	-
Regions:	Switzerland
Industries:	Electronics, Manufacturing
Source links:	ETH News

A NEW INVISIBLE MATERIAL

Materials inspired by disappearing Hollywood dinosaurs and real-life shy squid have been invented by UCI engineers. The thin swatches can quickly change how they reflect heat, smoothing or wrinkling their surfaces in under a second after being stretched or electrically triggered. That makes them invisible to infrared night vision tools or lets them modulate their temperatures.

Basically, the team of researchers has invented a soft material that can reflect heat in similar ways to how squid skin can reflect light. It goes from wrinkled and dull to smooth and shiny, essentially changing the way it reflects the heat. Potential uses include better camouflage for troops and insulation for spacecraft, storage containers, emergency shelters, clinical care, and building heating and cooling systems.

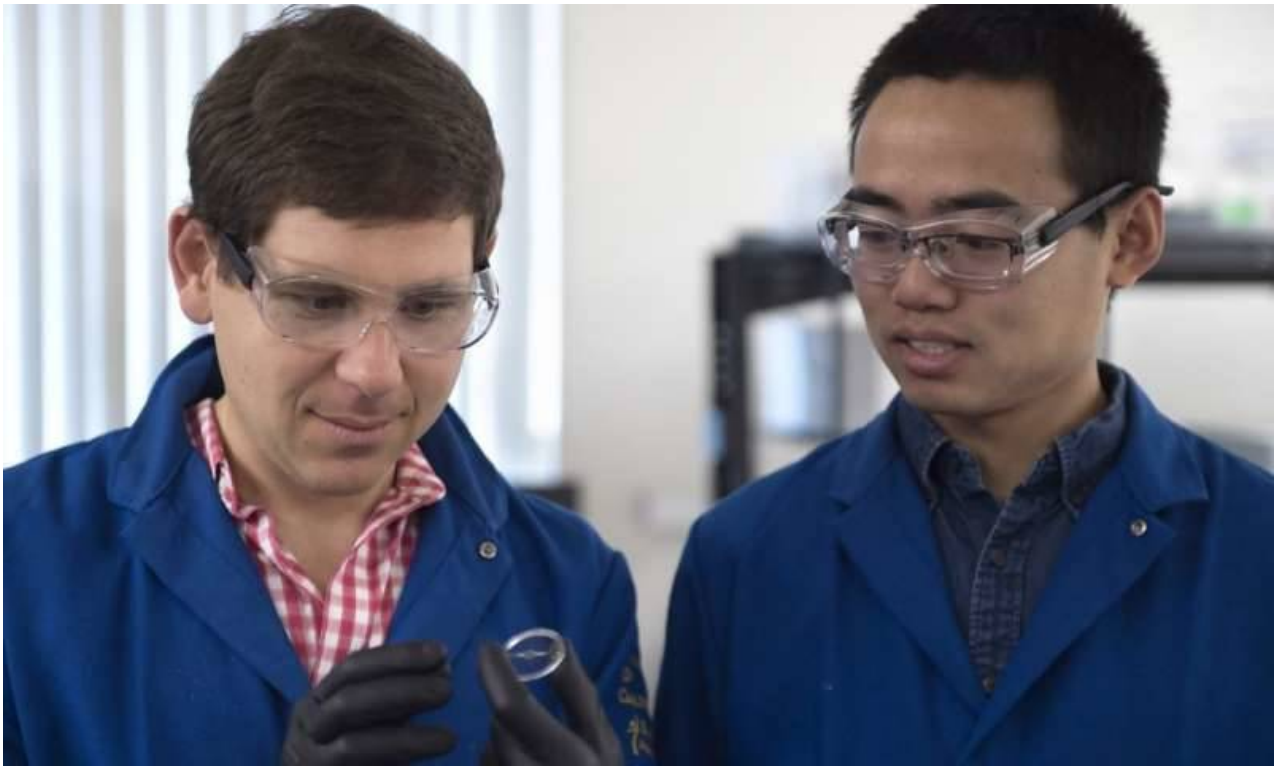


A new material
source - uci.edu

Since objects can be seen by light in the visible spectrum from a source reflecting off their surfaces and hitting the viewer's eye, the most natural form of invisibility (whether real or fictional) is an object that neither reflects nor absorbs light (that is, it allows light to pass through it). This is known as transparency and is seen in many naturally occurring materials (although no naturally occurring material is 100% transparent). The researchers were inspired both by science fiction and science fact - seeing dinosaurs disappear and reappear under an infrared camera in 'Jurassic World' and seeing squid filmed underwater do similar things. So the team decided to merge those concepts to design a really unique technology. Made of sandwiches of aluminum, plastic, and sticky tape, the material transforms from a wrinkled grey to a glossy surface when it is either pulled manually or zapped with voltage.

Products that reflect heat, such as emergency blankets, have existed for decades. But in

the past several years, inventors in Gorodetsky's lab and others have pushed to create dramatically enhanced versions via bio-inspired engineering. One focus has been to imitate how squid and other cephalopods can nearly instantaneously change their skin to blend into their surrounding environment. Now, the team of researchers have done it, creating prototypes that can next be scaled up into large sheets of commercially useable material. Patents are pending.



The team of researchers
source - uci.edu

Military camouflage once had a simple purpose – to hide personnel and equipment from the enemy's sight. But advances in detection technologies have added obstacles to the pursuit of invisibility, and materials scientists are now beginning to discuss new technologies, including adaptive and heat-concealing materials, in the public domain. It was hard, especially the first phase when the researchers were learning how to work with the sticky material. After trial-and-error processes involving thousands of attempts, the team of researchers saw the mirror-like coating change when they pulled it sideways. The whole project was very exciting. The research was led by Alon Gorodetsky, an assistant professor at University of California, Irvine, and doctoral student Chengyi Xu.

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On market since:	-
Regions:	United States
Industries:	Manufacturing
Source links:	UCI News

'FOG HARP' INCREASES COLLECTION CAPACITY FOR CLEAN WATER

The new fog nets to increase their collection capacity by threefold have been developed by the researchers at Virginia Tech. After all, installing giant nets along hillsides and mountaintops to catch water out of thin air sounds more like folly than science. However, the practice has become an important avenue to clean water for many who live in arid and semi-arid climates around the world. A passive, durable, and efficient method of water collection, fog harvesting consists of catching the microscopic droplets of water suspended in the wind that make up fog.

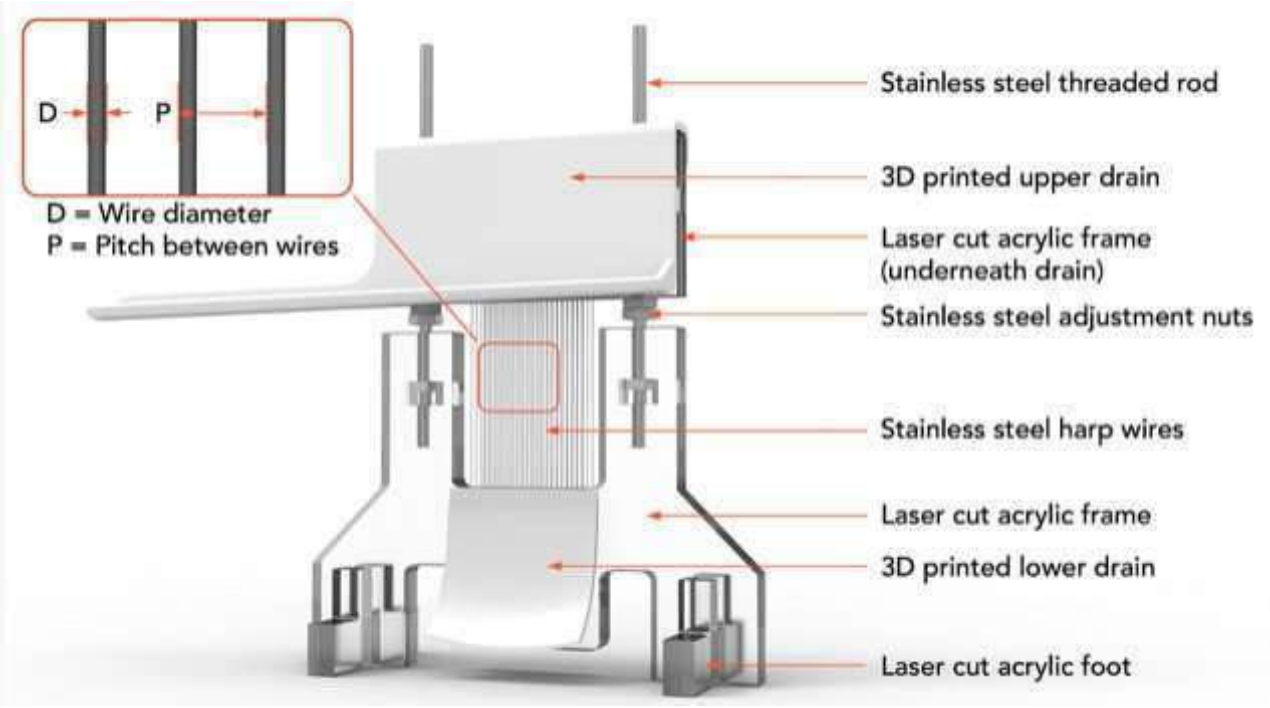
Fog harvesting is possible - and has gained traction over the last several decades - in areas of Africa, South America, Asia, the Middle East, and even California. As illustrated by recent headlines of South Africa's countdown to 'Day Zero,' or the day the water taps are expected to run dry, water scarcity continues to be a growing problem across the globe. Leading researchers now estimate that two-thirds of the world's population already live under conditions of severe water scarcity at least one month of the year.

A prototype of the fog harp
source - iStock.com

The team demonstrates how a vertical array of parallel wires may change the forecast for fog harvesters. In a design the researchers have dubbed the 'fog harp,' these vertical wires shed tiny water droplets faster and more efficiently than the traditional mesh netting used in fog nets. Fog nets have been in use since the 1980s and can yield clean water in any area that experiences frequent, moving fog. As wind moves the fog's microscopic water droplets through the nets, some get caught on the net's suspended wires. These droplets gather and merge until they have enough weight to travel down the nets and settle into collection trooghs below. In some of the largest fog harvesting projects, these nets collect an average of 6,000 liters of water each day.

However, the traditional mesh design of fog nets has long posed a dual constraint problem for scientists and engineers. If the holes in the mesh are too large, water droplets pass

through without catching on the net's wires. If the mesh is too fine, the nets catch more water, but the water droplets clog up the mesh without running down into the trough and wind no longer moves through the nets. That is why, fog nets aim for a middle ground, a Goldilocks zone of fog harvesting: mesh that's not too big and not too small. This compromise means nets can avoid clogging, but they're not catching as much water as they could be.



To test the fog harp's design, researchers constructed small-scale models of vertical wire arrays
source - vt.edu

The researchers found that the smaller the wires, the more efficient the water collection was. These vertical arrays kept catching more and more fog, but the clogging never happened. The team has already constructed a larger prototype of the fog harp - a vertical array of 700 wires that measures 3 feet by 3 feet. They plan to test the prototype on nearby Kentland Farm. Through its unique combination of science and design, the researchers hope the fog harp will one day make a big impact where it's needed most - in the bottom of the water bucket.

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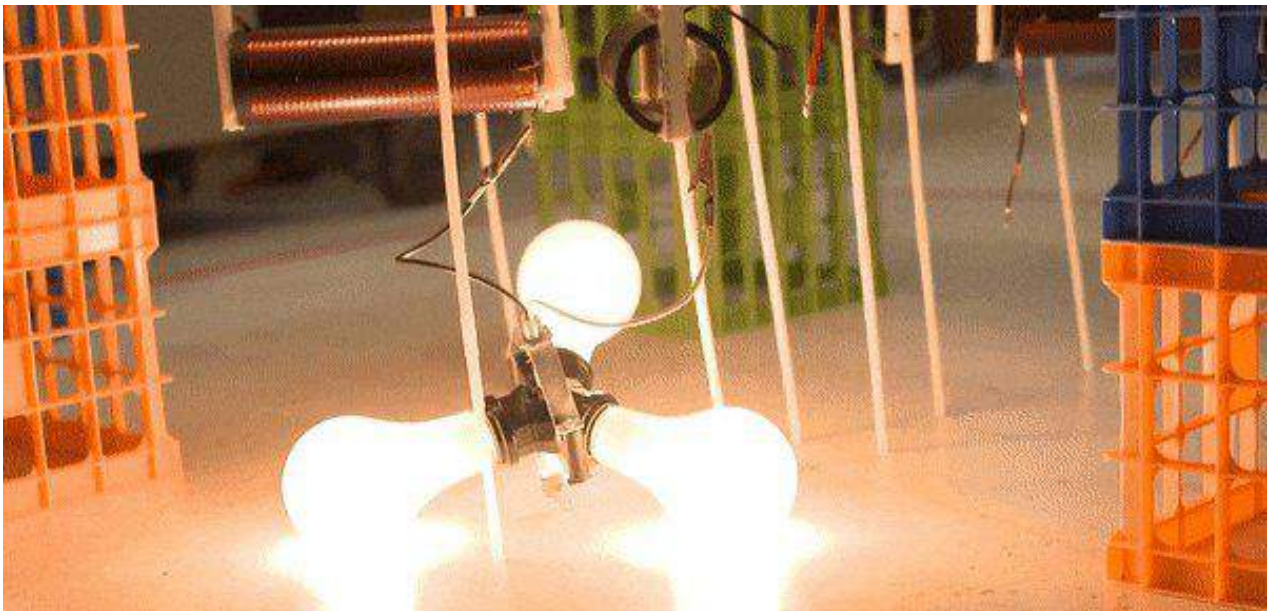
Regions:	United States
Industries:	Environment
Source links:	Virginia Tech News



FUTURE ELECTRIC CARS COULD RECHARGE WIRELESSLY WHILE YOU DRIVE

Electric vehicles that could recharge while driving down the highway, drawing wireless power directly from plates installed in the road that would make it possible to drive hundreds of miles without having to plug in have been developed by engineers at the University of Colorado at Boulder. The ability to send large amounts of energy across greater physical distance to in-motion platforms from low cost charging plates could one day allow the technology to expand beyond small consumer electronics like cell phones and begin powering bigger things like automobiles.

At the moment, most electric vehicles can travel between 100 and 250 miles on a single charge, depending on the make and model. But charging stations are still few and far between in much of the country, requiring drivers to be strategic in their travel. That problem could go away with this technology. The vehicle could simply travel in that lane when it needed an energy boost and could carry a smaller onboard battery as a result, decreasing the overall cost of the vehicle. Currently, some small consumer devices feature wireless power transfer, which allows the object to draw energy while lying on a specially-designed pad that is plugged into an outlet.

Replicating this capability for an automobile in motion is far more complicated, requiring significantly more power to be sent across a greater physical distance from the roadway to the vehicle. A car traveling at highway speeds would not linger on any single charging pad for more than a fraction of a second, so the pads would need to be placed every few meters to provide a continuous charge. To overcome the in-motion issue, the team had to think differently about methodology. Charging a smartphone only requires five watts of power. A laptop might need 100 watts. But an electric vehicle in motion requires tens of kilowatts of power, two orders of magnitude higher.

Most wireless power technology research to date has focused on transferring energy through magnetic fields - the so-called inductive apprpach. Magnetic fields, at strength levels appropriate for substantial energy transfer, are easier to generate than equivalent electric fields. However, magnetic fields travel in a looping pattern, requiring the use of fragile and lossy ferrites to keep the fields and the energy directed - resulting in an expensive system. Electrical fields, by contrast, naturally travel in relatively straight lines. Team wanted to take advantage of the more directed nature of electric fields for their innovation and substantially decrease the cost of the system.

The engineers set up metal plates parallel to one another, separated by 12 centimeters. The two bottom plates represent the transmitting plates within the roadway while the two top plates represent the receiving plates inside the vehicle. The device has steadily enhanced to the point where it can transmit kilowatts of power at megahertz-scale frequencies. The team is planning to continue developing the prototype and scale it for potential real-world applications.

Illustration demonstrating a vehicle driving over a series of charging plates in the road to draw electrical power source - colorado.edu

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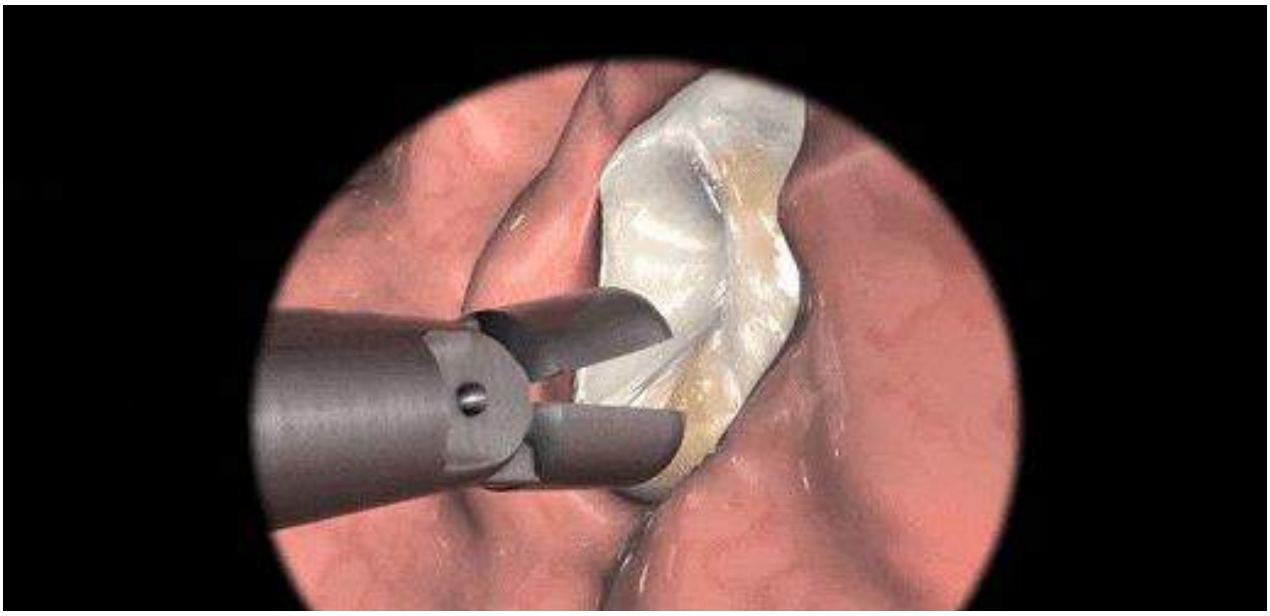
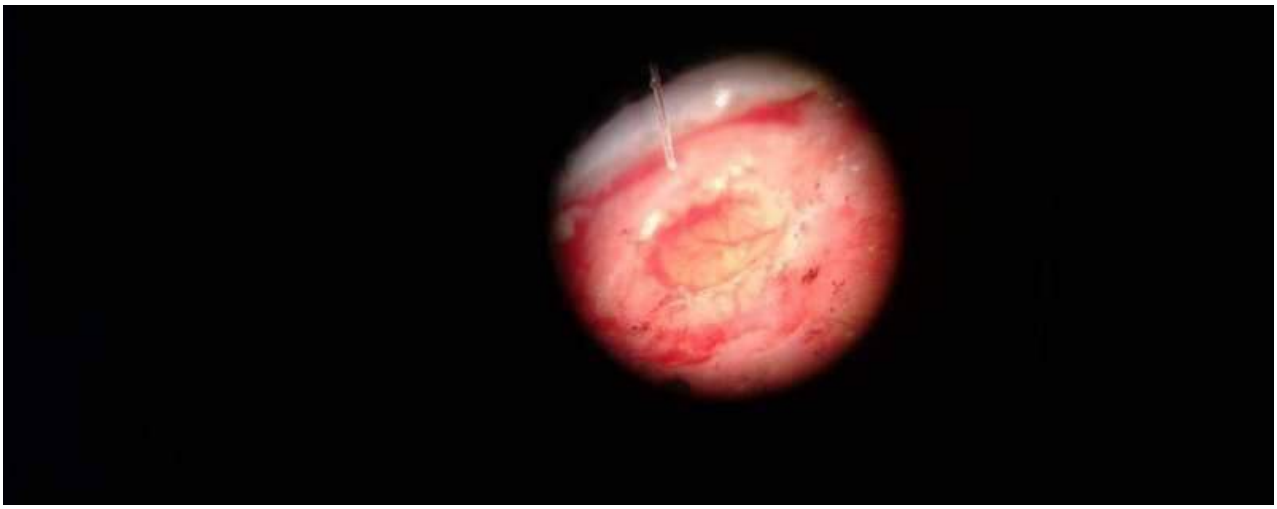
Industries:	Transport Systems and Vehicles
Source links:	CU Boulder Today



NEW FIBER-BASED ENDOSCOPE

An endoscope as thin as a human hair that can image the activity of neurons in the brains of living mice has been developed by the researchers at Optical Society of America. Because it is so thin, the endoscope can reach deep into the brain, giving researchers access to areas that cannot be seen with microscopes or other types of endoscopes.In addition to being used in animal studies to help the researchers understand how the brain works, this new endoscope might one day be helpful for certain applications in people.

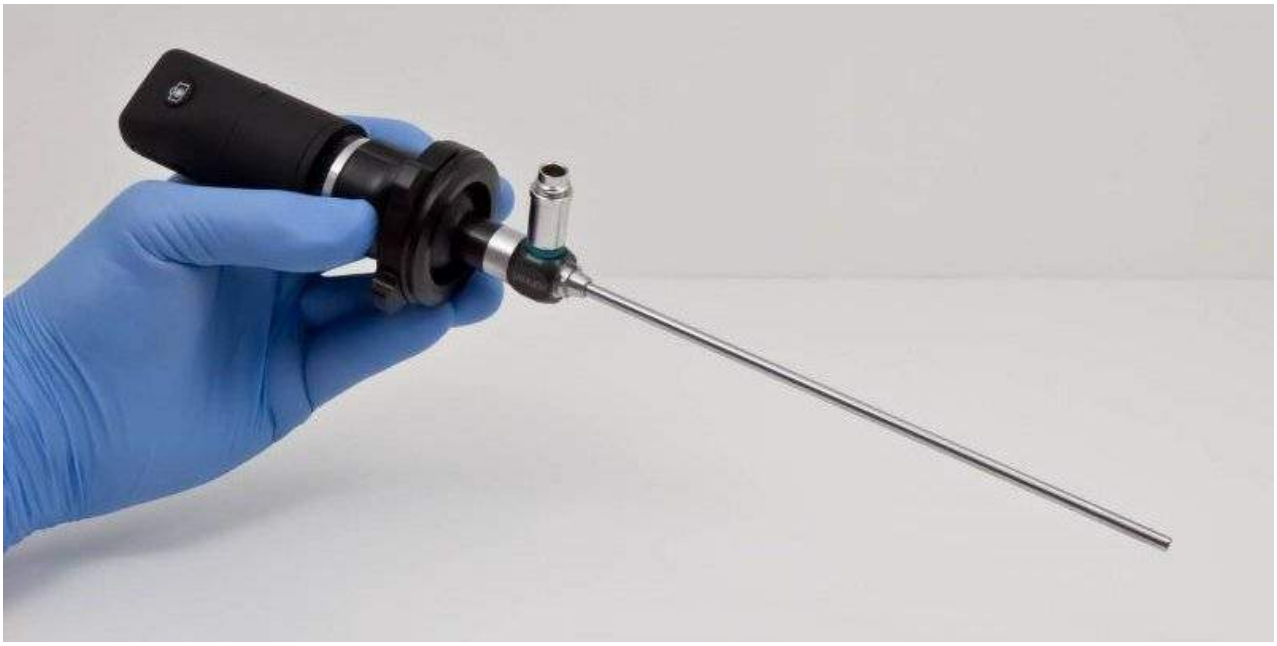
The new endoscope is based on an optical fiber just 125 microns thick. Because the device is five to ten times thinner than the smallest commercially available microendoscopes, it can be pushed deeper into the brain tissue without causing significant damage. The researchers report that the endoscope can capture micron-scale resolution images of neurons firing. This is the first time that imaging with such a thin endoscope has been demonstrated in a living animal.



With further development, the new microendoscope could be used to image neuron activity in previously inaccessible parts of the brain such as the visual cortex of primate animal models. It might also be used to study how neurons from different regions of the brain communicate with each other. The new microendoscope is based on a multimode optical fiber, which can carry different multiple beams of light at the same time. When light enters the fiber, it can be manipulated to generate a tiny spot at the other end, and can be moved to different positions on the tissue without moving the fiber. Scanning the tiny spot across the sample allows it to excite fluorescent molecules used to label neuron activity. As the fluorescence from each spot travels back through the fiber, an image of neuron activity is formed.

To achieve scanning fast enough to image neurons firing, the team used an optical compound known as a digital mirror device (DMD) to quickly move the light spot. The researchers developed a technique that allowed them to use the DMD to scan light at speeds up to 20 kilohertz, which is fast enough to see fluorescence from active neurons. Because the multimode fibers used for the endoscope scramble light, the researchers applied a method called wavefront shaping to convert the scrambled light into images. For

wavefront shaping, they sent different patterns of light through the fiber to a camera at the other end and recorded exactly how that specific fiber changed light that passed through. The camera was then removed, and the fiber placed into the brain for imaging. The previously obtained information about how the fiber changes the light is after that used to generate and scan a small point across the field of view.



In addition to showing that their endoscope could catch detailed neuronal activity, the researchers also demonstrated that multiple colors of light could be used for imaging. This capability could be used to observe interactions between two groups of neurons each labeled with a different color.

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Industries:	Healthcare

THE NEW WEARABLE SCANNER ALLOWS PATIENTS TO MOVE FREELY FOR THE FIRST TIME

A novel generation of brain scanner, that can be worn like a helmet allowing patients to move naturally while being scanned, has been developed by researchers at the University of Nottingham and the Wellcome Centre for Human Neuroimaging, UCL. The researchers demonstrate that they can measure brain activity while people make natural movements, including nodding, stretching, drinking tea and even playing ping pong. Not only can this new, light-weight, magnetoencephalography (MEG) system be worn, but it is also more sensitive than currently available systems.

The researchers hope this new scanner will enhance research and treatment for patients who can't use traditional fixed MEG scanners, such as young children with epilepsy or patients with neurodegenerative disorders like Parkinson's disease. Brain cells operate and communicate by producing electrical currents. These currents generate tiny magnetic fields that are detected outside the head. Researchers use MEG to map brain function by measuring these magnetic fields. This allows for a millisecond-by-millisecond picture of which parts of the brain are engaged when the researchers undertake different tasks, such as speaking or moving.

Brain scanner
source - nottingham.ac.uk

With the existing scanners, the patient must remain very still while being scanned, as even a 5-mm movement can make the images unusable. This means it is often complicated to scan people who find it difficult to remain still such as young children, or patients with movement disorders. It also poses problems when one might need a patient to remain still for a long time in order to capture a rarely occurring event in the brain, such as an epileptic seizure.

These problems have been solved in the novel scanner by scaling down the technology. As the new sensors are very light in weight and can work at room temperature, they can be placed directly onto the scalp surface. Positioning the sensors much closer to the brain increases the amount of signal that they can pick up. The light-weight nature of the new scanner also means that, for the first time, subjects can move their heads during the

scanning. However, the quantum sensors will only operate in this way when the Earth's magnetic field has been decreased by a factor of around 50,000. To solve this problem, the researchers created special electromagnetic coils, which helped to reduce the Earth's field around the scanner. These coils were designed specifically to sit either side of the subject, and close to the walls of the room, to ensure that the scanner environment is not claustrophobic.

The scanner is based around helmets that can be made to fit anyone who needs to be scanned. Following success of their prototype system, the researchers are now working towards new styles of helmet, which will have the appearance of a bicycle helmet, that will be suitable for babies and children as well as adults. The researchers predict this new type of scanner will provide a four-fold increase in sensitivity in adults, potentially increasing to 15 or 20-fold with infants. The new scanner is exciting because it will help to enhance the understanding of how the brain works and it has a huge potential for clinical use.

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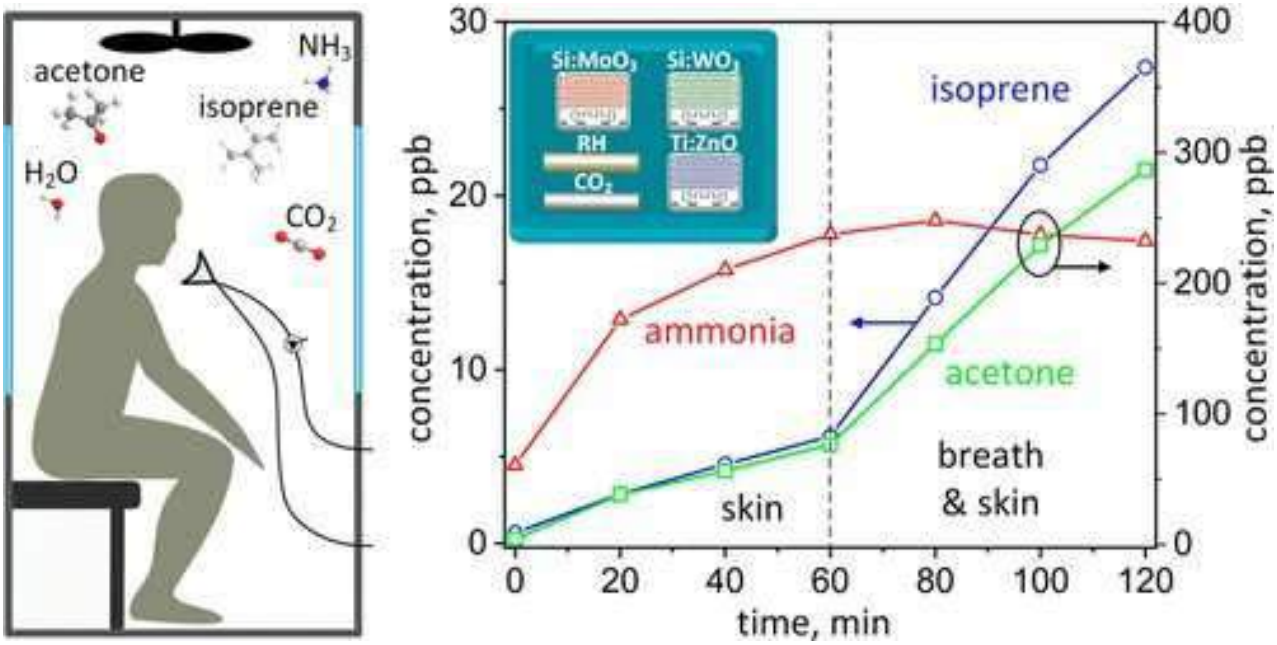
Regions:	United Kingdom
Industries:	Healthcare
Source links:	University of Nottingham News

RESEARCH

PORTABLE DEVICE TO SNIFF OUT TRAPPED HUMANS

An inexpensive, selective sensor that is light and portable enough for first responders to hold in their hands or for drones to carry on a search for survivors has been developed by the researchers at American Chemical Society. The first step after buildings collapse from an earthquake, bombing or other disaster is to rescue people who could be trapped in the rubble. But finding entrapped humans among the ruins can be challenging. In the hours following a destruction-causing event, the survival rate of people stuck in the rubble rapidly drops, so it's critical to get in there fast.

Current approaches include the use of human-sniffing dogs and acoustic probes that can detect cries for help. But these methods have drawbacks, such as the limited availability of canines and the silence of unconscious victims. Devices that detect a human chemical signature, which includes molecules that are exhaled or that waft off the skin, are perspective. But so far, these devices are too bulky and expensive for wide implementation, and they can miss signals that are present at low concentrations. So, the team of researchers wanted to develop an affordable, compact sensor array to detect even the most faint signs of life.



The illustration of portable device
source - acs.org

Earthquakes are lethal natural disasters frequently burying people alive under collapsed buildings. Tracking entrapped humans from their unique volatile chemical signature with hand-held devices would accelerate urban search and rescue (USaR) efforts. Here, a pilot study is presented with compact and orthogonal sensor arrays to detect the breath- and skin-emitted metabolic tracers acetone, ammonia, isoprene, CO2, and relative humidity (RH), all together serving as sign of life.

It consists of three nanostructured metal-oxide sensors, each specifically tailored at the nanoscale for highly sensitive and selective tracer detection along with commercial CO2 and humidity sensors. When tested on humans enclosed in plethysmography chambers to simulate entrapment, this sensor array rapidly detected sub-ppm acetone, ammonia, and isoprene concentrations with high accuracies and precision, unprecedented by portable

sensors but required for USaR. These results were in good agreement with benchtop selective reagent ionization time-of-flight mass spectrometry. As a result, an inexpensive sensor array is presented that can be integrated readily into hand-held or even drone-carried detectors for first responders to rapidly screen affected terrain.

An earthquake may cause injury and loss of life
source - acs.org

The researchers built their palm-sized sensor array from three existing gas sensors, each tailored to detect a specific chemical emitted by breath or skin: acetone, ammonia or isoprene. They also included two commercially available sensors for detecting humidity and CO2. In a human entrapment simulation, the sensors rapidly detected tiny amounts of these chemicals, at levels unprecedented for portable detectors - down to three parts per billion. The next step is to test the sensor array in the field under conditions similar to those expected in the aftermath of a calamity.

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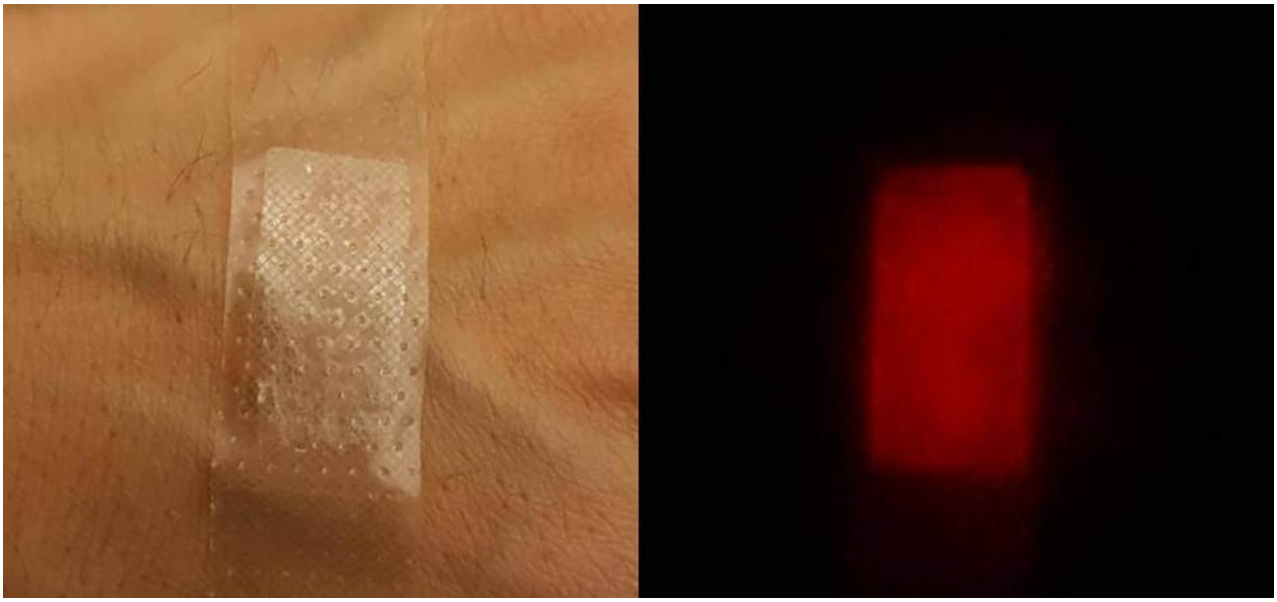
Regions:	United States
Industries:	Healthcare
Source links:	ACS News

A NEW WAY TO FIGHT AGAINST DETRIMENTAL BACTERIA

Far-red fluorescent silk that can kill harmful bacteria has been developed by the researchers at Purdue University. A silk hybrid material attacks bacteria when illuminated by a green light, thanks to a far-red fluorescent protein researchers transferred to its genetic makeup. The all-natural material would be safer than conventional photocatalytic, or light-activated, means to kill harmful pathogens such as bacteria, which use potentially biohazardous semiconductors and require cancer-causing ultraviolet light for activation.

Silk is an ancient and well-known biomaterial. It doesn't have any issues with the human body. And the nice thing about green light is thnt it's not detrimental - the color corresponds to the strongest intensity of the solar spectrum. To combine the benefits of silk and green light, researchers inserted the gene for 'mKate2,' a far-red fluorescent protein, into a silk host. Shining a green light on the resulting hybrid generates reactive oxygen species (ROS), which are efficient radicals for breaking down organic contaminants and attacking the membrane and DNA of pathogens.



The processing technology of fluorescent (mKate2) silk can be applied to developing smart medical bandages source - purdue.edu

Fluorescent proteins often result in phototoxicity and cytotoxicity, in particular because some red fluorescent proteins decrease and release reactive oxygen species (ROS). The photogeneration of ROS is considered as a detrimental side effect in cellular imaging or is proactively utilized for ablating cancerous tissue. Taking advantage of green (visible) light activation, native, and regenerated mKate2 silk can produce and release superoxide and singlet oxygen, in a comparable manner of visible light-driven plasmonic photocatalysis.

When E. coli on the fluorescent silk were illuminated by a weak green light for 60 minutes, the bacteria's survival rate dropped to 45 percent. The researchers discovered that the hybrid could be processed into a solution, fabric, bandage, and film. They have basically added fluorescence to silk to facilitate disinfection or decontamination using just visible light.

When a green light shines on red fluorescent silk, a mechanism to kill pathogens is activated
source - purdue.edu

The team of researchers believes that green-light activated red fluorescent silk could be both more efficient and scalable than other plasmonic photocatalysts, in which metal nanoparticles hybridized from semiconductor materials also use visible light but could still pose negative environmental consequences. The silk photocatalysts would be easier and safer to produce than plasmonic ones since silkworms, instead of industrial facilities, provide the host for ROS-generating materials. It's a completely new green manufacturing of nanomaterials.

Because ambient white light also includes green light, the researchers anticipate that the silk hybrid material should typically have a strong enough light source to generate ROS as long as a green light controls ROS generation. The team plans to take advantage of silk's biocompatibility with the human body both inside and out. The researchers are thinking about some implantable and injectable wound healing materials that dissolve over time in the body. After that, they wouldn't need to do additional surgery to take it out.

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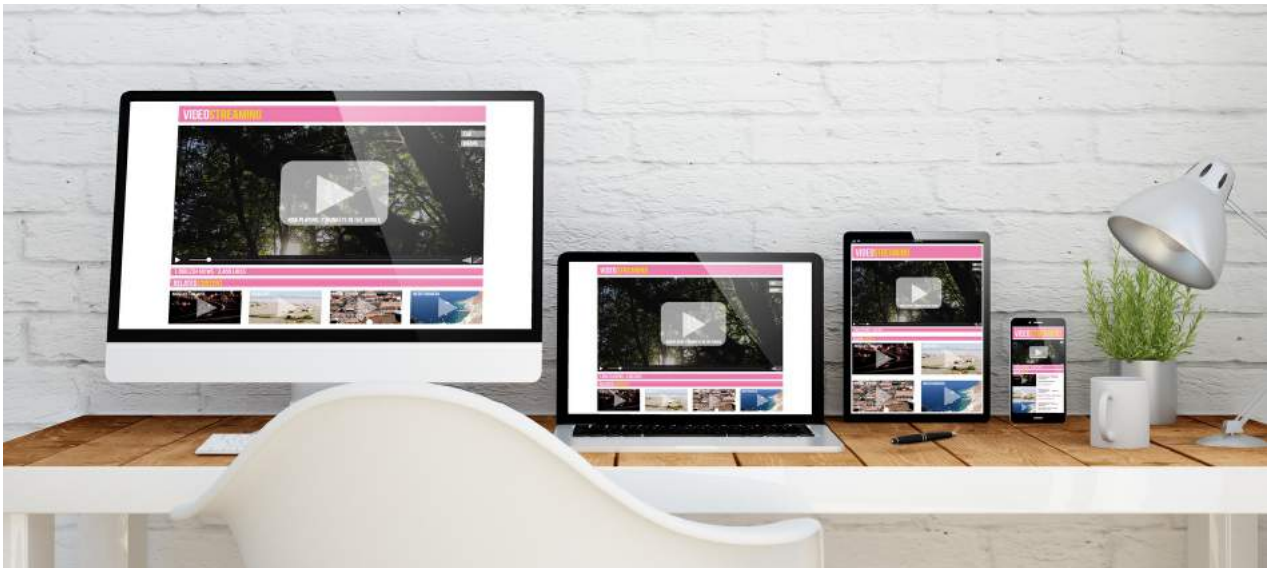
On market since:	-
Regions:	United States
Industries:	Biotechnology
Source links:	Purdue University



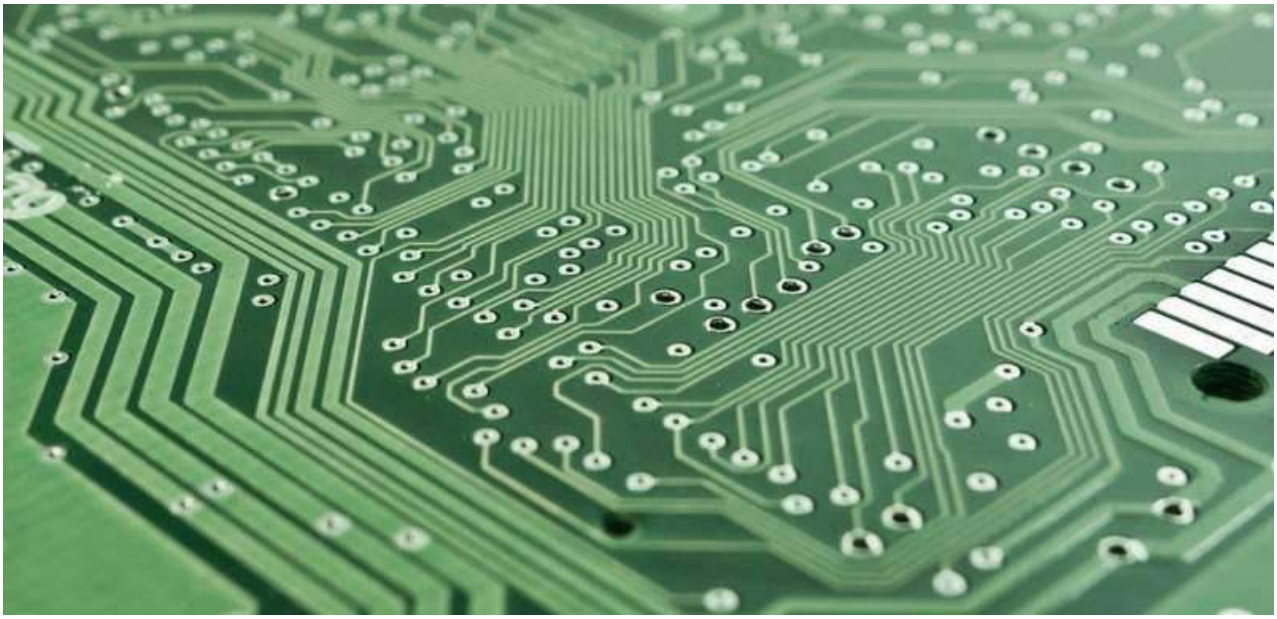
A NEW TRANSISTOR FOR FLEXIBLE TVS AND WEARABLES

A nanoscale transistor for flexible televisions, tablets, and phones has been developed by the team of researchers at The University of Manchester and Shandong University in China. The international team has developed an ultrafast, nanoscale transistor - known as a thin film transistor, or TFT, - made out of an oxide semiconductor. The TFT is the first oxide-semiconductor based transistor that is capable of operating at a benchmark speed of 1 GHz. This could make the next generation electronic gadgets even faster, brighter and more flexible than ever before.

A TFT is a type of transistor usually used in a liquid crystal display (LCD). These can be found in most modern gadgets with LCD screens such as smart phones, tablets, and high-definition televisions. How do they work? LCD features a TFT behind each individual pixel and they act as individual switches that allow the pixels to change state rapidly, making them turn on and off much more quickly.

But most existing TFTs are silicon-based which are opaque, rigid and expensive in comparison to the oxide semiconductor family of transistors which the team from the UK and China are developing. Whilst oxide TFTs will enhance picture on LCD displays, it is their flexibility that is even more impressive. TVs can already be made extremely thin and bright. This work may help make TV more mechanically flexible and even cheaper to produce.

But, perhaps even more importantly, the GHz transistors may enable medium or even high performance flexible electronic circuits, such as truly wearable electronics. Wearable electronics requires flexibility and in many cases transparency, too. This would be the perfect application for this research. In addition, there is a trend in developing smart homes, smart hospitals, and smart cities - in all of which oxide semiconductor TFTs will play a key role.



A nanoscale transistor
source - manchester.ac.uk

Oxide-based technology has seen rapid development when compared to its silicon

counterpart which is increasingly close to some fundamental limitations. The team of researchers believes there has been fast progress in oxide-semiconductors in recent years and extensive efforts have been made in order to enhance the speed of oxide-semiconductor-based TFTs.

The oxide-based technology has already started replacing amorphous silicon in some gadgets. The team of researchers suggests these latest developments have brought commercialization much closer. To commercialize oxide-based electronics there is still a range of research and development that has to be carried out on materials, lithography, device design, testing, and last but not the least, large-area manufaacturing. It took many decades for silicon technology to get this far, and oxides are progressing at a much faster pace. Making a high performance device, like the GHz IGZO transistor, is challenging because not only do materials need to be optimized, a range of issues regarding device design, fabrication, and tests also have to be investigated.

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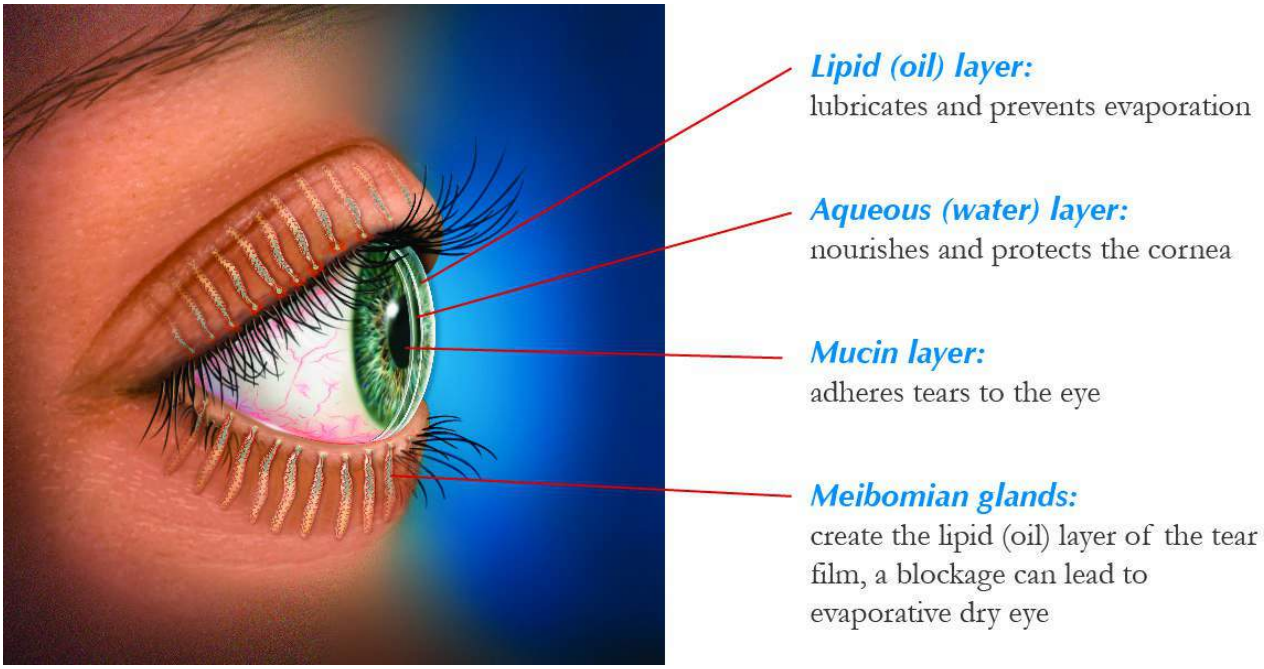
Regions:	United Kingdom, China
Industries:	Electronics
Source links:	The University of Manchester

A NEW TREATMENT FOR VISION LOSS IN DIABETES

A novel method to treat vision loss in a diabetes has been developed by the researchers at the Michigan state University. A particular type of lipid, or fat - thought to only exist in the skin - lives also in human eye and might play a major role in deterring the eye disease diabetic retinopathy. This study presents an unexpected finding that the connections between cells in the retinal blood vessels contain unusual, long-chain lipids that may keep vessels from leaking, possibly preventing diabetic retinopathy from occurring.

Diabetes is a disease that occurs when the pancreas does not secrete enough insulin or the body is unable to process it properly. Insulin is the hormone that regulates the level of sugar (glucose) in the blood. The effect of diabetes on the eye is called diabetic retinopathy. Diabetic retinopathy is a common complication of diabetes, it may not have any symptoms or may not affect sight in the early stages but, as the condition progresses, eventually the sight will be affected. When the condition is caught early, treatment is efficient at reducing or preventing damage to sight.



A special eye lipid can help to treat retinopathy
source - msu.edu

Diabetic related sight loss is the most common form of blindness in people of working age in many countries. In about 10% of cases, diabetic macular oedema (DME) may occur where blood vessels leak their contents into the macular region of the retina and this may cause a more rapid form of vision loss. Blood vessels in the retina are closely connected by structures called tight junctions, which are part of the blood-retinal barrier, a virtually impenetrable wall. The team of researchers demonstrated that these connecting structures contain omega-linked acyl - very long chain ceramides - elongated lipids that appear to strengthen this barrier. Diabetes can expose blood vessels to high levels of glucose and unhealthy amounts of lipids, which throws off the balance of nutrients that are transported throughout the body.

New research can prevent diabetic retinopathy from occurring
source - msu.edu

When this becomes unbalanced, the vessels leak and become fragile, leading to the development of diabetic retinopathy. It appears though that these long-chain lipids and the enzymes that produce them can protect the retina and its blood vessels. In cases of diabetes, the enzyme ELOVL4 is suppressed by the disease, which decreases its ability to produce these helpful lipids and prevent further damage. Next steps for the team of researchers will be to understand what these lipids can really do and how exactly they're situated in the tight junctions of the retina so novel treatments may be possible.

Incorporating more of the long-chain lipids into the eye could potentially be a new treatment down the road and involve injections or even eye drops. Lipids often get a bad rap due to their association with health issues such as high cholesterol and heart disease, but the team of researchers is encouraged by what they have discovered. There are bad lipids and then there are good lipids. The researchers have found good lipids in the eye that have the potential of changing the development of diabetic retinopathy.

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On market since:	-
Regions:	United States
Industries:	Healthcare
Source links:	Michigan State University

DIGGING IN DIRT UNEARTHS NEW KIND OF ANTIBIOTICS

A novel class of powerful antibiotics called malacidins, which are going to be efficient against multidrug-resistant bacteria has been developed by the researchers at Rockefeller University. In an effort to discover bacterial molecules with potential as drugs, the researchers sequenced the genes of microbes from more than 2,000 soil samples from New York City parks. In laboratory and animal testing, malacidins wiped out many infections, including some that are resistant to traditional antibiotics. Moreover, infectious bacteria exposed to malacidins didn't develop resistance to the new antibiotics in long-term lab experiments.

It will take years of additional research before malacidins might be ready for human clinical trials. Still, the discovery could someday help address a looming public-health crisis, as the current antibiotics are increasingly losing their effectiveness against microorganisms that cause dangerous infections. Soil is a rich environment for microbiologists to discover. It consists of a remendeous array of microorganisms that are even more diverse than the human microbiome - a single gram of soil may contain thousands of species of bacteria.

Unearthing new class of antibiotics
source - rockefeller.edu

But the vast majority of these bacteria will not adapt to lab cultivation and have therefore not been accessible for scientific exploitation. The team solved that problem by pioneering a technique to identify possible drug compounds from microbial DNA in soil, instead of extracting these components from the microbes themselves. The method makes culturing unnecessary, and relies instead on high-tech tools like DNA sequencing and computational analysis.

One problem with the new strategy is that dirt contains far too much DNA for researchers to analyze fully. No matter what power of sequencing you have today, it's still not enough to sequence all the DNA in a single soil sample, much less in the millions or trillions of environments that exist on Earth. The researchers have to come up with more creative ways of sorting through all that genetic information.

Their answer was to screen the DNA for genes resembling those coding for known drugs - in this case, a relatively new class of antibiotics that works only in the presence of calcium.

These drugs have the added advantage that they don't readily encourage infectious bacteria to build up resistance. One of the sequences the scientists discovered turned out to encode the malacidin molecules. The physical structure of these compounds, and the way they function, are different from that of other calcium-binding drugs.

The team sequenced the genes of microbes from 2,000 soil samples from New York City parks
source - rockefeller.edu

The researchers are now studying variants of the newly discovered malacidin molecule to see if another analog might work even better as a germ killer. Moreover, researchers are ramping up their search for new antibiotics. If new therapies aren't developed, world-wide deaths due to untreatable infections are predicted to rise more than ten-fold by 2050. Continuing research efforts could help reverse that trend.

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On market since:	-
Regions:	United States
Industries:	Healthcare, Biotechnology
Source links:	The Rockefeller University

A NEW TREATMENT FOR DEPRESSION

A novel method to fight against depression has been discovered by the team of researchers at the American Psychiatric Association. A nasal spray formulation of ketamine demonstrates promise in the rapid treatment of symptoms of major depression and suicidal thoughts. The double-blind study compared the standard treatment plus an intranasal formulation of esketamine, part of the ketamine molecule, to standard treatment plus a placebo for rapid treatment of symptoms of major depression, including suicidality, among individuals at imminent suicide risk.

Depression (major depressive disorder) is a common and serious medical illness that negatively affects how you feel, the way you think and how you act. Fortunately, it is also treatable. Depression causes feelings of sadness and a loss of interest in activities once enjoyed. It can lead to a variety of emotional and physical problems and can reduce a person's ability to function at work and at home.

Ketamine shows fast-acting benefits
source - psych.org

The study involved 68 participants randomly assigned to one of two groups - either receiving esketamine or placebo twice a week for four weeks. All participants continued to receive treatment with antidepressants throughout. The team of researchers looked at effects at four hours after first treatment, at 24 hours and at 25 days. The researchers found an important improvement in depression scores and decreased suicidal ideation in the esketamine group compared to the placebo group at four hours and at 24 hours. The esketamine effects were not greater than the placebo at 25 days. The measurement of suicide risk took into consideration both the patient's and clinician's perspectives.

The results of the study support nasal spray esketamine as a possible effective rapid treatment for depressive symptoms in patients assessed to be at imminent risk for suicide. Esketamine could be a really significant treatment to bridge the gap that exists because of the delayed effect of most common antidepressants. Most antidepressants take four to six

weeks to become fully efficient.

A new research offers one more treatment for depression
source - psych.org

This study was a proof-of-concept, phase 2, study for esketamine. It must still go through a phase 3 study before possible FDA approval. It was funded by Janssen Research and Development, LLC. The authors caution that more research is needed on the potential for abuse of ketamine. But the researchers note the known potential for abuse and existing reports of abuse of prescribed ketamine. They discuss the need for an extra research relating to the abuse potential of ketamine during phase 3 trials, such as monitoring of patients' craving and potential ketamine use from other sources.

The team of researchers and their colleagues still argue that steps to control the use of ketamine would not be aimed at preventing its use for beneficial purposes but would allow for treatment to continue to be available to those with need, while the population that is at-risk for abuse is protected from an epidemic of misuse.

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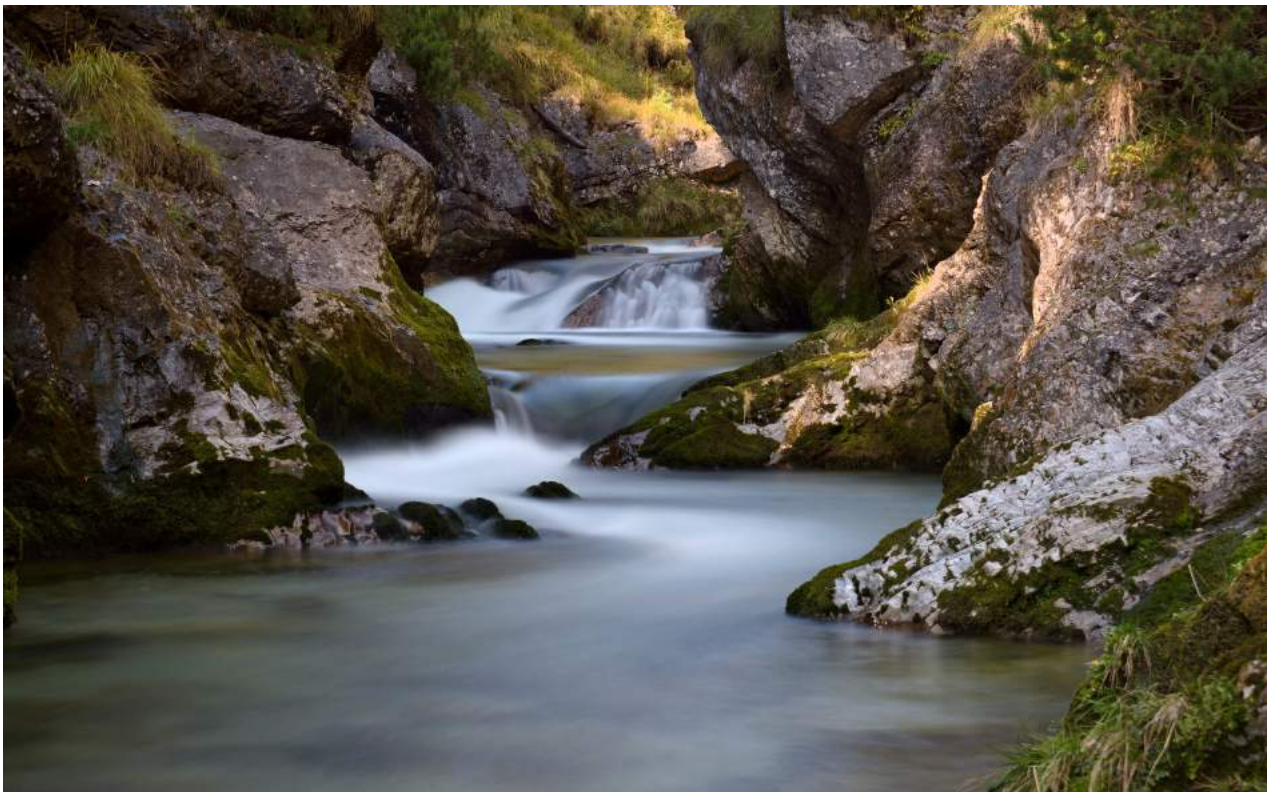
Industries:	Healthcare
Source links:	American Psychiatric Association



A NEW WAY TO REMOVE ARSENIC FROM WATER

A moss that is capable of removing arsenic from contaminated water has been discovered by the researchers at Stockholm University. And it happens quickly - in just one hour, the arsenic level is so low that the water is no longer detrimental for people to drink. The aquatic moss Warnstofia fluitans, which grows in northern Sweden, has the ability to quickly absorb and adsorb arsenic from water. The discovery allows for an environmentally friendly way to purify water of arsenic. One possible scenario is to grow the moss in streams and other watercourses with high levels of arsenic.

Arsenic is a natural compound of the earth's crust and is widely distributed throughout the environment in the air, water and land. It is highly toxic in its inorganic form. People are exposed to elevated levels of inorganic arsenic through drinking contaminated water, using contaminated water in food preparation and irrigation of food crops, industrial processes, eating contaminated food and smoking tobacco.

This is aquatic moss in Stockholm University greenhouse
source - su.se

Long-term exposure to inorganic arsenic, mainly through drinking-water and food, can cause the chronic arsenic poisoning. Skin lesions and skin cancer are the most characteristic effects. The greatest threat to public health from arsenic originates from contaminated groundwater. Fish, shellfish, meat, poultry, dairy products and cereals can also be dietary sources of arsenic, although exposure from these foods is generally much lower compared to exposure through contaminated groundwater. In seafood, arsenic is mainly found in its less toxic organic form.

In the northern part of Sweden, water from mining areas is often contaminated by arsenic. The team of researchers hopes that the plant-based wetland system that they are developing will solve the arsenic problem in Sweden's northern mining areas. These experiments demonstrate that the moss has a very high capacity to remove arsenic. It takes no more than an hour to remove 80 per cent of the arsenic from a container of water.

By then, the water has reached such a low level of arsenic that it is no longer detrimental to people.

A moss can remove arsenic from contaminated water source - su.se

In 2004, the use of arsenic compounds in wood products was banned, but arsenic still reaches ground and water systems due to mining. This happens because the ground and bedrock in certain parts of Sweden naturally contain arsenic. As a result, the drinking water and water used for the irrigation of crops also contain elevated levels of arsenic. The plants absorb the arsenic from the soil, and it over time ends up in the food that people eat. In Sweden, this applies to wheat, root vegetables, leafy greens, etc. In other countries, there are high levels in rice, for instance.

How much arsenic people consume ultimately depends on how much of these foods they eat, as well as how and where they were grown. The researchers' aim is that the plant-based wetland system they are developing will filter out the arsenic before the water becomes drinking water and irrigation water. That way, the arsenic will not make it into the food.

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A PLASTIC-EATING ENZYME

An enzyme that is able to digest some of the most commonly polluting plastics, providing a potential solution to one of the world's biggest environmental problems has been developed by the researchers at the University of Portsmouth and the US Department of Energy's National Renewable Energy Laboratory (NREL). This discovery could result in a recycling solution for millions of tonnes of plastic bottles, made of polyethylene terephthalate, or PET, which persists at the moment for hundreds of years in the environment. During this study, the team engineered an enzyme that is even better at degrading the plastic than the one that evolved in nature.

The researchers are now working on enhancing the enzyme further to allow it to be used industrially to eradicate plastics in a fraction of the time. They made the breakthrough when they were examining the structure of a natural enzyme which is thought to have evolved in a waste recycling centre in Japan, allowing a bacterium to degrade plastic as a food source.

Plastic bottles take centuries to biodegrade, but new enzyme discovery brings hope
source - port.ac.uk

PET, patented as a plastic in the 1940s, has not existed in nature for very long, so the team aimed to discover how the enzyme evolved and if it might be possible to enhance it. The goal was to determine its structure, but they finished going a step ahead and engineered by chance an enzyme which was even better at breaking down PET plastics. The research team can now apply the tools of protein engineering and evolution to continue to enhance it.

The team found out that PETase looks very similar to a cutinase, but it has some unusual features including a more open active site, able to accommodate man-made instead of natural polymers. These differences indicated that PETase could evolved in a PET-containing environment to enable the enzyme to degrade PET. To verify that hypothesis, the researchers mutated the PETase active site to make it more like a cutinase. And that was when the unexpected happened - the researchers found that the PETase mutant was better than the natural PETase in degrading PET.

Professor John McGeehan
source - port.ac.uk

In addition, the enzyme can also degrade polyethylene furandicarboxylate, or PEF, a bio-based substitute for PET plastics that is being hailed as a replacement for glass beer bottles. The engineering process is much the same as for enzymes being used at the moment in bio-washing detergents and in the manufacture of biofuels - the technology exists and it's well within the possibility that in the following years the researchers will see an industrially viable process to convert PET and potentially other substrates like PLA, PBS, and PEF back into their original building blocks so that they can be sustainably recycled.

It will be interesting to see whether, based on this study, the performance of the enzyme can be enhanced and made suitable for industrial-scale application in the recycling and the future circular economy of plastic. This research is just the beginning and there is much more to be done in this area. The international team of researchers is tackling one of the biggest problems facing our planet.

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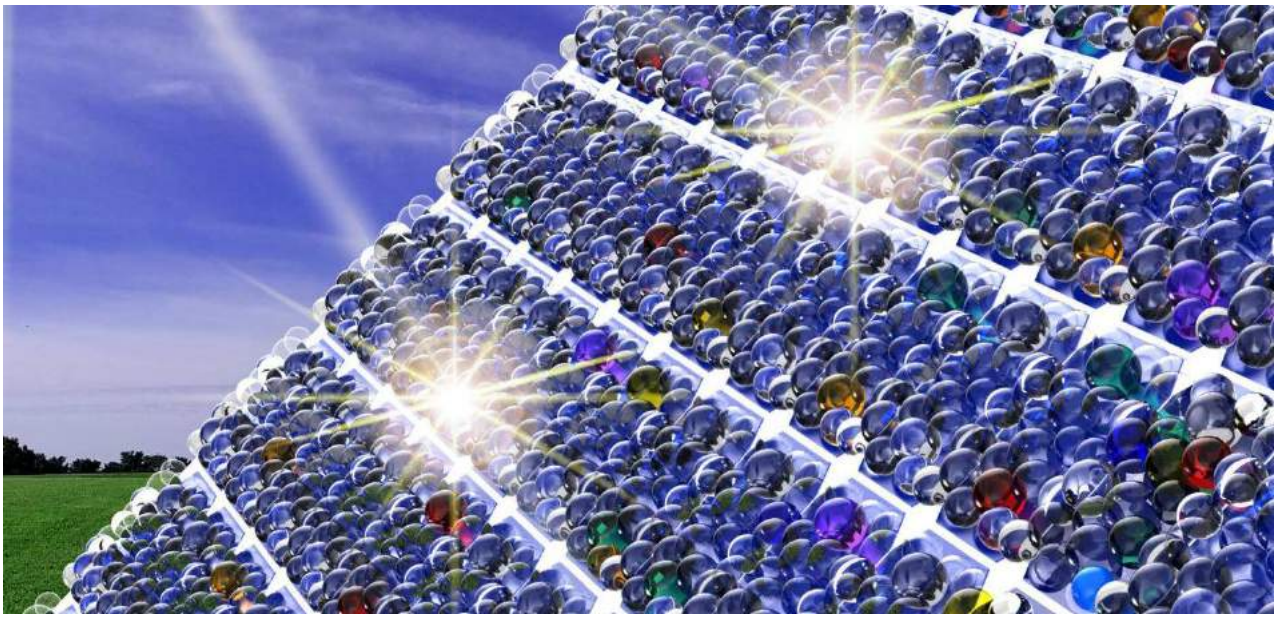
A NEW COATING FOR SOLAR PANELS

A nanoscale coating for solar cells that enables them to absorb about 20 percent more sunlight than uncoated devices with trapping light with an optical version of a whispering gallery has been developed by the team of researchers at the National Institute of Standards and Technology (NIST). The coating, applied with a technique that could be incorporated into manufacturing, opens a novel way for developing high-efficiency and low-cost solar cells with abundant, renewable and environmentally friendly materials. The coating consists of thousands of tiny glass beads, only about one-hundredth the width of a human hair.

When sunlight hits the coating, the light waves are steered around the nanoscale bead, similar to the way sound waves travel around a curved wall such as the dome in St. Paul's Cathedral in London. At such curved structures, known as acoustic whispering galleries, a person standing near one part of the wall easily hears a faint sound originating at any other part of the wall.



This is illustration shows the nanoresonator coating, consisting of thousands of tiny glass beads
source - nist.gov

Although whispering galleries for light were developed about a decade ago, the team of researchers has only recently explored their use in solar-cell coatings. In the experimental set up developed by a team including the scientists at the National Institute of Standards and Technology and their colleagues at the University of Maryland's NanoCenter, the light captured by the nanoresonator coating over time leaks out and is absorbed by an underlying solar cell made of gallium arsenide.

Using a laser as a light source to excite individual nanoresonators in the coating, the team of researchers discovered that the coated solar cells absorbed, on average, 20 percent more visible light than bare cells. The measurements also revealed that the coated cells produced about 20 percent more current. The study is the first to demonstrate the efficiency of the coatings using precision nanoscale measurements. Although calculations had suggested the coatings would improve the solar cells, the researchers could not prove this was the case until they had developed the nanoscale measurement technologies that were needed.

New coating enables solar cells to absorb about 20 percent more sunlight than uncoated device
source - nist.gov

The team of researchers also developed a rapid, less-costly approach of applying the nanoresonator coating. Researchers had previously coated semiconductor material by dipping it in a tub of the nanoresonator solution. The dipping method takes time and coats both sides of the semiconductor even though only one side requires the treatment.

In the researchers' method, droplets of the nanoresonator solution are placed on just one side of the solar cell. A wire-wound metal rod is pulled across the cell after that, spreading out the solution and forming a coating made of closely packed nanoresonators. This is the first time that the team researchers has applied the rod method, used for more than a century to coat material in a factory setting, to a gallium arsenide solar cell. This is an inexpensive process and is compatible with mass production.

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On market since:	-
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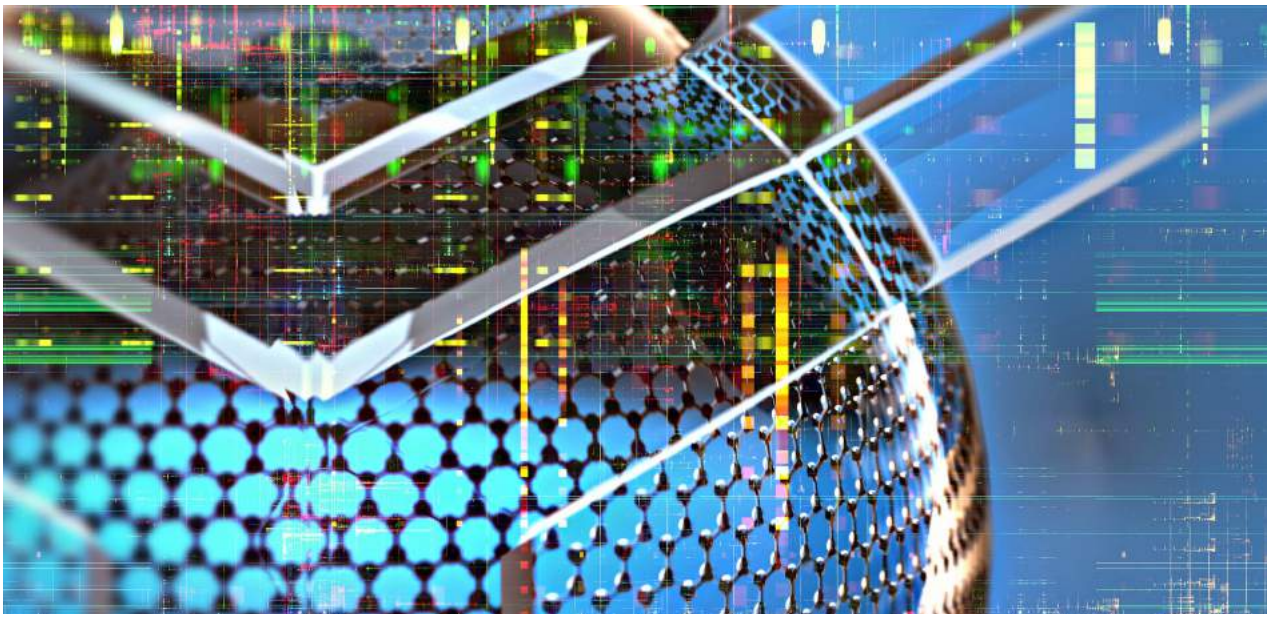
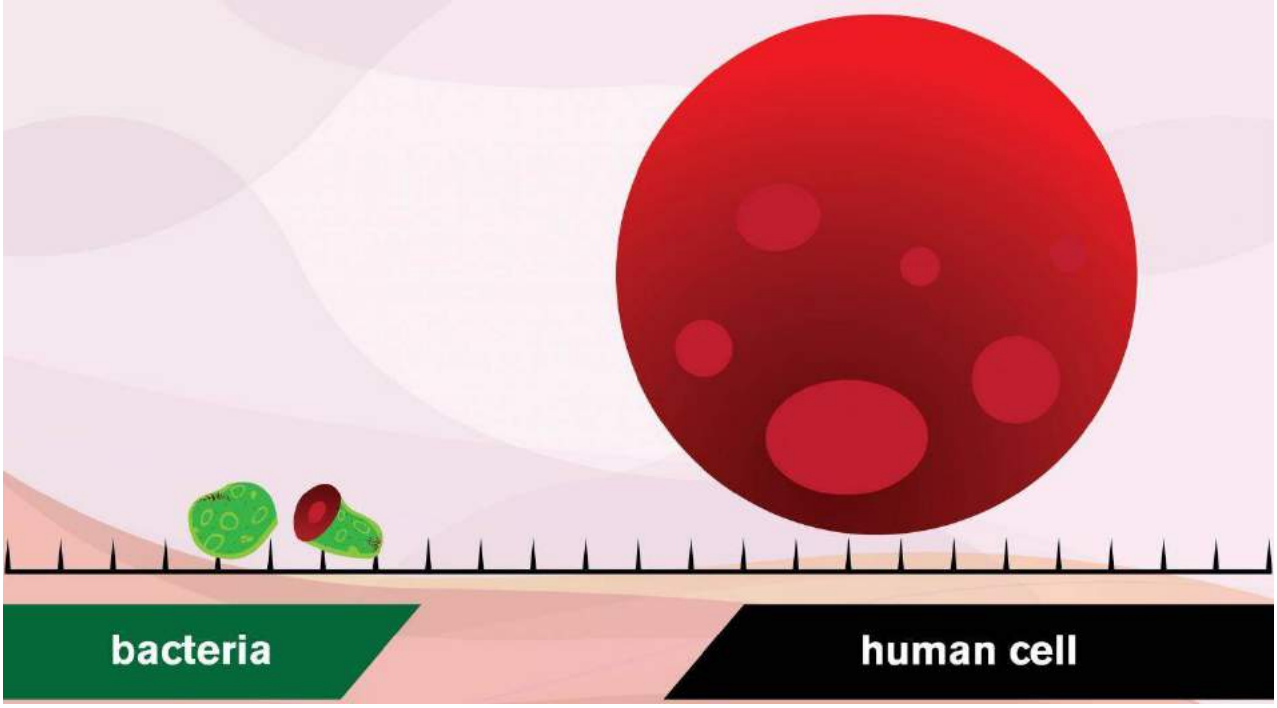
Industries:	Manufacturing
Source links:	NIST News



A NEW WAY TO KILL BACTERIA ON IMPLANTS

A novel method to stop infections during procedures such as implant surgery has been developed by the researchers at Chalmers University of Technology. Operations for surgical implants, such as hip and knee replacements or dental implants, have increased in recent years. However, in such procedures, there is always a risk of bacterial infection. In the worst case scenario, this can make the implant to not attach to the skeleton, meaning it must be removed. Bacteria travel around in fluids, such as blood, looking for a surface to cling on to. Once in place, they begin to grow and propagate, forming a protective layer, known as a biofilm.

A research team at Chalmers has now demonstrated that a layer of vertical graphene flakes forms a protective surface that makes it impossible for bacteria to attach. Instead, bacteria are sliced apart by the sharp graphene flakes and killed. Coating implants with a layer of graphene flakes can therefore help protect the patient against infection, eliminate the need for antibiotic treatment, and decrease the risk of implant rejection. The osseointegration - the process by which the bone structure grow to attach the implant - is not disturbed. However, the graphene has been shown to benefit the bone cells.



Vertical graphene flakes form a protective surface that makes it impossible for bacteria to attach
source - chalmers.se

Chalmers University is a leader in the field of graphene research, but the biological applications did not begin to materialise until a few years ago. The researchers saw conflicting results in earlier studies. Some demonstrated that graphene damaged the bacteria, others that they were not affected. The researchers discovered that the key parameter is to orient the graphene vertically. If it is horizontal, the bacteria are not harmed.

The sharp flakes do not damage human cells. The reason is simple: one bacterium is one micrometer, one thousandth of a millimeter, in diameter, while a human cell is 25 micrometers. So, what constitutes a deadly knife attack for a bacterium, is therefore only a tiny scratch for a human cell. Good bacteria are also killed by the graphene. But that's not

a problem, as the effect is localised and the balance of microflora in the body remains undisturbed.

Chalmers cooperated with Wellspect Healthcare, a company which makes catheters and other medical instruments, in this research. They will now continue with a second study. The projects are funded by Vinnova (a Swedish government agency).

Vertical flakes of graphene are not a new invention, having existed for a few years. But the Chalmers research teams are the first to use the vertical graphene in this way. The next step for the research team will be to verify the graphene flakes further, by coating implant surfaces and studying the effect on animal cells. Graphene is made of carbon atoms. It is only a single atomic layer thick, and therefore the world's thinnest material. Graphene is made in flakes or films. It is 200 times stronger than steel and has very good conductivity due to its rapid electron mobility. Graphene is also extremely sensitive to molecules, which allows it to be used in sensors.

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Source links:	Chalmers University of Technology

SPRINGTAIL-ISPIRED COOLING SYSTEM FOR ELECTRONICS

Novel coOling system inspired by an ancient insect has been developed by the researchers at the Washington University in St. Louis. Over hundreds of millions of years of evolution, water-repellant skin has enabled tiny insects, called springtails, to breathe through their skin without suffocating in damp soil flooded by rainwater. More recently, such natural engineering has inspired a new approach to cooling new generations of miniaturized electronic devices. The secret of the springtail's skin is tiny surface compartments that contain sharp edges: a physical design that resists the advance of liquids and can help contain the flow of liquids.

Researchers adapted this idea in a 'porous membrane' design that could someday keep electronic systems from overheating through evaporative cooling. The porous membrane consists of tiny liquid-filled pillars that rely upon the sharp-edged trick to keep the liquid contained, even as the open ends of the pillars allow for liquid evaporation to get rid of excess heat.

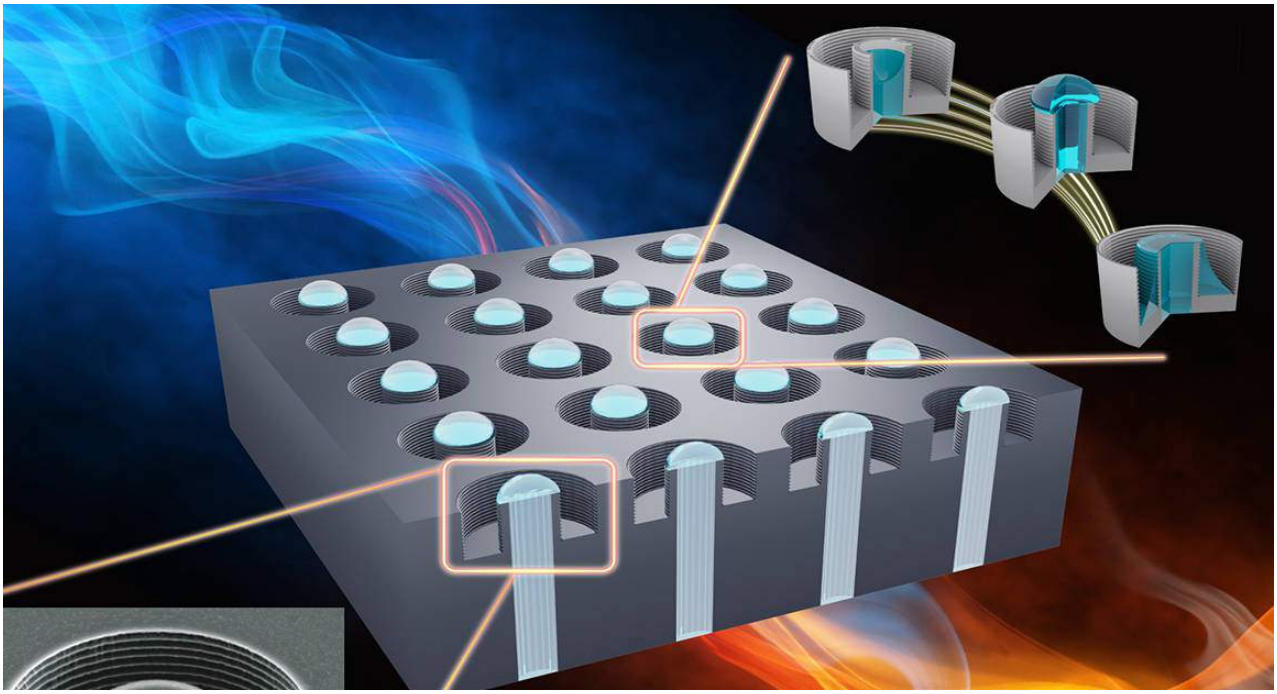
Burning electronics
source - wustl.edu

This technology can significantly enhance the cooling efficiency in a wide variety of applications such as data centers. In addition to robust cooling, it will also reduce the electronic footprint as compared to traditional cooling technology. Many layers of such porous membranes could eventually be integrated within microelectronic stacks to provide cooling within laptops, Internet of Things devices and data centers.

Better cooling is necessary for packing more electronics into a smaller amount of physical space. Such efforts lie at the heart of modern technological advancement with ordinary people expecting smaller and yet more powerful computing devices. Companies expect the same boost in computing power provided by warehouse-size data centers in order to harness a growing number of online applications and services.

One popular solution to meet the demand for more computing power has come from deploying 3D stacked chips in the high-end servers used by major data centers operated by Silicon Valley companies such as Apple, Facebook, and Google. But stacked chips

struggle to rid themselves of all the waste heat being generated. Mixing electronics and water can be a recipe for disaster. So rather than using water-based cooling, researchers turned to dielectric liquids that act as electrical insulators. Such a method is particularly perspective in interlayer two-phase cooling for heat removal in 3D stacked chips, where dielectric liquid is required to avoid risks associated with water in electronic compounds.



A closer look at the membrane's micropillars that are lined with sharp edges to help contain the dielectric liquids source - wustl.edu

By showing how the sharp-edged micropillars could successfully contain the dielectric liquids under certain test conditions, the researchers found a possible way forward in realizing this evaporative cooling design. The researchers were the first to demonstrate retention of extreme low surface tension liquids behind a porous membrane based on a unique geometric feature with sharp solid edges. The team of researchers estimates that the design will require about three or four more years of work before it shows up in commercial technologies.

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Source links:	Washington University in St. Louis

CAFFEINE-CATALYZED GELS

The new gels for drug delivery made of caffeine have been developed by the researchers at MIT. Caffeine is well-known for its ability to help people stay alert, but a team of researchers has now come up with a novel use for this chemical stimulant - catalyzing the formation of polymer materials. Using caffeine as a catalyst, the researchers have devised a way to create gummy, biocompatible gels that could be used for drug delivery and other medical application. The researchers believe these new materials could be helpful in creating new medical devices and drug delivery systems.

Most synthetic approaches for synthesizing and cross-linking polymeric gels and other materials use catalysts or conditions that can damage sensitive substances such as biologic drugs. In contrast, here the researchers used green chemistry and common food ingredients. The researchers demonstrated that they could load the gels with two antimalarial drugs, and they expect the material could also be used to carry other types of drugs. Drugs carried by this kind of material could be chewable or easier to swallow.

Flexible polymer gels
source - mit.edu

Making polymer gels usually requires metal catalysts, which could be hazardous if any of the catalyst remains in the material after the gel is formed. The MIT team wanted to come up with a new way to make gels using catalysts and starting materials that are based on food products and other materials that are safe to ingest. The aim was to try to simplify the method of manufacturing and impart an improved safety profile from the beginning by using potentially safer catalysts.

Although caffeine has not been used for chemical synthesis before, it paid the researchers' attention because it is plant-derived and can act as a weak base, meaning that it gently removes protons from other molecules. It also has a similar structure to some other organic weak bases that have been used to catalyze the type of chemical reaction needed to form these gels - the formation of ester bonds to create a polyester.

Researchers use caffeine as the catalyst for new gels
source - mit.edu

The researchers demonstrated that they could load two malaria drugs, artesunate and piperaquine, into these polymers. They could also vary the chemical and mechanical properties of the gel by altering its composition. They created gels that contain either PEG or another polymer called polypropylene glycol, as well as some that combine those two polymers in different ratios. This allows them to control properties such as the material's strength, its surface structure, and the rate at which the drugs are released.

The gels can also be imprinted with patterns such as the microscale architecture found on the surface of lotus leaves, which allows them to repel water. Altering the surface traits of the material could help researchers control how quickly or slowly the gels move through the digestive tract. The resulting gels contain a small amount of caffeine, roughly the same as that found in a cup of tea. In preliminary safety tests, the researchers haven't discovered any harmful effects in four types of human cells, or in rats.

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Source links:	MIT News

LAVAS IN THE LAB COULD LEAD MINERS TO NEW IRON ORE DEPOSIT

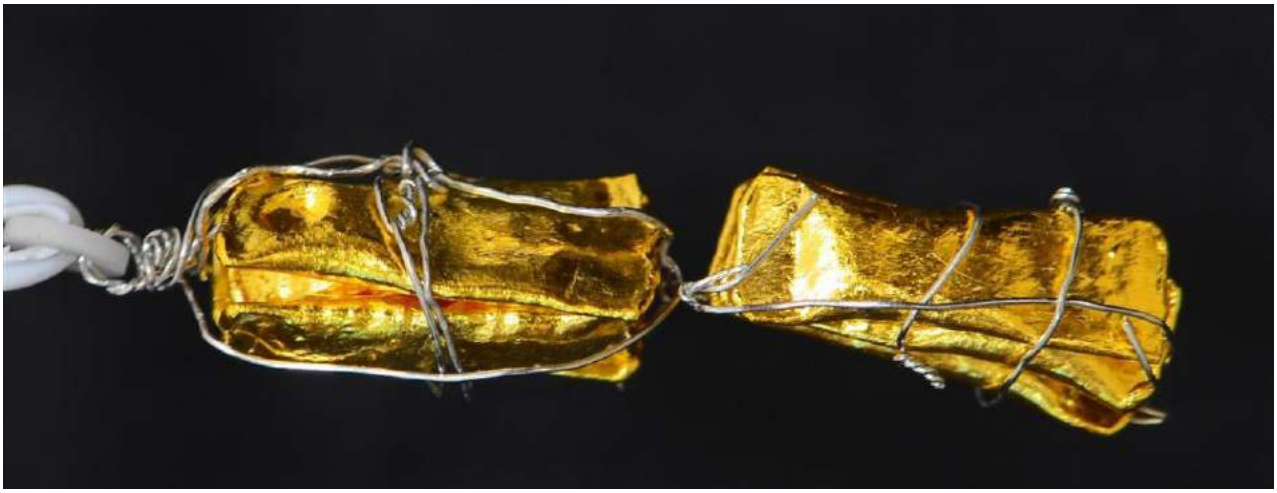
A novel method to discover iron ore deposits for mining has been developed by the international team of researchers from KU Leuven, Leibniz University Hannover, and ULiège. Some magmas split into two separate liquids, one of which is very rich in iron. Iron ore is mined in about 50 countries, with Australia, Brazil and China as the largest producers. It is mostly used to produce the steel objects that are all around us - from paper clips to kitchen appliances and the supporting beams in skyscrapers. Most iron ore deposits are found in sedimentary rocks. Others are mined in volcanic complexes such as El Laco in Chile and Kiruna in Sweden.

These iron ore deposits, called Kiruna-type deposits, account for about 10% of the global production of iron, yet nobody knows how they are formed. The team of researchers present the first evidence that these iron ore deposits are formed when magma splits into two separate liquids. Previous studies have always focused on the texture or the composition of natural rocks.

The samples were placed in small golden capsules
source - kuleuven.be

Chemically lava is made of the elements silicon, oxygen, aluminum, iron, magnesium, calcium, sodium, potassium, phosphorus, and titanium plus other elements in very small concentrations. The researchers were the first to actually reproduce magmas in the lab such as the ones found in El Laco. They wanted to reproduce the conditions found in magma chambers, where molten rock accumulates when it cannot rise to the surface of the Earth. This is also where the iron ore deposits beneath volcanoes are formed, so reproducing the temperature and pressure of the magma chambers seemed well worth examining.

That's why the team of researchers produced a mixture of iron-rich ore samples and typical lavas surrounding Kiruna-type deposits. This created a bulk magma composition that the researchers believe exists in the deep magma chamber beneath volcanoes. The researchers placed the mixture in a furnace and raised the temperature to 1,000-1,040°C. They also increased the pressure to about 1000 times the atmospheric pressure of Earth. These are the conditions of a magma chamber.



The samples subjected to temperatures of 1,000-1,040°C
source - kuleuven.be

The team of researchers was surprised to find that, under these conditions, the magma split into two separate liquids. This process is known as immiscibility. Just think of what happens when oil spills into the ocean: the water becomes streaked with oil because oil and water cannot mix. One of these liquids contained a lot of silica, whereas the other was extremely rich in iron - up to 40% - and phosphorus. When this iron-rich liquid starts to cool down, you get iron-phosphorous Kiruna-type ore deposits.

This is the first evidence that immiscibility is key to the formation of iron ore deposits such as the ones mined in El Laco. If the team of researchers is right, these findings may help to find new iron ore deposits. This is necessary to keep up with the global demand for iron: recycling alone is not enough yet. And if you want to know where to look for iron ore, you have the understanding how the deposits are formed.

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Industries:	Environment, Manufacturing
Source links:	KU Leuven News

' EVERYTHING-REPELLENT' COATING FOR EVERYDAY ITEMS

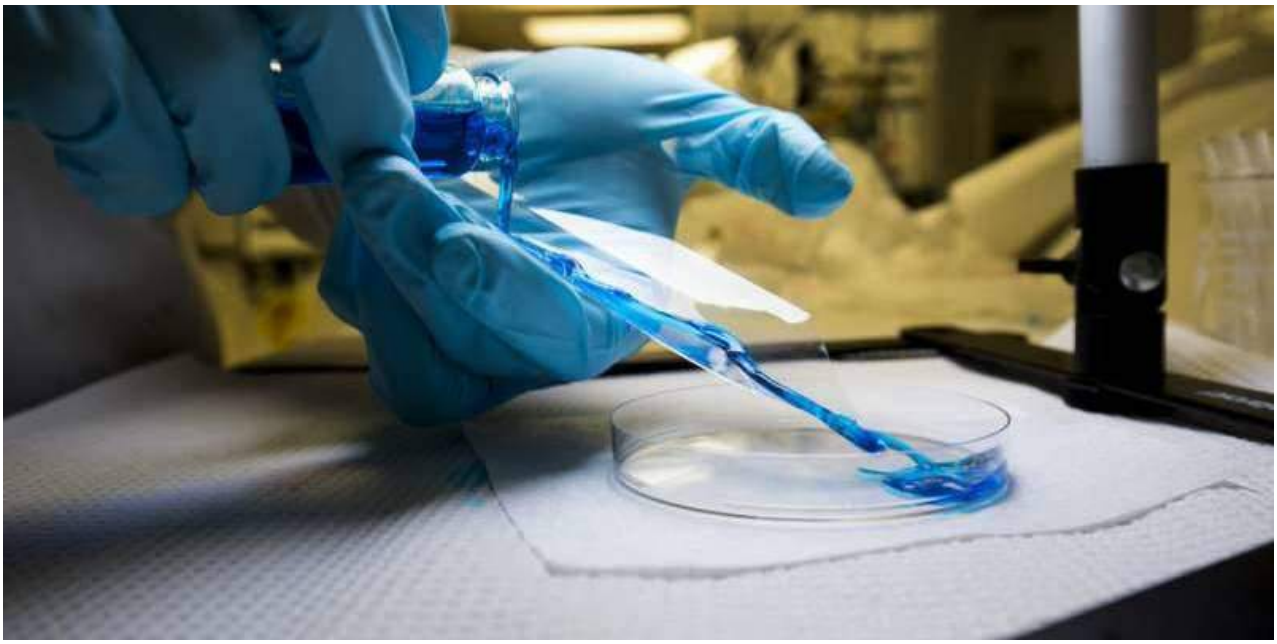
A smooth, durable, clear coating that swiftly sheds water, oils, alcohols peanut butter from everyday items has been developed by the researchers at the University of Michigan. Called 'omniphobic''in materials science parlance, the new coating repels just about every known liquid. The team's earlier efforts produced durable coatings that repelled ice and water, and a more fragile omniphobic coating. The new omniphobic coating is the first that's durable and clear. The researchers envision the new coating as a way to prevent surfaces from getting grimy, both in home and industry. It could work on computer displays, tables, floors and wall.

The researchers are excited about what this could do to make homes and daycares cleaner places, and they are looking at a variety of possible applications in industry as well. The new coating is the latest result of the team's systematic approach, which breaks with the traditional materials science 'mix-and-see' approach. By mapping out the fundamental properties of a vast library of substances, they're able to mathematically predict how any two will behave when they're combined. This enables them to conduct a nearly endless variety of combinations with very specifically tailored properties.

'Everything-repellent' coating
source - umich.edu

In the past, researchers might have taken a very durable substance and a very repellent substance and mixed them together. But this doesn't necessarily yield a durable, repellent coating. They found out that even more significant than durability or repellency is a property called 'partial miscibility,' or the ability of two substances to mix together in exactly the right way. Chemicals that play well together make a much more durable product, even if they're less durable individually.

Tweaking the miscibility of this particular coating posed a special challenge. To make a versatile coating that's optically clear and smooth enough to repel oils and alcohols, the team needed to find a repellent ingredient and a binder with exactly the right amount of miscibility, as well as the ability to stick to a wide variety of substrates. They also needed a coating that would stay smooth during processing and drying.



New coating swiftly sheds water and other liquids
source - umich.edu

The repellent and binder mix together well enough to make a clear coating, but there's a very small amount of phase separation between them. That separation allows the F-POSS to sort of float to the surface and create a nice repellent layer. The team believes that the coating will be inexpensive by the time it sees the mass market - fluorinated polyurethane is an inexpensive, common ingredient. And while F-POSS is rare and expensive today, manufacturers are in the process of scaling it up to mass production, which should dramatically lower its cost. The research team is also doing further studies to ensure that the coating is nontoxic for use in places like daycare centers. They estimate that the coating could go to market within the next two years, and the researchers believe childproof coatings are just the beginning.

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Industries:	Creative Industries
Source links:	University of Michigan News

NEW WAY TO EVAPORATE WATER DROPLETS ON THE SURFACES

A novel method to control how liquids dry on surfaces which could bring benefits to a range of industries, has been discovered by researchers from Northumbria University and The Open University. Watermarks remain when a droplet dries on a solid surface, for instance, when raindrops dry on the surface of a car, or when water dries on a wine glass after washing-up. The way in which watermarks appear on a surface is uncontrollable because the shape and location of a droplet as it evaporates is unpredictable.

This poses limits to many applications, such as inkjet printing, where an ink droplet can leave a distorted shape on paper, and micro-engineering, where watermarks can spoil the performance of delicate microstructures. When a droplet evaporates on a solid surface, its edge 'pins' and 'depins' in an uncontrolled manner. This effect occurs due to the microscopic roughness of the bare solid surface. However, the researchers could control the way droplets dried, through a combination of wavy solid geometry and an ultra-smooth surface treatment.

Water droplets evaporating on the surface of a car
source - northumbria.ac.uk

Their findings could have an impact on many everyday applications – for example, the motor industry could treat car surfaces differently to minimise watermarks, and the smartphone and computer industry could enhance the efficiency of micro-heatpipes, which remove heat from microprocessors. An egg-box is an example of a wavy solid: it has repeating peaks and valleys that form a wavy pattern. The researchers 3D printed such a wavy pattern and covered its rough surface with a thin lubricant layer. The resulting composite surface keeps the wavy shape, but becomes 'ultra-smooth'.

When the researchers left water droplets to evaporate on these wavy surfaces, they initially retracted from the solid in a smooth way, as one would expect for a perfectly smooth solid. However, the wavy surface makes the droplets 'snap' at specific points,

changing their position and shape. This is a new mode of evaporation, which the researchers have named 'snap evaporation'.

Remarkably, this process is highly reproducible, and the researchers have found that the actual design of the wavy pattern can control the position and shape of the droplet. The reason for the snap behaviour lies in bifurcation theory, a branch of mathematics that studies how a system, in this case the droplet, responds to a change in a control parameter - in this case a reduction of mass due to evaporation.

The main idea behind this theory is that the configuration that a droplet takes on a wavy solid pattern is not unique. There are different shapes and positions that the same amount of liquid can occupy on a given wavy pattern. During evaporation, the mass of a droplet changes, and it turns out that what was a stable drop shape and position becomes unstable. At this point, which is known as a bifurcation, the droplet must change its shape and position. The implications of this study can have an impact in many everyday applications, and at the moment the team is working with industrial partners that can benefit from the research.

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On market since:	-
Regions:	United Kingdom
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Source links:	Northumbria University

NOVEL WAY TO MEET CORN'S NITROGEN NEED

A new way to help a nitrogen-hungry crop like sweet corn that may save up to half of their nitrogen fertilizer cost has been developed by the researchers at the American Society of Agronomy. The key is to use a faba bean cover crop. Faba bean is an ancient crop increasingly used as a cover crop. Cover crops are grown in the months between main crops when the soil would otherwise be bare. Cover crops can control erosion, build soil, and suppress weeds. Grasses, legumes, and other non-grassy plants are the most commonly used cover crops.

Faba is a legume, as are peas, beans, and lentils. They are a good source of protein. They also bring an important benefit to agriculture: they are nitrogen fixers. These plants, working with bacteria in the soil, take nitrogen from the atmosphere and after that add nitrogen to the soil. Faba is known to be one of the most powerful nitrogen fixers.

The plants help increase vital nitrogen in the soil
source - agronomy.org

Nitrogen is a vital nutrient for plants' growth. Farmers who grow sweet corn typically add nitrogen in the form of commercial fertilizer for best yield. The team of researchers tested faba bean as a cover crop before planting sweet corn. They wanted to learn if the nitrogen from the faba bean plants would meet the high nitrogen needs of the sweet corn. They also wondered whether tilling the faba residues into the soil or leaving them to decompose in place would provide more nitrogen for the corn.

This study demonstrated the timing of when faba was planted had a dramatic effect on the biomass - the total weight - the plants produced before winter weather stopped growth. More biomass means more nitrogen. Faba beans planted on August 1 had more than twice the biomass of faba beans planted just two weeks later. Not surprisingly, the sweet corn planted the following spring produced much better yields when it was planted in the earliest-sown faba compared to later-sown faba. The amount of nitrogen legumes can add to the soil is closely tied to the amount of biomass they produce.

Fatemeh Etemdi, a co-author of this study, counts the lateral branches of faba bean plants
source - agronomy.org

The sweet corn yields were also much more higher in the plots where the plant residue was left in the surface (no-till). Tilled residues decomposed quicker than the no-till, providing their nitrogen sooner. This proved to be too soon for the sweet corn. The no-till treatment slowed the decomposition of the faba bean residues. A delayed release of nitrogen into the soil better matched the needs of the young sweet corn. In addition, the faba bean residues alone did not provide enough nitrogen for the best sweet corn yields. Extra nitrogen was needed. However, only about half as much was needed compared to corn grown without a faba bean cover crop.

Faba bean cover crops can add a large amount of nitrogen to the soil. But to make the most of its potential, especially if harvesting some fresh pods is expected, faba bean has to be planted as early as possible after harvesting the summer crop. In addition, to contribute best to the nitrogen needs of the spring crop, the residues should not be tilled into the soil and must be left on the soil surface.

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NEW WAY TO RESTORE FERTILITY IN WOMEN WITH DISABLING OVARY DISORDER

A novel method to restore fertility in women suffering Polycystic Ovary Syndrome has been developed by the researchers at the University of Otago. Polycystic Ovary Syndrome (PCOS) is a major endocrine disorder affecting about one in 10 women of reproductive age globally, and is one of the leading causes of infertility in women. At the moment, there is no cure. The syndrome is a set of symptoms related to elevated levels of androgens (male hormones) in females and includes irregular or no menstrual periods, heavy periods, excess body and facial hair, acne, pelvic pain and patches of thick, darker, velvety skin.

It is associated with Type 2 diabetes, obesity, obstructive sleep apnoea, heart disease, mood disorders and endometrial cancer. Findings from the research, conducted in a pre-clinical model and demonstrate that blocking androgen actions could help re-set reproductive function to normal levels by modifying brain circuitry important to fertility. The team of researchers is excited about their findings which are potentially significant for women suffering from the syndrome. Signs and symptoms of PCOS often develop around the time of the first menstrual period during puberty. Sometimes PCOS develops later, for example, in response to substantial weight gain.

New method can help to restore fertility
source - adobe.com

The findings suggest that despite the early development of brain pathology in some forms of Polycystic Ovary Syndrome, normal reproductive function can potentially be restored in adult women with the disorder through modifying the wiring in the brain. There is growing evidence the brain is involved in both the development and pathology of Polycystic Ovary Syndrome. The Otago researchers' earlier work in a preclinical model on the syndrome has identified changes in specific brain circuits that may underlie the disorder.

In this most recent study, the team of researchers investigated when these circuit abnormalities develop and whether the circuits are 'hard-wired' or can be changed by blocking androgen actions once the disorder is established. The researchers discovered that brain changes occur prior to the onset of puberty, which is before the syndrome

appears, suggesting that the brain pathology precedes disease development.

New therapy can fight PCOS
source - otago.ac.nz

The team of researchers also discovered that, despite this early 'programming' of neural circuitry, long-term blockade of androgen actions was able to completely restore normal brain wiring and reproductive cycles. Although the work is still pre-clinical, it gives clues about potentially effective therapies in treating the reproductive pathology of Polycystic Ovary Syndrome in women. The researchers established a collaboration with clinicians in Sweden to retrospectively look at the impact of androgen receptor blocker drugs on long-term reproductive outcomes in women with the syndrome. The exact cause of PCOS is unknown. Early diagnosis and treatment along with weight loss may reduce the risk of long-term complications such as type 2 diabetes and heart disease.

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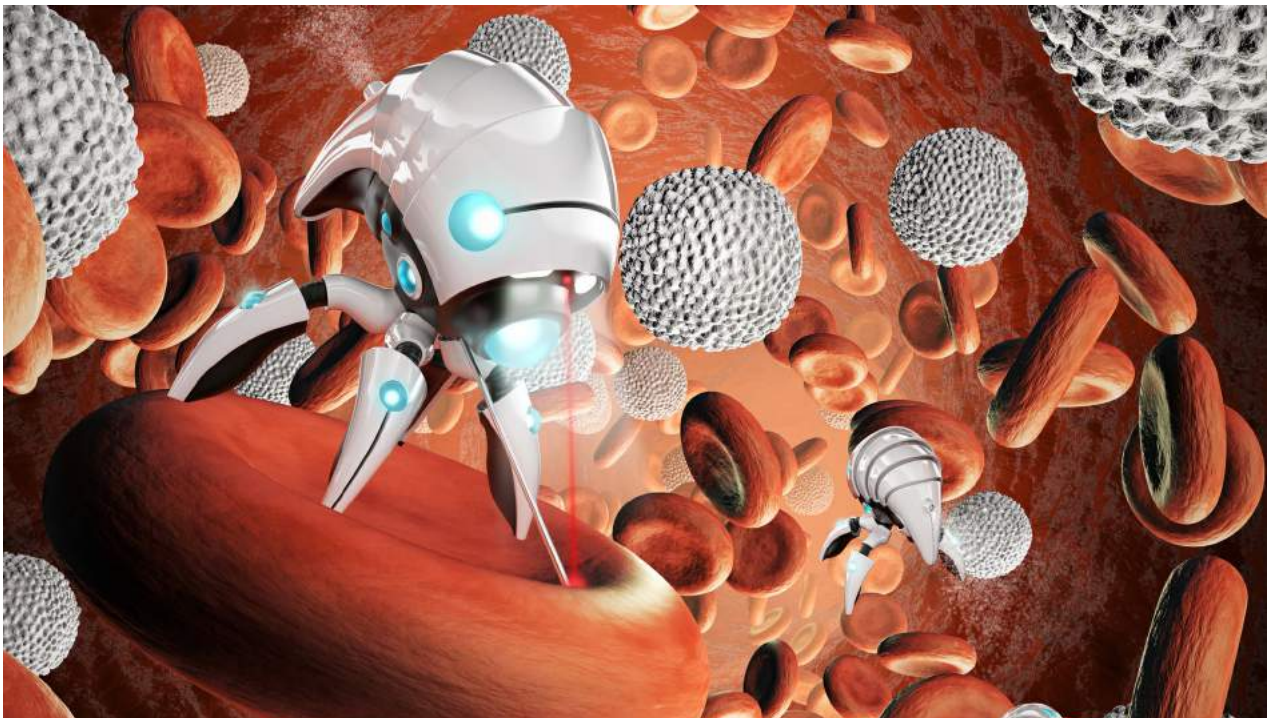
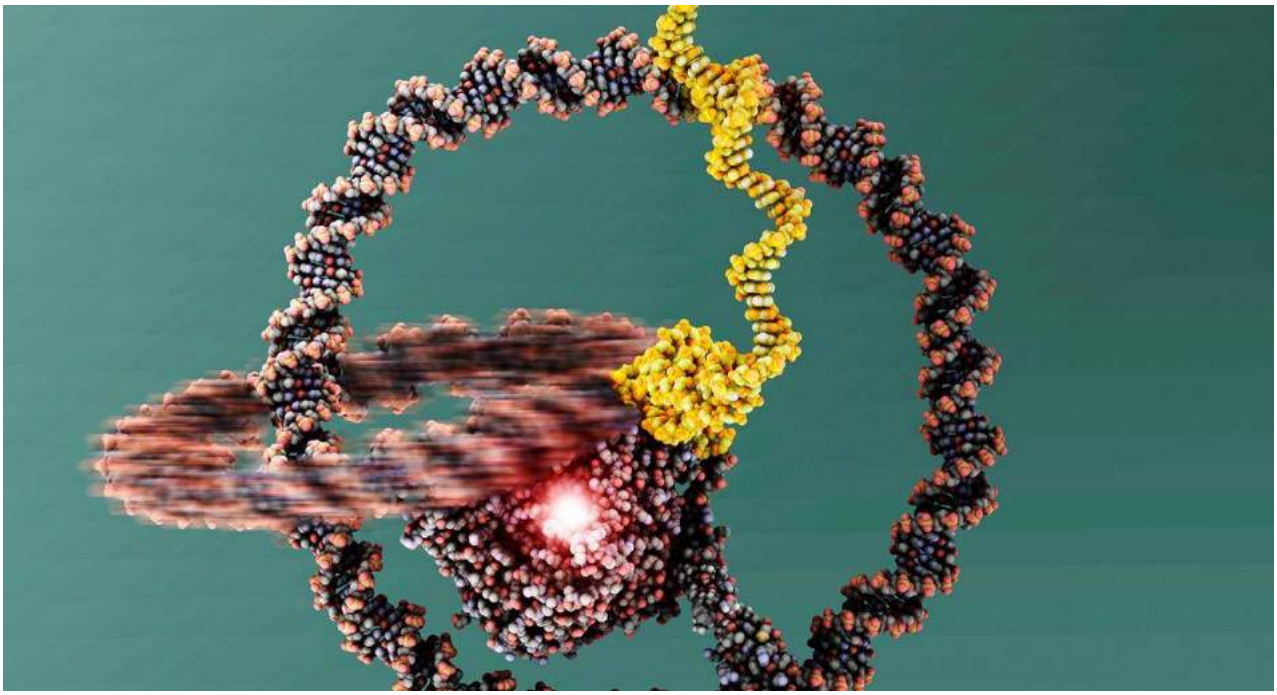
Industries:	Healthcare
Source links:	University of Otago News



TINY NANOMACHINE FOR DRUG TRANSPORTATION

A tiny machine that constitutes a rotatory motor and can move in a specific direction has been developed by the researchers at the University of Bonn. The researchers used circular structures from DNA. Nanomachines include structures of complex proteins and nucleic acids that are powered with chemical energy and can perform directed movements. The principle is known from nature. Bacteria, for instance, propel themselves forward using a flagellum. The team used structures made of DNA nanorings. The two rings are linked like a chain. One ring fulfills the function of a wheel, the other drives it like an engine with the help of chemical energy.

The tiny vehicle measures only about 30 nanometers. The 'fuel' is provided by the protein 'T7 RNA polymerase'. Coupled to the ring that serves as an engine, this enzyme synthesizes a RNA strand based on the DNA sequence and uses the chemical energy released during this process for the rotational movement of the DNA ring. As the rotation progresses, the RNA strand grows like a thread from the RNA polymerase. The researchers are using this ever-expanding RNA thread, which basically protrudes from the engine as a waste product, to keep the tiny vehicle on its course by using markings on a DNA-nanotube track.

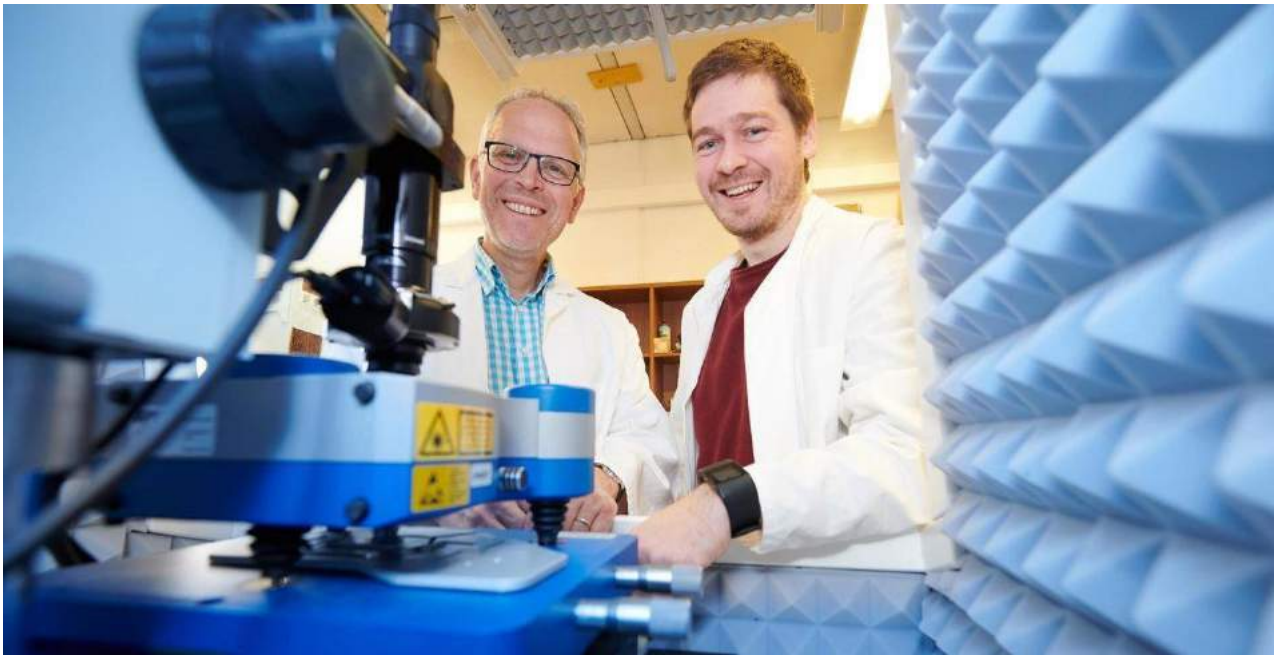


The two rings are linked like a chain and can well be recognized
source - uni-bonn.de

Length of the test drive is 240 nanometers. Attached to this thread, the unicycle machine covered about 240 nanometers on its test drive. That was a first go. The track can be extended as desired. In the next step the researchers are not only aiming at expanding the length of the route, but also plan more complex challenges on the test track. At built-in junctions, the nanomachine should decide which way to go. The researchers can use these methods to predetermine which turn the machine should take.

Of course, the scientists cannot watch the tiny vehicle at work with the naked eye. By using an atomic force microscope that scanned the surface structure of the nanomachine, the scientists were able to visualize the interlocked DNA rings. In addition, the team used fluorescent markers to show that the 'wheel' of the machine was actually turning.

Fluorescent 'waymarkers' along the nanotube path lit up as soon as the nano-unicycle passed them. The speed of the vehicle could also be calculated. One turn of the wheel took about ten minutes. That's not very fast, but nevertheless a big step for the researchers. Moving the nanomachine in the desired direction is not trivial.



The researchers at an atomic force microscope
source - uni-bonn.de

Of course, unlike macroscopic machines, the nanomachine was not assembled with a welding torch or wrench. The construction is based on the principle of self-organization. As in living cells, the desired structures arise spontaneously when the corresponding components are made available. It works like an imaginary puzzle. Each puzzle piece is designed to interact with very specific partners. If you bring together exactly these partners in a single vessel, each particle will find its partner and the desired structure is automatically created. Tiny machines could transport drugs through the bloodstream precisely to where they are required.

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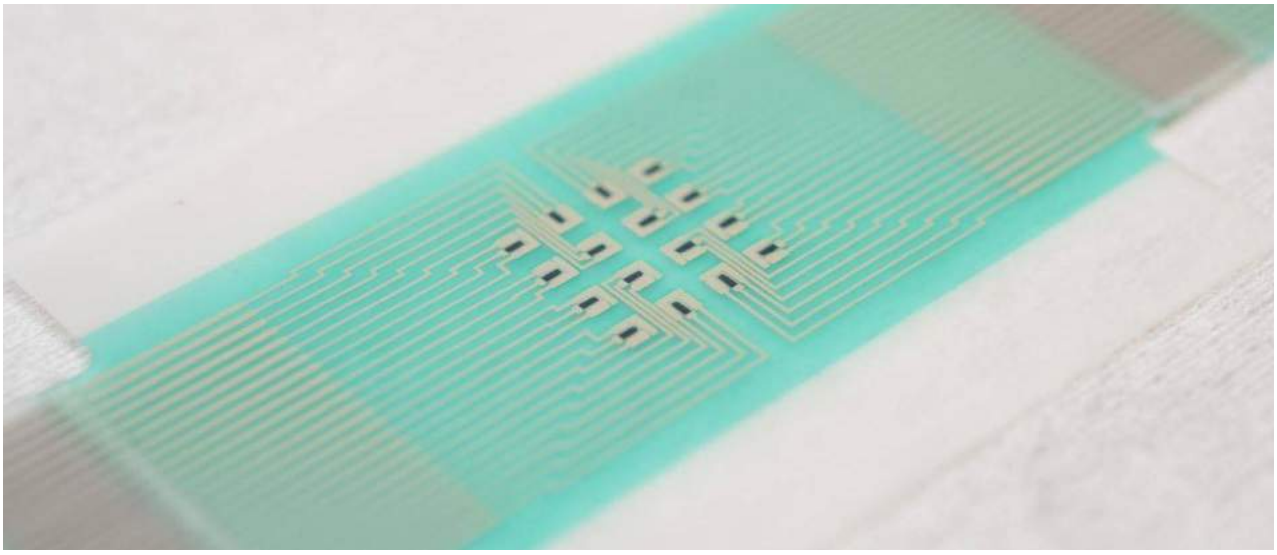
Source links:	University of Bonn

BLOODLESS DIABETES MONITOR PATCH

A non-invasive, adhesive patch, which promises the measurement of glucose levels through the skin without a finger-prick blood test, potentially removing the need for millions of diabetics to frequently carry out the painful and unpopular tests has been developed by the researchers at the University of Bath. The patch does not pierce the skin, instead it draws glucose out from fluid between cells across hair follicles, which are individually accessed via an array of miniature sensors using a small electric current. The glucose collects in tiny reservoirs and is measured. Readings can be taken every 10 to 15 minutes over several hours.

Crucially, because of the design of the array of sensors and reservoirs, the patch does not require calibration with a blood sample - meaning that finger prick blood tests are unnecessary. Having established proof of the concept behind the device in a study, the research team from the University of Bath hopes that it can over time become a low-cost, wearable sensor that sends regular, clinically relevant glucose measurements to the wearer's phone or smartwatch wirelessly, alerting them when they may need to take action.



Bloodless diabetes monitor patch
source - bath.ac.uk

A significant advantage of this device over others is that each miniature sensor of the array can operate on a small area over an individual hair follicle - this significantly decreases inter- and intra-skin variability in glucose extraction and increases the accuracy of the measurements taken such that calibration via a blood sample is not required.

A non-invasive method to monitor blood sugar has proven a difficult goal to attain. The closest that has been achieved has required either at least a single-point calibration with a classic 'finger-stick', or the implantation of a pre-calibrated sensor via a single needle insertion. The monitor developed at Bath promises a truly calibration-free approach, an essential contribution in the fight to combat the ever-increasing global incidence of diabetes. The specific architecture of the array permits calibration-free operation, and it has the further benefit of allowing realisation with a variety of materials in combination.

The sensor array is designed to draw fluid across a single hair follicle
source - bath.ac.uk

In this study the team tested the patch on both pig skin, where they demonstrated it could accurately track glucose levels across the range seen in diabetic human patients, and on healthy human volunteers, where again the patch was able to track blood sugar variations throughout the day. The next steps include further refinement of the design of the patch to optimise the number of sensors in the array, to demonstrate full functionality over a 24-hour wear period, and to undertake a number of key clinical trials.

Diabetes is a serious public health problem which is increasing. An efficient, non-invasive method of monitoring blood glucose could both help diabetics, as well as those at risk of developing diabetes, make the right choices to either manage the disease well or reduce their risk of developing the condition.

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Industries:	Healthcare
Source links:	University of Bath News

NEW SOURCE OF GLOBAL NITROGEN

A novel way to extract nitrogen has been discovered by the researchers at the University of California Davis and National Science Foundation. The study shows that more than a quarter of that nitrogen is derived from the weathering of Earth's bedrock. The results demonstrate that up to 26 percent of the nitrogen in ecosystems is sourced from rocks, with the remaining amount from the atmosphere. This research reveals significant connections among the atmosphere, the biosphere, and the rocks at Earth's surface. The findings show that rock weathering is a globally important source of nitrogen to soils and ecosystems.

That runs counter to the centuries-long paradigm that has laid the foundation for the environmental sciences. Rock-derived nitrogen may fuel the growth of forests and grasslands, and allow them to sequester more carbon dioxide than previously thought. Mapping the nutrient profiles in rocks for their carbon uptake potential could help drive conservation efforts.

The researcher shows that weathering rocks are a significant source of nitrogen
source - ucdavis.edu

The natural cycle of nitrogen involves several biological and non-biological process including: denitrification, mineralization, nitrogen fixation, nitrification, microbial and plant uptake of nitrogen, ammonia volatilization, ammonia fixation and leaching of nitrite nitrate. Nitrogen exists naturally in the environment and is constantly being converted from organic to an inorganic form and vice versa. Production of commercial fertilizer adds up to the natural source of nitrogen. The main source of nitrogen include: atmospheric precipitation, geological sources, agricultural land, livestock and poultry operations and urban waste.

Geology might have a huge control over which systems can take up carbon dioxide and which ones can't. When thinking about carbon sequestration, the geology of the planet can help guide the researchers' decisions. The work also helps solve the case of the missing nitrogen. For decades, scientists have recognized that more nitrogen accumulates in soils and plants than can be explained by input from the atmosphere alone, but researchers

couldn't pinpoint what was missing.

This rock type contains high levels of nitrogen
source - ucdavis.edu

The team of researchers demonstrates that the paradox of nitrogen is literally 'written in stone'. There's enough nitrogen in rocks, and it breaks down fast enough, to explain the cases where there has been this mysterious gap. In previous work, the scientists analyzed rocks collected from the Klamath Mountains in northern California, and discovered that the rocks and the surrounding trees contained large amounts of nitrogen. In the current study, they built on that work, analyzing the entire planet's nitrogen balance. The scientists developed a model to assess rock nitrogen availability on a global scale.

These results are going to require rewriting textbooks. While there were hints that plants could use rock-derived nitrogen, this discovery shatters the paradigm that the ultimate source of nitrogen is the atmosphere. A discovery of this magnitude will open up a new era of research on this essential nutrient.

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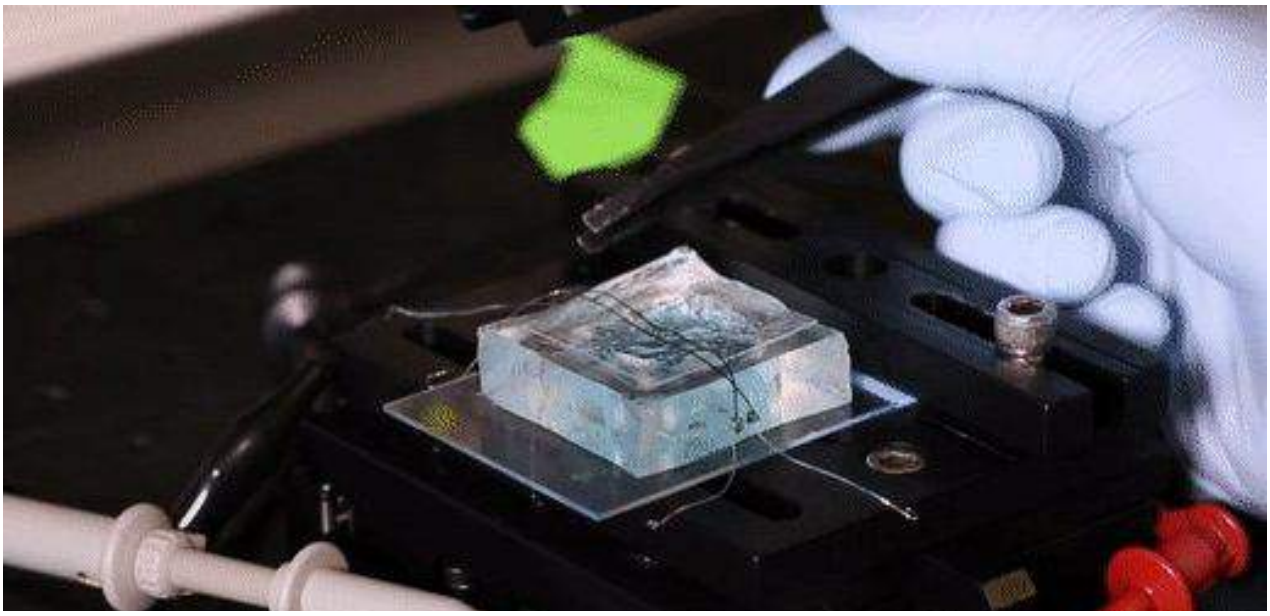
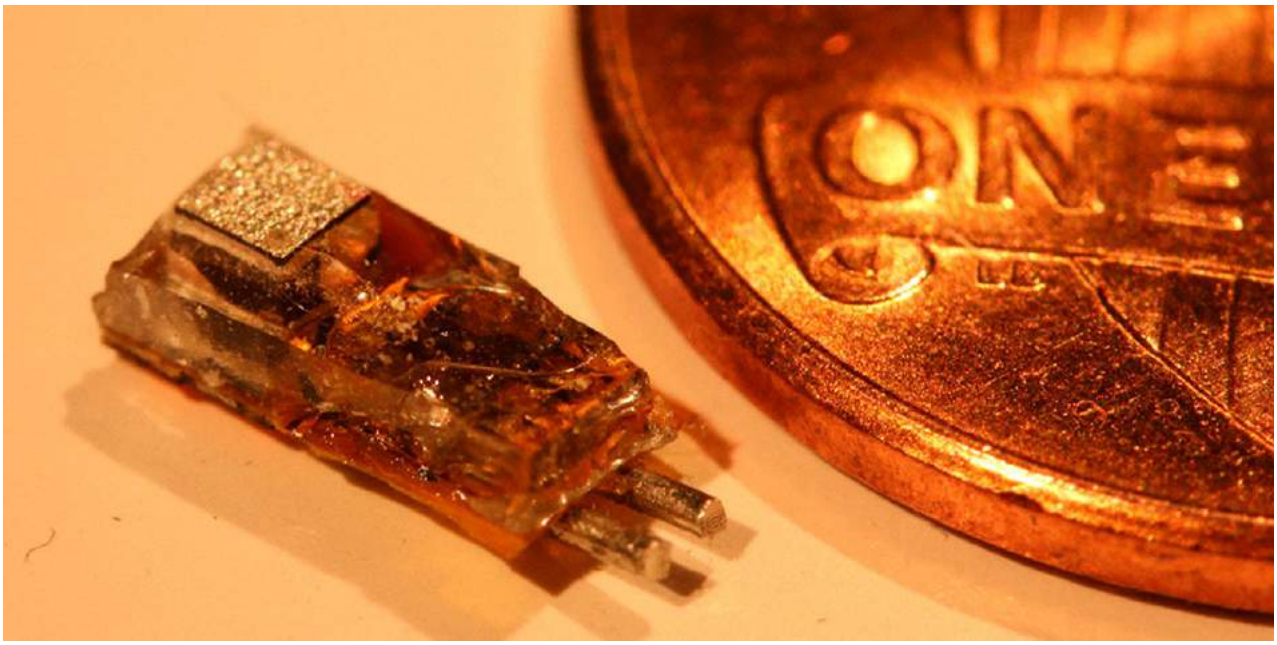
Industries:	Environment
Source links:	UC Davis News



ULTRASOUND-POWERED NERVE IMPLANT

A new kind of millimeter-scale nerve-stimulating implant that beats all others of its size at a crucial parameter - how deep inside the body it can operate - has been developed by the researchers at Stanford University. The 6.5-millimeter, long programmable implant can receive both power and data via ultrasound through more than 10.5 centimeters of tissue. That's deep enough for most any application. And due to its versatility and small size, it could be injected through a needle rather than requiring real surgery, they envision that it will greatly expand the number of conditions treated with electrical stimulation of the body's nerves.

So far, most of those treatments have focused on stimulating spinal nerves for controlling pain and the vagus nerve for epilepsy and depression. However, researchers have been working on expanding the role of such 'electroceutical' treatments to include ending postpartum bleeding, alleviating rheumatoid arthritis, and restoring bladder control, among many others.

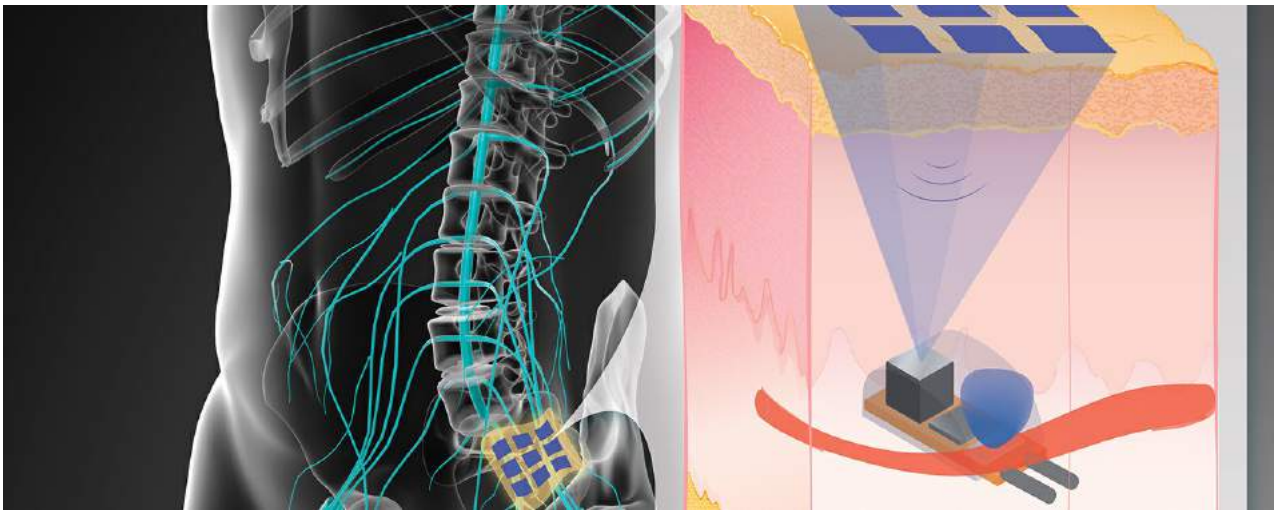


Nerve Implant
source - stanford.edu

Because implants today require surgery, implantable devices are seen as a last resort solution. If you have a disease with any other solution you'll probably opt for that. But a nerve stimulator that can be implanted with minimally invasive surgery or simply be injected would allow nerve stimulation treatments to reach 100-fold more patients. The Stanford implant consists of a piezoelectric receiver that transforms ultrasound applied from outside the body to electricity, a capacitor for storing that electricity, two stimulating electrodes, a LED, and a custom chip to control it all. Those compounds are all inside a biocompatible package about the size of a fat grain of rice or a rather slim tic-tac.

The device is capable of extraordinary flexibility in its electrical stimulation parameters. It's programmable via data sent through the ultrasound signal, allowing the stimulation's amplitude, pulse width, and frequency to be adjusted to whatever recipe will best interface with the body's peripheral nerves. The researchers have orders of magnitude more power available at large tissue depths than in conventional wireless implants. Getting power and data deep inside the body has always been a problem, but it gets more

complicated the smaller the implant is. The team's aim was to design it to be very small and operate very deep.



The programmable stimulator is inserted at a nerve and gets its power from externally applied ultrasound source - stanford.edu

The researchers chose ultrasound to carry the power and data instead of radio signals as other implants do, because its small wavelength matched the millimeter size of the implant and because ultrasound can penetrate far into the body without harming intervening tissue. Now that they've built working stimulators, it's time to test them in living things. One early application is likely to be as the stimulator in a bladder control system. But first they will be conducting tests in animals. That's where the system's LED will come in handy. Being able to coordinate and compare electrical and optical stimulation would open up a lot of science.

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Industries:	Electronics, Healthcare
Source links:	Stanford News

A VACCINE FOR EDIBLE PLANTS

A new plant protection method has been developed by the researchers at the University of Helsinki and the French National Centre for Scientific Research (CNRS). Novel technologies are being sought to replace the traditional pesticides used to protect plants, particularly edible plants such as cereals. The team of researchers is shedding light on the efficacy of environmentally friendly RNA-based vaccines that protect plants from diseases and pests. Plant diseases and pests cause considerable crop losses and threaten global food security.

The diseases and pests have traditionally been fought with chemical pesticides, which spread throughout our environment and may be hazardous to human health, beneficial organisms and the environment. A new approach to plant protection involves vaccinating plants against pathogens with double-stranded RNA molecules that can be sprayed directly on the leaves.

Plant diseases and pests cause considerable crop losses and threaten global food security
source - helsinki.fi

Plant pests are often regarded as an external, introduced factor in crop production. That is a misperception, as in most cases pest species occur naturally within the agro-ecosystem. Pests and accompanying species - such as predators, parasites, pollinators, competitors and decomposers - are components of crop-associated agro-biodiversity that perform a wide range of ecosystem functions. Pest upsurges or outbreaks usually occur following the breakdown of natural processes of pest regulation.

The vaccine triggers a mechanism known as RNA interference, which is an innate defence mechanism of plants, animals and other eukaryotic organisms against pathogens. The vaccine can be targeted to the chosen pathogen by using RNA molecules which share sequence identity with the pest's genes and prevents their expression. This means that the double-stranded RNA molecules do not affect the expression of genes in the protected plant, but only target the plant disease or pest. RNA is also a common molecule in nature

that degrades rapidly rather than building up in the environment.

Symptoms of pests
source - iStock.com

The challenge in developing RNA-based vaccines to protect plants has involved the production of RNA molecules. Double-stranded RNA molecules have been produced through chemical synthesis, both as drug molecules and for research purposes, but such production methods are ineffective and expensive for plant protection. As part of the Academy of Finland's Synthetic Biology Research Programme, the team has developed a new production method for double-stranded RNA molecules. Together with researchers at the CNRS, the group has demonstrated the efficacy of RNA-based vaccines produced using the new method against plant virus infections.

The method utilises the RNA amplification system of a bacteriophage, i.e. a bacteria-destroying virus, and the RNA production takes place in bacterial cells. This new method will enable the efficient production of RNA-based vaccines and promote the development and adoption of RNA-based plant protection methods. It's complicated to predict when the vaccine will be made available because no relevant legislation exists yet.

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Source links:	University of Helsinki

NEWLY DISCOVERED HORMONE HELPS KEEP PLANTS FROM DEHYDRATING

A small hormone that helps plants retain water when none is available in the soil has been discovered by the researchers at the RIKEN Center for Sustainable Resource Science. The study shows how the peptide CLE25 moves from the roots to the leaves when water is scarce and helps prevent water loss by closing pores in the leaf surface. In animals, peptide hormones are small chains of amino acids that move through the blood and help keep our bodies in balance when the environment changes. For instance, when your blood pressure is low, your body produces the hormone vasopressin, which circulates in the blood and acts to narrow your arteries, which increases your blood pressure back to normal levels.

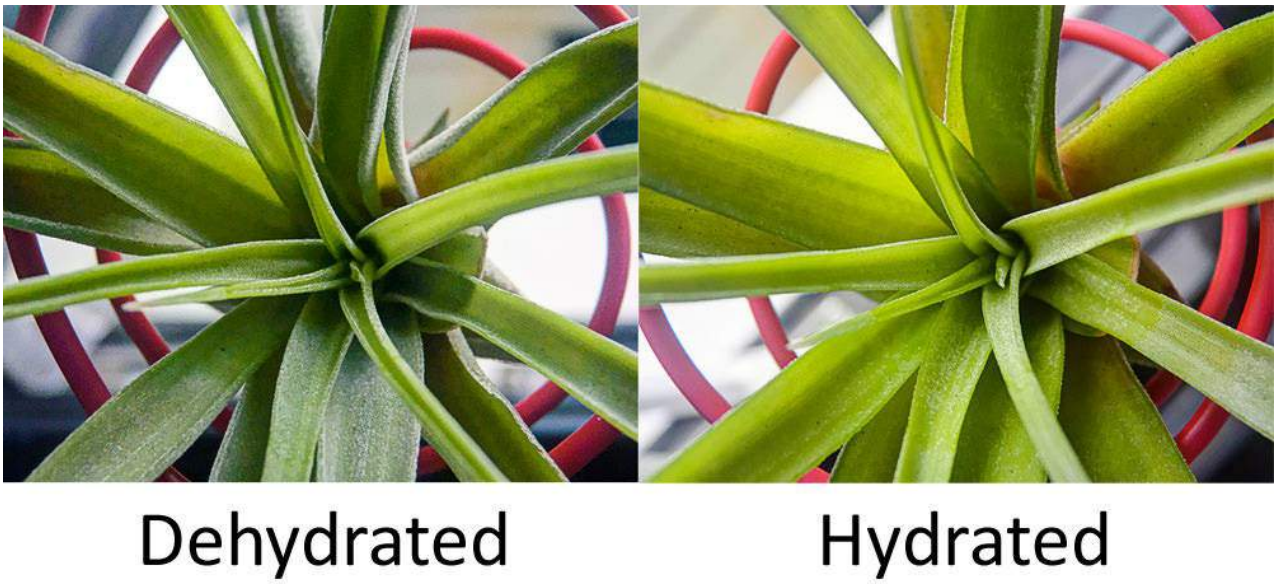
Plants also have hormones, called phytohormones but scientists know much less about them. The plant scientists at RIKEN CSRS wanted to find out whether any plant hormones respond to physical-abiotic stress. Although the researchers know that some peptide hormones in plants mediate cellular development, until now nobody had identified any that regulate responses to physical stresses such as dehydration.

This research absolutely has applications
source botanic.com

The team began by looking at CLE peptides that are synthesized in the roots and at ABA, a hormone that is known to accumulate in leaves and help close pores in response to drought stress. Applying many CLE peptides to plant roots demonstrated that only CLE25 led to increased ABA in the leaves and pore closure. The team determined that the link between these two events was the increase in an enzyme necessary for making ABA. In addition to this artificial situation, they showed that CLE25 levels increase in the roots of plants that are subjected to dehydration stress, leading to the same results. The next question was whether CLE25 moves through the plant circulatory system.

Detecting functional peptide hormones is very complicated in living cells because the amounts are so small. With this technology, the researchers were able to tag CLE25 molecules and visualize their movement from the roots to the leaves, indicating that it was indeed a mobile hormone and that it likely interacted with other molecules in leaves to

produce ABA.



Dehydrated air plant
source botanic.com

Before investigating how CLE25 induces ABA synthesis once it arrives at the leaf, the team created mutant plants that lacked CLE25 or ABA and performed several control experiments that confirmed their findings. Particularly, after only three hours of dehydration, plants without CLE25 already showed 7 times less leaf ABA and had lost more water than control plants. Finally, the team examined several mutants and discovered that BAM1 and BAM3 receptors in the leaf were the link between CLE25 and ABA production.

Now that they have discovered the CLE25 peptide hormone and determined how it helps plants retain water, the team is confident that this is just the beginning. This research absolutely has applications in the real world and should contribute to the development of abiotic stress-resistant crops that take advantage of the mobile peptide system in plants.

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Industries:	Environment
Source links:	RIKEN CSRS

BREAKTHROUGH MADE IN ATOMICALLY THIN MAGNETS

A novel method to produce thin magnets has been developed by the team of the researchers at Cornell University. They have become the first to control atomically thin magnets with an electric field, a breakthrough that provides a blueprint for producing exceptionally powerful and efficient data storage in computer chips, among other applications. In 1966, Cornell physicist David Mermin and his postdoc Herbert Wagner theorized that 2-D magnets could not exist if the spins of their electrons could point in any direction.

It was n't until 2017 that some of the first 2-D materials with the proper alignment of spins were discovered, opening the door to an entirely new family of materials known as 2-D van der Waals magnets. If it's a bulk material, you can't easily access the atoms inside. But if the magnet is just a monolayer, you can do a lot to it. You can apply an electric field to it, put extra electrons into it, and that can modulate the material properties.

The researcher aligns an optical setup
source - cornell.edu

Using a sample of chromium triiodide, the research team set out to do just that. Their goal was to apply a small amount of voltage to create an electric field and control the 2-D compound's magnetism, giving them the ability to switch it on and off. To achieve this, they stacked two atomic layers of chromium triiodide with atomically thin gate dielectrics and electrodes. This created a field-effect device that could flip the electron-spin direction in the chromium triiodide layers using small gate voltages, activating the magnetic switching. The process is reversible and repeatable at temperatures under 57-degrees Kelvin.

The discovery is an important one for the future of electronics because the majority of existing technology is based on magnetic switching, like in memory devices that record and store data. However, magnets in most modern electronics don't respond to an electric

field. Instead, a current is passed through a coil, creating a magnetic field that can be used to switch the magnet on and off. It's an ineffective method because the current creates heat and consumes electrical power.

New thin magnets can have many potential applications
source - cornell.edu

Two-dimensional chromium-triiodide magnets have a unique advantage in that an electric field can be directly applied to activate the switching, and very little energy is required. The process is also very efficient because if you have a nanometer thickness and you apply just one volt, the field is already 1 volt per nanometer. That's huge.

The research team plans to continue exploring 2-D magnets and hopes to form new collaborations around campus, including with scientists and engineers who can help them find new 2-D magnetic materials that, unlike chromium triiodide, can work at room temperature. In a sense, what the team has demonstrated here is more like a device concept. When the researchers find the right kind of material that can operate at a higher temperature, they can immediately apply this idea to those materials. But it's not there yet. The research was led by Jie Shan and Kin Fai Mak.

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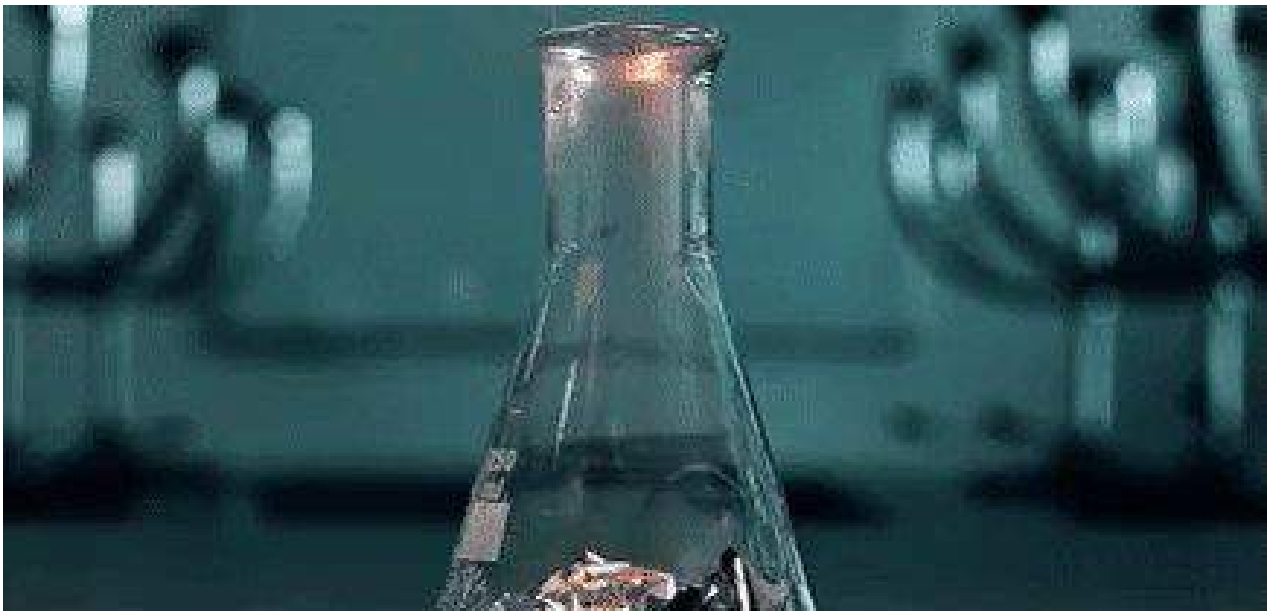
Regions:	United States
Industries:	Electronics
Source links:	Cornell News



A NEW WAY TO PRODUCE AMMONIA

A renewable energy approach for synthesizing ammonia, an essential component of fertilizers that support the world's food production needs has been developed by the researchers at the University of Notre Dame. The Haber-Bosch process developed in the early 1900s for producing ammonia relies on non-renewable fossil fuels and has limited applications for only large, centralized chemical plants. The new process utilizes a plasma, an ionized gas, in combination with non-noble metal catalysts to generate ammonia at much milder conditions than is possible with Haber-Bosch.

Ammonia is one of the most highly produced inorganic chemicals. There are numerous large-scale ammonia production plants worldwide. A typical modern ammonia-producing plant first converts natural gas or LPG (liquefied petroleum gases such as propane and butane) or petroleum naphtha into gaseous hydrogen. The method for producing hydrogen from hydrocarbons is known as steam reforming. The hydrogen is then combined with nitrogen to produce ammonia via the Haber-Bosch process.

There are literally dozens of large-scale ammonia production plants throughout the industrial world
source - chemengineering.com

The energy in the plasma excites nitrogen molecules, one of the two components that go into making ammonia, allowing them to react more readily on the catalysts. Because the energy for the reaction comes from the plasma rather than high heat and intense pressure, the process can be carried out at small scale. This makes the new process well-suited for use with intermittent renewable energy sources and for distributed ammonia production. Plasmas have been considered by many as a way to make ammonia that is not dependent on fossil fuels and had the potential to be applied in a less centralized way. The real challenge has been to find the right combination of plasma and catalyst. By combining molecular models with results in the laboratory, the researchers were able to focus in on combinations that had never been considered before.

The team of researchers has discovered that because the nitrogen molecules are activated by the plasma, the requirements on the metal catalysts are less stringent, allowing less expensive materials to be used throughout the process. This approach

overcomes fundamental limits on the heat-driven Haber-Bosch process, allowing the reaction to be carried out at Haber-Bosch rates at much milder conditions. Ammonia production depends on plentiful supplies of energy, predominantly natural gas. Due to ammonia's critical role in intensive agriculture and other processes, sustainable production is desirable. This is possible by using renewable energy to generate hydrogen by electrolysis of water.

The lead author, William Scheider
source - nd.edu

The goal of the researchers' work was to develop an alternative approach to making ammonia, but the insights that have come from this collaboration between the research groups can be applied to other difficult chemical processes, such as converting carbon dioxide into a less detrimental and more useful product. As the team of researchers continues studying plasma-ammonia synthesis, they will also consider how else plasma and catalysts could benefit other chemical transformations. The research was funded by the Department of Energy.

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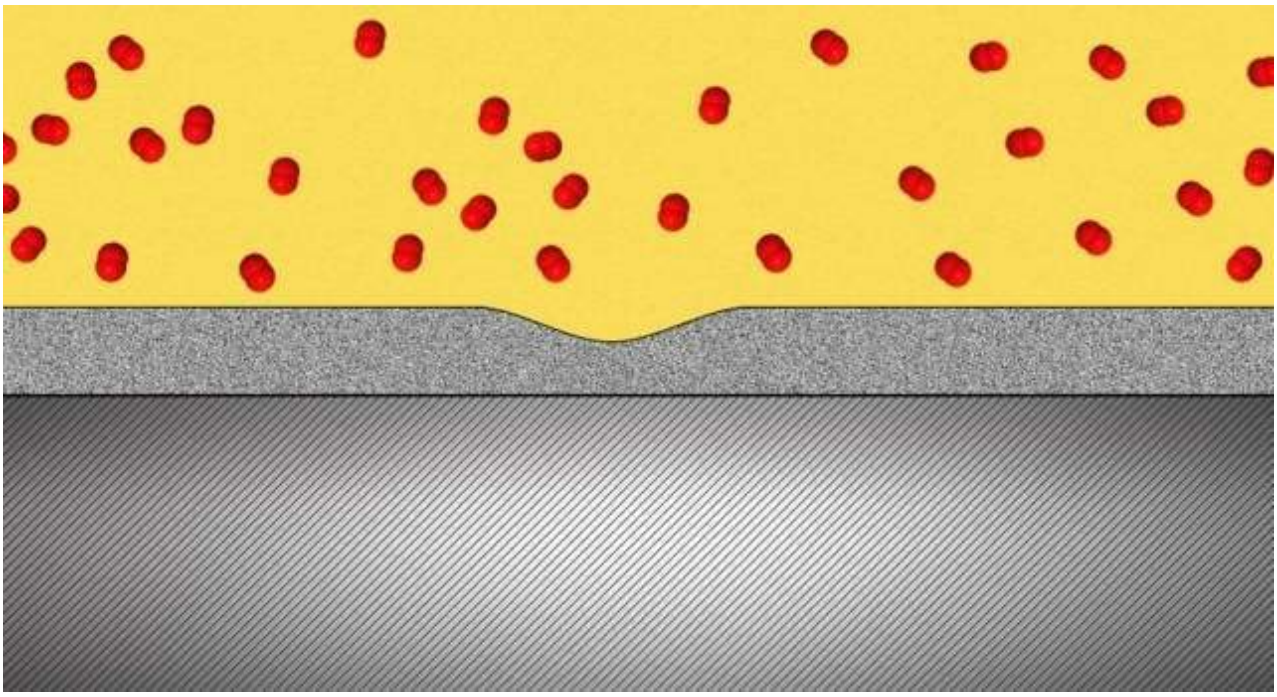
Industries:	Chemicals
Source links:	University of Notre Dame News

SELF-HEALING METAL OXIDES COULD PROTECT AGAINST CORROSION

A novel method that could protect metals against corrosion has been developed by the researchers at MIT. A solid oxide protective coating for metals can, when applied in sufficiently thin layers, deform as if it were a liquid, filling any cracks and gaps as they form. The thin coating layer should be especially useful to prevent leakage of tiny molecules that can penetrate through most materials, such as hydrogen gas that could be used to power fuel-cell cars, or the radioactive tritium (a heavy form of hydrogen) that forms inside the cores of nuclear power plants.

Most metals, with the notable exception of gold, tend to oxidize when exposed to air and water. This reaction, which produces rust on iron, tarnish on silver, and verdigris on copper or brass, can weaken the metal over time and lead to cracks or structural failure. But there are theee known elements that produce an oxide that can actually serve as a protective barrier to prevent any further oxidation: aluminum oxide, chromium oxide, and silicon dioxide.



Self-healing aluminium
source - mit.edu

The researchers used highly specialized instruments to observe in detail the surface of metals coated with these 'special' oxides to see what happens when they are exposed to an oxygen environment and placed under stress. While most transmission electron microscopes (TEMs) require that samples be studied in a high vacuum, the team used a modified version called an environmental TEM (E-TEM) that allows the sample to be studied in the presence of gases or liquids of interest. The device was used to study the process that can lead to a type of failure known as stress corrosion cracking.

Metals under stress from pressure inside a reactor vessel and exposed to an environment of superheated steam can corrode quickly if not protected. Even with a solid protective layer, cracks can form that allow the oxygen to penetrate to the bare metal surface, where it can then penetrate into interfaces between the metal grains that make up a bulk metal material, causing further corrosion that can penetrate deeper and lead to structural failure.

Many metals oxidize when exposed to air and water
source - liquidarmour.com

Traditionally, people think that the metal oxide would be brittle. That's where the specialized E-TEM setup at Brookhaven National Laboratory, one of only about 10 such devices in the world, came into play. The researchers demonstrated inside the E-TEM that the aluminum with its oxide coating could be stretched to more than double its length without causing any cracks to open up. The oxide forms a very uniform conformal layer that protects the surface, with no grain boundaries or cracks, even under the strain of that stretching. Technically, the material is a kind of glass, but it moves like a liquid and fully coats the surface as long as it is thin enough.

People can't imagine that a metal oxide can be ductile. For example, sapphire is a form of exactly the same material, aluminum oxide, but its bulk crystalline form makes it a very strong but brittle material. The self-healing coating could have many potential applications with the advantage of its smooth, continuous surface without cracks or grain boundaries that could penetrate into the material.

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Industries:	Chemicals
Source links:	MIT News

A NEW WAY TO FIGHT AGAINST POLLUTION IN WATER

A polymer mat that has the ability to fish biologically harmful contaminants from water through a strategy known as 'bait, hook, and destroy' has been developed by the researchers at Rice University. Tests with wastewater demonstrated the mat can efficiently remove targeted pollutants, in this case a pair of biologically harmful endocrine disruptors, using a fraction of the energy required by other technology. The technique can also treat drinking water.

The mat depends on the ability of a common material, titanium dioxide, to capture pollutants and, upon exposure to light, degrade them through oxidation into harmless byproducts. Titanium dioxide is already used in some wastewater treatment systems. It is usually turned into a slurry, combined with wastewater and exposed to ultraviolet light to destroy contaminants. After that, the slurry must be filtered from the water.

A mat is immersed in water with methylene blue as a contaminant
source - rice.edu

The mat, made of spun polyvinyl fibers, simplifies the process. The researchers made it highly porous by adding small plastic beads that chemicals later dissolve. The pores offer plenty of the surface area for titanium oxide particles to inhabit and await their prey. The mat's hydrophobic (water-avoiding) fibers naturally attract hydrophobic contaminants like the endocrine disruptors used in the tests. Once bound to the mat, exposure to light activates the photocatalytic titanium dioxide, which produces reactive oxygen species (ROS) that destroy the contaminants.

The researchers believe their mat can be cleaned and reused, scaled to any size, and its chemistry can be tuned for different pollutants. The existing photocatalytic treatment suffers from two limitations. One is inefficiency because the oxidants produced are scavenged by things that are much more abundant than the target pollutant, so they don't destroy the pollutant. Second, it costs a lot of money to retain and separate slurry photocatalysts and prevent them from leaking into the treated water. In some cases, the energy cost of filtering that slurry is more than what's needed to power the UV lights.

A new mat can remove detrimental pollution from water
source - rice.edu

The researchers solved both limitations by immobilizing the catalyst to make it very easy to reuse and retain. They don't allow it to leach out of the mat and impact the water. The porous polymer mat plays a significant role because it attracts the target pollutants. That's the bait and hook. After that the photocatalyst destroys the pollutant by producing hydroxyl radicals. The nanoscale pores are introduced by dissolving a sacrificial polymer on the electrospun fibers. The pores enhance the contaminants' access to titanium dioxide. The experiments showed dramatic energy reduction compared to wastewater treatment using slurry.

The researchers not only destroy the pollutants faster but they also significantly reduce their electrical energy per order of reaction. Tuning the mat would involve changing its hydrophobic or hydrophilic properties to match target pollutants. It's an opportunity not only to reduce energy requirements but also space requirements or photocatalytic water treatment.

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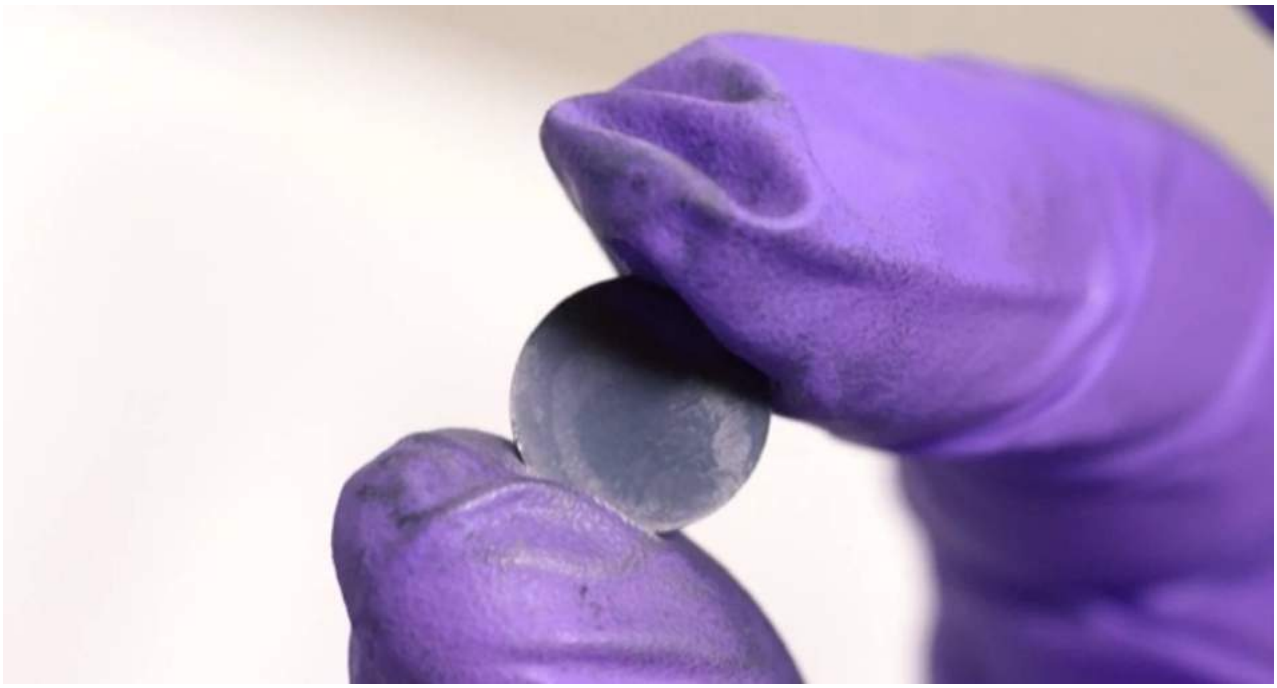
Industries:	Environment
Source links:	Rice News

A NEW METHOD TO MAKE GRAPHITE PELLETS FROM GRAPHENE

A novel economical and easy way to create shiny pellets of graphite from functionalized graphene has been developed by the team of researchers at Rice University. Researchers can press chemically altered graphene powder into a lightweight, semiporous solid that retains many of the strong and conductive qualities of graphite, the form of carbon found in pencils, lubricants, and other products that normally require high-temperature processing.

Graphite has a layered, planar structure. The individual layers are called graphene. In each layer, the carbon atoms are arranged in a honeycomb lattice with separation of 0.142 nm, and the distance between planes is 0.335 nm. Atoms in the plane are bonded covalently, with only three of the four potential bonding sites satisfied. The fourth electron is free to migrate in the plane, making graphite electrically conductive.



For graphite pellets, just add elbow grease
source - rice.edu

Mohamad Kabbani, a former graduate student of Rice University materials scientist Pulickel Ajayan and lead author of the paper describing the process, demonstrated that the environmentally friendly, scalable process can be done in minutes by hand by grinding chemically modified graphene into a powder and using a hand-powered press to squeeze the powder into a solid pellet.

The researchers could turn carbon nanotubes into graphene with a mortar and pestle rather than harsh chemicals. This time, the team has demonstrated how to make a battery-sized pellet, but they can press the graphene powders with chemical functionalities attached to it into any form. The material could be suitable for structural, catalytic, electrochemical, and electronic applications. This is the first time anyone's made these at room temperature and without very high pressure. Usually, these kinds of materials require sintering (a process that uses pressure or heat to form solids without melting them) at temperatures above 1,000 degrees Celsius to produce strong pellets. In this case,

mechano-chemistry at the nanoscale saved the team a lot of energy and money.

The process began with two sets of functionalized nanotubes, one with carboxylic acid and the other with hydroxyl molecules. Once crushed to combine them either by hand or machine, researchers place them in a lab-scale hydraulic press and subject them to 5 tons of pressure. The functional groups cross-linked the graphene sheets to each other, and even though the researchers used no liquids, the sheets produced a tiny amount of water as a byproduct of the reaction. The pellets remained stable when researchers placed them in hot water for five hours, even when they stirred them. This confirmed the interlocking of the graphene sheets within.

The combination of light weight, high strength, and high conductivity is appealing for applications such as conducting cables and electrodes. The pellet material is stronger and lighter than commercial graphite electrodes and could be perspective for electrical storage applications with high energy and power densities.

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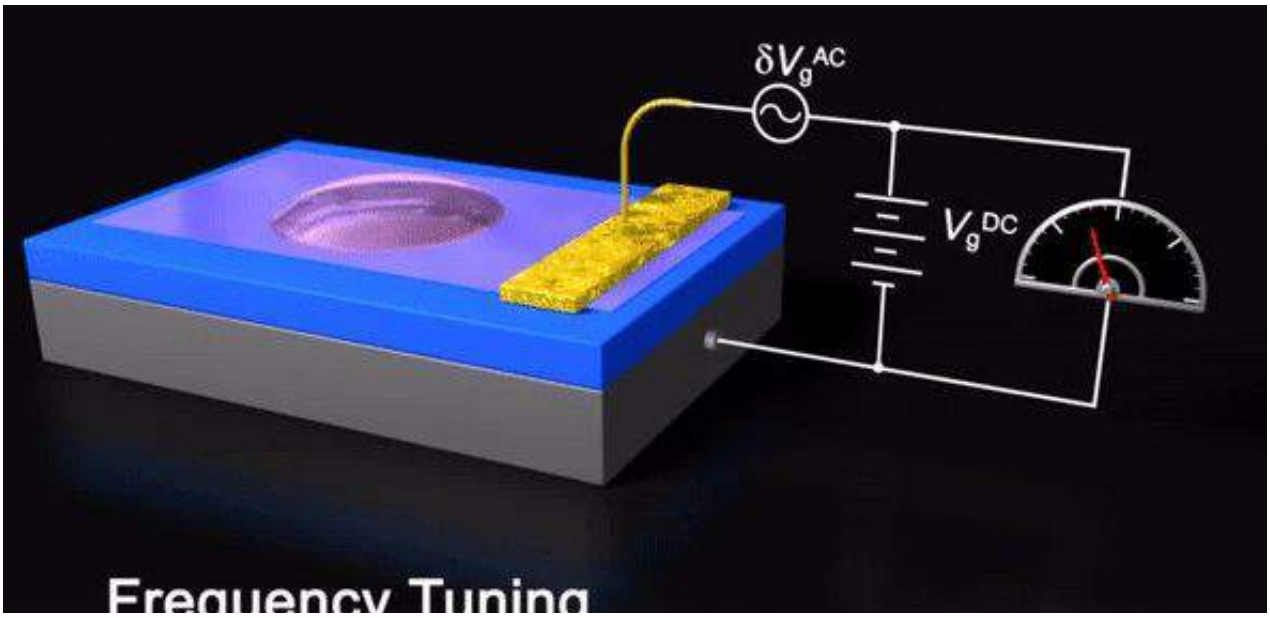
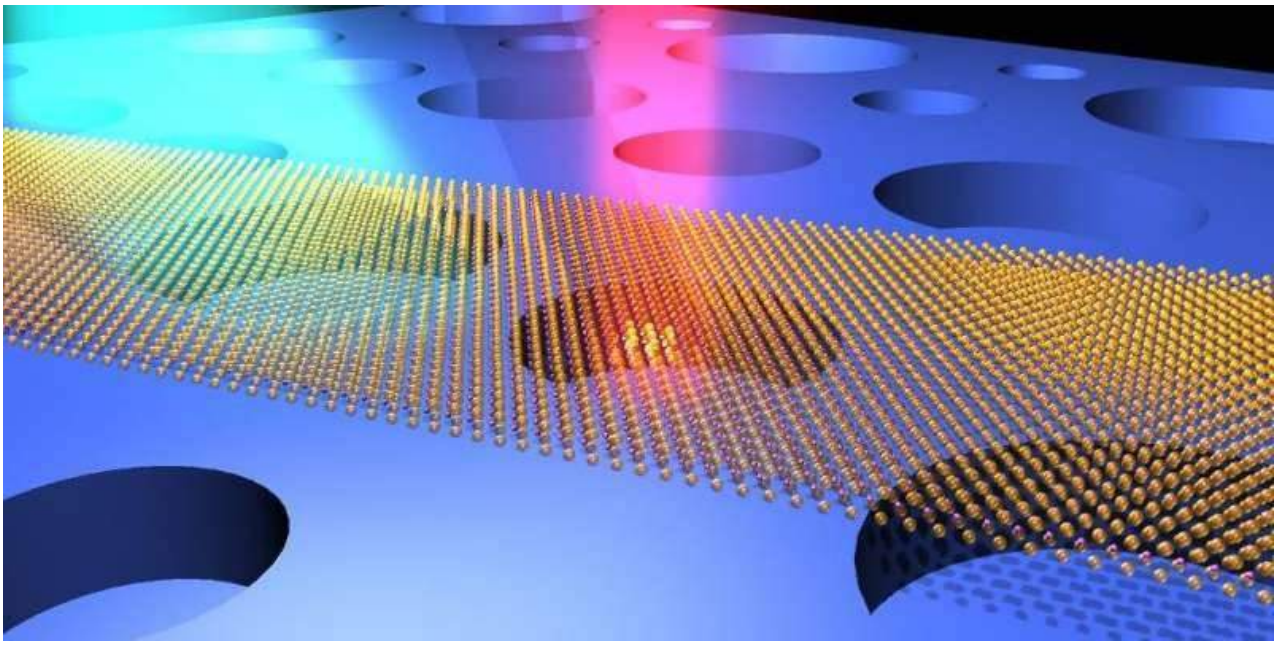
Industries:	Electronics
Source links:	Rice News



CAT LIKE HEARING BECAME POSSIBLE WITH DEVICE SMALLER THAN HUMAN EARDRUM

The atomically thin 'drumheads' able to receive and transmit signals across a radio frequency range far greater than what we can hear with the human ear have been developed by the researchers at Case Western Reserve University. But the drumhead is tens of trillions times (10 followed by 13 zeros) smaller in volume and 100,000 times thinner than the human eardrum. The advances will likely contribute to making the next generation of ultralow-power communications and sensory devices smaller and with greater detection and tuning ranges.

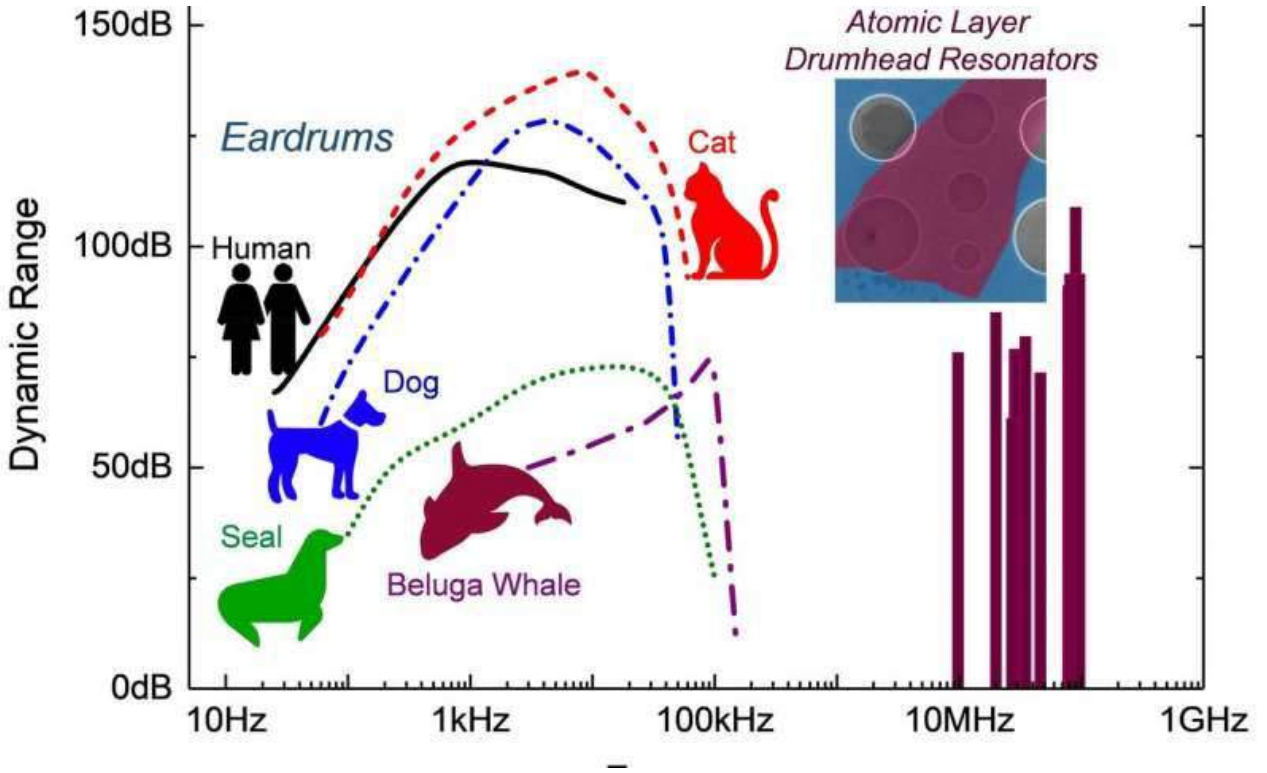
Sensing and communication are key to a connected world. In recent decades, the researchers have been connected with highly miniaturized devices and systems, and they have been pursuing ever-shrinking sizes for those devices. The challenge with miniaturization: Also achieving a broader dynamic rage of detection, for small signals, such as sound, vibration, and radio waves.



Ultrasensitive optical interrogation of the motions of atomically thin drumhead nanoelectromechanical resonators source - case.edu

In the end, the researchers need transducers that can handle signals without losing or compromising information at both the 'signal ceiling' (the highest level of an undistorted signal) and the 'noise floor' (the lowest detectable level). While this work was not geared toward specific devices currently on the market, it was focused on measurements, limits and scaling which would be significant for essentially all transducers.

Those transducers may be developed over the next decade, but for now, the team of researchers has alraady demonstrated the capability of their key components, the atomic layer drumheads or resonators, at the smallest scale yet. The work represents the highest reported dynamic range for vibrating transducers of their type. To date, that range had only been attained by much larger transducers operating at much lower frequencies - like the human eardrum. The key to all sensory systems, from naturally occurring sensory functions in animals to sophisticated devices in engineering, is that desired dynamic range.



Comparison of dynamic ranges and frequency bands of the eardrums
source - case.edu

Dynamic range is the ratio between the signal ceiling over the noise floor and is usually measured in decibels (dB). Human eardrums normally have dynamic range of about 60 to 100dB in the range of 10Hz to 10kHz, and our hearing quickly decreases outside this frequency range. Other animals, such as the common house cat or beluga whale, can have comparable or even wider dynamic ranges in higher frequency bands.

The researchers construct drumheads by exfoliating individual atomic layers from the bulk semiconductor crystal and using a combination of nanofabrication and micromanipulation techniques to suspend the atomic layers over micro-cavities pre-defined on a silicon wafer, and then making electrical contacts to the devices. Further, these atomically thin RF resonators being tested at Case Western Reserve demonstrate excellent frequency 'tunability,' meaning their tones can be manipulated by stretching the drumhead membranes using electrostatic forces, similar to the sound tuning in much larger musical instruments in an orchestra.

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Industries:	Electronics
Source links:	Case Daily

POLYMERS THAT MIMIC CHAMELEON SKIN

A biocompatible synthetic material that replicates tissue mechanics and alters color when it changes shape, like chameleon skin, has been developed by the researchers at CNRS in cooperation with the researchers at University of North Carolina at Chapel Hill and University of Akron. They promise new materials for biomedical devices. Biological tissues have complex mechanical properties - soft-yet-strong, tough-yet-flexible - that are difficult to reproduce using synthetic materials.

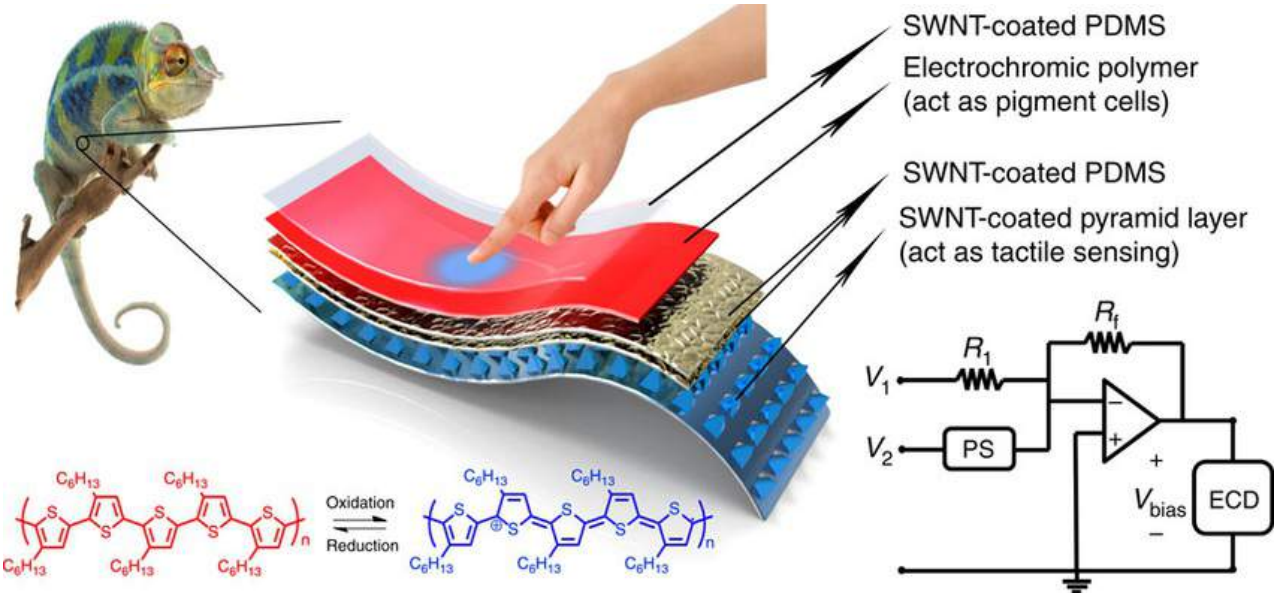
To produce a medical implant, the team of researchers needs to select materials with similar mechanical properties to those in biological tissues, so as to mitigate inflammation or necrosis. A number of tissues including the skin, the intestinal wall, and the heart muscle, have the particularity of being soft yet stiffening when they are stretched. Until now, it has been impossible to reproduce this behavior with synthetic materials.

Polymers that mimic chameleon skin
source - shutterstock.com

The researchers have attempted to achieve this with a unique triblock copolymer. They have synthesized a physically cross-linked elastomer composed of a central block onto which side chains are grafted (like a bottle brush) and with linear terminal blocks at each end. The team of researchers has found that by carefully selecting the polymer's structural parameters, the material followed the same strain curve as a biological tissue, in this case pigskin. It is also biocompatible, since it does not require additives, e.g. solvent, and remains stable in the presence of biological fluids.

Another property of the material appeared during the experimeents: its color change upon deformation like chameleon skin. A chameleon changes its color to adjust its body temperature to that of the outside temperature. A cold chameleon will turn dark to absorb more heat, while a hot chameleon will turn lighter in shade in order to reflect. As the scientists have demonstrated, this is a purely physical phenomenon, which is caused by light scattering from the polymer structure. Atomic force microscopy and X-ray diffraction

experiments have shown that the terminal blocks of these polymers assemble in nanometer spheres, distributed in a brush-polymer matrix. Light interferes with this microphase-separated structure to produce color according to the distance between the spheres. So when the material is stretched it changes color. It is the same mechanism that explains - in large part - how chameleons change color.



A new material that replicates tissue mechanics and alters color when it changes shape, like chameleon skin
source - shutterstock.com

The researchers have therefore succeeded in encoding in a unique synthetic polymer both mechanical properties (flexibility, strain profile) and optical properties, which had never previously been achieved. By adjusting the length or density of the 'brush's' various side chains, these properties can be modulated. This discovery could lead to medical implants or more personalized prostheses (vascular implants, intraocular implants, replacement of intervertebral discs), and also to materials with completely new strain profiles, and applications that have not yet been imagined.

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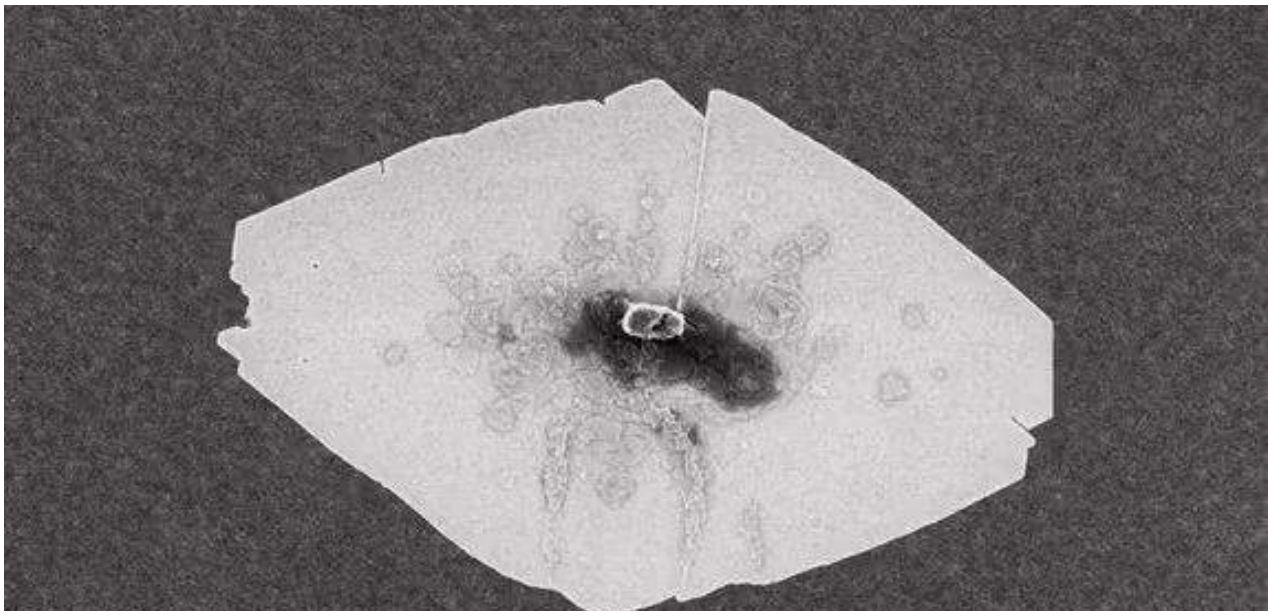
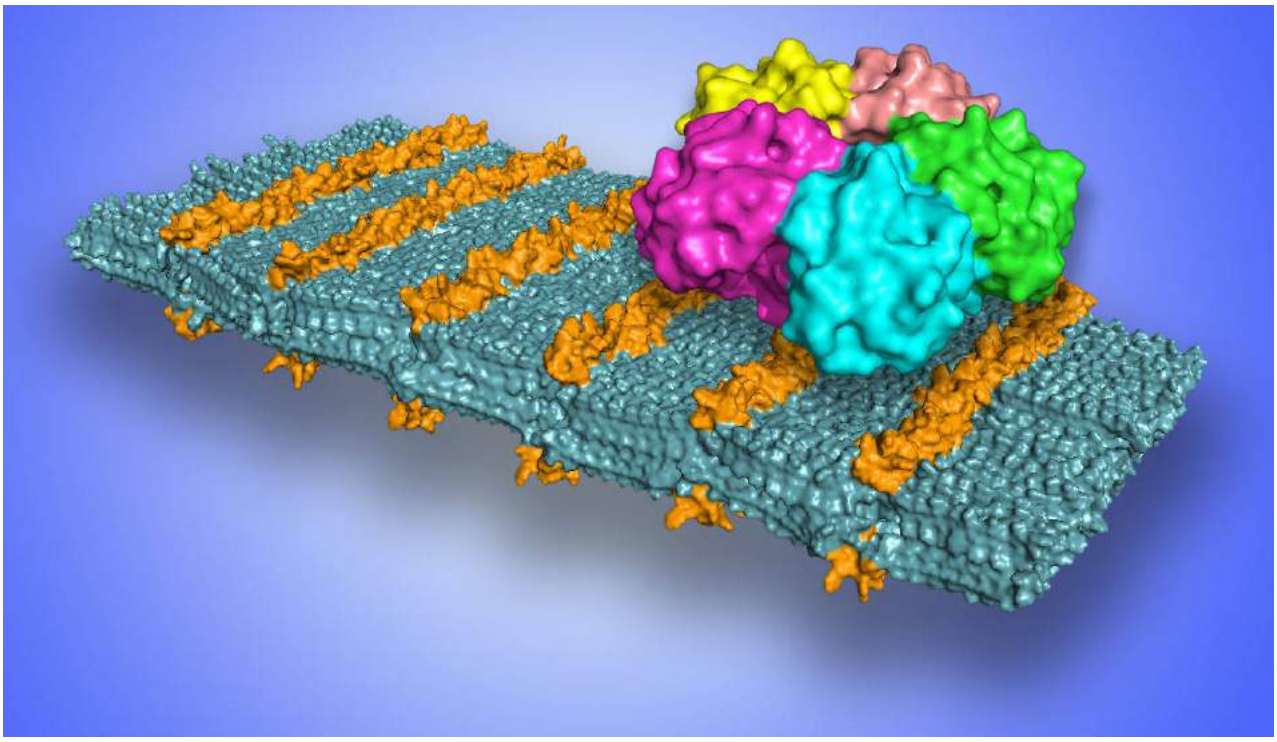
Industries:	Biotechnology
Source links:	CNRS



SUGAR-COATED NANOSHEETS TO SELECTIVELY TARGET PATHOGENS

A process for creating ultrathin, self-assembling sheets of synthetic materials that can function like designer flypaper in selectively binding with viruses, bacteria, and other pathogens has been developed by the researchers at Berkeley Lab. In this way the new platform could potentially be used to inactivate or detect pathogens. The team created the synthesized nanosheets at Berkeley Lab's Molecular Foundry, a nanoscale science center, out of self-assembling, bio-inspired polymers known as peptoids.

The sheets were designed to present simple sugars in a patterned way along their surfaces, and these sugars, in turn, were demonstrated to selectively bind with several proteins, including one associated with the Shiga toxin, which causes dysentery. Because the outside of our cells are flat and covered with sugars, these 2-D nanosheets can efficiently mimic cell surfaces.



A molecular model of a peptoid nanosheet shows loop structures in sugars that bind to the Shiga toxin
source - lbl.gov

It's not just a 'lock and key' - it's like Velcro, with a bunch of little loops that converge on the target protein together. Now the researchers can mimic a nanoscale feature that is ubiquitous in biology. The team noted that numerous pathogens, from the flu virus to cholera bacteria, bind to sugars on cell surfaces. So picking the right sugars to bind to the peptoid nanosheets, in the right distributions, can determine which pathogens will be drawn to them. The peptoid platform is also more rugged and stable compared to natural biomolecules, so it can potentially be deployed into the field for tests of bioagents by military personnel and emergency responders.

And peptoids - an analog to peptides in biology that are chains of amino acids – are cheap and easy-to-make polymers. The chemical information that instructs the molecules to spontaneously assemble into the sugar-coated sheets is programmed into each molecule during its synthesis. This work demonstrates the ability to readily engineer sophisticated

biomimetic nanostructures by direct control of the polymer sequence. The nanosheets could also potentially be used in environmental cleanups to neutralize specific toxins and pathogens, and the sheets could potentially be scaled to target viruses like Ebola and bacteria like E. coli, and other pathogens.

A 3-D-printed model of a peptoid nanosheet, showing patterned rows of sugars
source - lbl.gov

In the latest study, the researchers confirmed that the bindings with the targeted proteins were successful by embedding a fluorescent dye in the sheets and attaching another fluorescent dye on the target proteins. A color change indicated that a protein was bound to the nanosheet. The intensity of this color change can also guide researchers to enhance them, and to discover new nanosheets that could target specific pathogens.

Scientists also conducted X-ray-based experiments at Berkeley Lab's Advanced Light Source to analyze the nanoscale structure of the sheets, and confirm the presence of sugars on their surface. The Molecular Foundry and Advanced Light Source are DOE Office of Science User Facilities. This work was supported by the U.S. Defense Threat Reduction Agency, the U.S. Defense Advanced Research Projects Agency, and the National Research Foundation of Korea.

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Industries:	Biotechnology
Source links:	Berkeley Lab News

GOGGLE LENSES THAT CAN ADDRESS THE CHALLENGES POSED BY FLAT FLIGHT

A novel method to improve ski goggles to mitigate the hazards of 'flat light' has been developed by the group of students at MIT. Skiers taking to the slopes at the Olympics in Pyeongchang in a few weeks have a common enemy: flat light. Flat light occurs on overcast days when light diffuses through moisture in the air, creating a white-out effect that makes shadows and colors difficult to see. It impedes skiers' ability to perceive the terrain in front of them, which could mean the difference between going home with a gold medal, or going home empty-handed.

For American aline skier and two-time Olympic gold medalist Ted Ligety, skiing in flat light conditions could add seconds to his time as he charges down a giant slalom course. For racers, a difference of seconds can exist between how they perform in the sun and how they perform in flat light. There is much more confidence to push hard in the good light.

Ted Ligety wearing the helmet and goggle collection
source - mit.edu

The group of students decided to developed a lens that allows skiers to see clearly in flat light. The team sought to determine which ski goggles currently on the market provided the best performance in flat light conditions. Once they knew which goggles were best, they analyzed the lens' properties and characteristics. The researchers used some machine-learning clustering algorithms to see if there was a particular combination of characteristics in the goggles users liked.

To determine how these lenses responded to flat light, the team first needed to replicate flat light conditions. They simulated a flat-light effect within a dark room, and after that enlisted the help of 30 participants, many of whom are members of the MIT Outing Club, to test and rate a number of goggles in a controlled environment. Participants were asked to look into a box that had been outfitted to mimic the sun's natural spectrum. A material formulated to resemble the snowpack was placed in the box to simulate the contours of a ski slope. Each participant was presented two goggles at a time, a control goggle and a test goggle, and could switch between the two at will. Users would answer two questions

about each of the test goggles and rate them according to a scale specifically developed by the team of students.

Ted Ligety freeskiing at Snowbird, Utah
source - mit.edu

Armed with the participants' answers to these questions, the team took high-resolution images through each lens and performed a spectrum analysis examining contrast, brightness, and other parameters. By the end of the project, millions of data points were generated. The students presented their findings to the class and to the team at Shred - a company co-founded by Ted Ligety and Carlo Salmini MBA'11, a material engineer and MIT Sloan School of Management alum. While additional research and testing that are needed before goggles can completely eliminate the effects of flat light, for Ligety the research conducted by the team shows that there is a meaningful opportunity to further improve the lens contrast technology available to all skiers, including Olympic athletes.

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Regions:	United States
Industries:	Sports and Recreation
Source links:	MIT News

A NEW METHOD MAY REVERSE VISION LOSS FROM DIABETES

A potential way of stalling or even reversing diabetes-related blindness has been developed by the team of researchers at Johns Hopkins University. In experiments with mice, scientists discovered a protein that triggers vision loss caused by diabetic retinopathy and retinal vein occlusion, two diseases characterized by the closure of blood vessels in the retina. By suppressing levels in the eye of the protein called vascular endothelial growth factor, scientists were able to re-establish normal blood flow in the mice retinas.

This work is particularly significant because it helps explain why diabetic retinopathy and retinal vein occlusion continue to worsen across a patient's lifetime if left untreated. The team of researchers has found that increased VEGF levels attract white blood cells into the retina. Once there, the scientists adhere to the walls of blood vessels, disrupting blood flow. Decreasing VEGF or blocking it with an antibody caused the white blood cells to dissipate, opening the closed vessels and restoring blood flow to the area.

New method will help reverse diabetes blindness
source - shutterstock.com

The inspiration for the study came from observations in clinical trials for ranibizumab, a drug designed to block VEGF in patients with diabetic retinopathy and retinal vein occlusion. After VEGF was suppressed, blood flow enhanced to parts of the retina that were previously blocked. Patients' conditions also improved. The team of scientists believed that this disease caused the blood vessels to die off and was, therefore, irreversible.

To investigate the unexpected observation, the team of researchers chose six genetically modified mice to overexpress VEGF when given a drug called doxycycline. After three days of VEGF overexpression, telltale clumps of white blood cells were collecting in the blood vessels of the mice retinas. After that the researchers stopped overexpressing VEGF in the mice. Seventeen days later, the white blood cell clumps had broken up and blood flow had returned. The team of scientists explored the cellular signals responsible for the vessel-plugging effects of VEGF and found that when white blood cells interacted with VEGF, they migrated into retina blood vessels. High levels of VEGF also activated a molecule called VCAM-1, which acts as an adhesive between many types of immune cells

and blood vessels.

The leading cause of blindness in people of working age is diabetic retinopathy
source - shutterstock.com

After that the team of researchers repeated their previous experiment, but administered an antibody targeted to inhibit VCAM-1 while also increasing VEGF expression. When compared to the retinal vessels of mice not treated with the inhibitor, the VCAM-1 inhibitor-treated mice showed significantly fewer white blood cell clumps and better blood flow in the retinal blood vessels. This means that VEGF drives the early stages of diabetic retinopathy and retinal vein occlusion, as well as the late stages when vision decreases. The research was led by Peter Campochiaro, professor of ophthalmology at Johns Hopkins University's Wilmer Eye Institute.

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Patent status:	-
On market since:	-
Regions:	United States
Industries:	Healthcare
Source links:	Johns Hopkins University News

CELLULOSE KNOW-HOW COULD LEAD TO BETTER BIOFUEL

A new way to produce biofuel has been developed by the researchers at Penn State University. The team identified the major steps in how plants create cellulose, and the tools their cells use to create it, including the proteins that transport critical components to the location where it's made. A comprehensive look at how plants build cellulose, the primary building block of the walls of most plant cells that is used in a wide variety of manmade materials, could have important implications for its use in biofuels.

Cellulose is the single most abundant biopolymer on Earth. It makes up about 95 percent of paper and 90 percent of cotton, and its derivatives are even in the emulsifiers in ice cream. In the past ten years or so, cellulose has also been considered as a major component of biofuels. Understanding how cellulose is synthesized may allow the researchers to optimize its use as a renewable energy source. The cellulose in many of the products they use every day is primarily produced by plants. Despite the economic significance of cellulose, prior to this study researchers only had a basic understanding of how plants make it.

New insights could indicate how to break apart cellulose for biofuels
source - iStock.com

The researchers knew that cellulose is synthesized in the plasma membrane that surrounds plant cells within a heteromeric protein complex, a grouping of different kinds of proteins, called the cellulose synthase complex, and that the main component of this complex is a unique cargo protein called cellulose synthase. But the team didn't know if other proteins are involved in the complex, or how the proteins get to the plasma membrane. To start answering these questions, they used a combination of approaches, including cell imaging, functional genetics, and proteomics, to create a timeline of events and to identify the main proteins involved in preparing the cell for synthesis.

Researchers show that a protein called cellulose synthase interactive 1 (CSI1) interacts with the cellulose synthase complex prior to synthesis and may help mark the site at the plasma membrane where synthesis occurs. They also demonstrate that CSI1 interacts with a

separate complex called the exocyst complex, which is involved in transporting materials to the plasma membrane in a variety of species, and a protein called PATROL1. These components may contribute to how quickly the cellulose synthase complex travels to the cell's outer membrane before synthesis.

Researchers have identified the main proteins that prepare plants to create cellulose
source - futurity.com

The researchers knew that the exocyst complex is evolutionarily conserved, with essentially unchanged structure in yeast and mammals, and here they confirmed its role in plants. But PATROL1 is a plant-specific protein that is not like anything they see in mammals or yeast. The researchers are puzzled by what PATROL1 actually does and are excited to continue to investigate its function. Because CSI1 interacts with many components that are integral to cellulose synthesis, the research team plans to use it as a tool to further elucidate this important process and its evolution. They hope to translate what they know about how plant cells build cellulose to more efficiently break it apart again for use in biofuels.

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Industries:	Energy

AN ELECTROLYTE SOLUTION TO INCREASE CHARGE CYCLES

A small lithium-metal battery that can re-charge about seven times more than batteries with conventional electrolytes has been developed by the researchers at Pacific Northwest National Laboratory. A battery's electrolyte solution shuttles charged atoms between electrodes to generate electricity. Finding an electrolyte solution that doesn't corrode the electrodes in a lithium-metal battery is a challenge but the PNNL approach successfully creates a protective layer around the electrodes and achieves significantly increased charge and discharge cycles.

Conventional electrolytes used in lithium-ion batteries, which power household electronics like computers and cell phones, are not suitable for lithium-metal batteries. Lithium-metal batteries that replace a graphite electrode with a lithium electrode are the 'holy grail' of energy storage systems because lithium has a greater storage capacity and, therefore, a lithium-metal battery has double or triple the storage capacity. That extra power enables electric vehicles to drive more than two times longer between charges.

A novel electrolyte for vehicle batteries
source - pnnl.gov

Adding more lithium-based salt to the liquid electrolyte mix creates a more stable interface between the electrolyte and the electrodes which, in turn, affects the life of the battery. But that high concentration of salt comes with distinct downsides, including the high cost of lithium salt. The high concentration also increases viscosity and lowers conductivity of the ions through the electrolyte.

The researchers were trying to preserve the advantage of the high concentration of salt but offset the disadvantages. By combining a fluorine-based solvent to dilute the high concentration electrolyte, the team was able to significantly lower the total lithium salt concentration yet keep its benefits. In this process, they were able to localize the high concentrations of lithium-based salt into 'clusters' which are able to still form protective barriers on the electrode and prevent the growth of dendrites, microscopic, pin-like fibers, that cause rechargeable batteries to a short circuit and limit their lifespan.

Research hints at double the driving range for electric vehicles
source - shutterstock.com

PNNL's patent-pending electrolyte was tested in PNNL's Advanced Battery Facility on an experimental battery cell similar in size to a watch battery. It was able to retain 80 percent of its initial charge after 700 cycles of discharging and recharging. A battery using a standard electrolyte can only maintain its charge for about 100 cycles. Researchers will test this localized high concentration electrolyte on 'pouch' batteries developed at the lab, which are the size and power of a cell phone battery, to see how it performs at that scale. This research is part of the Battery500 Consortium led by PNNL which aims to develop smaller, lighter, and less expensive batteries that nearly triple the specific energy found in batteries that power today's electric cars. Specific energy measures the amount of energy packed into a battery based on its weight.

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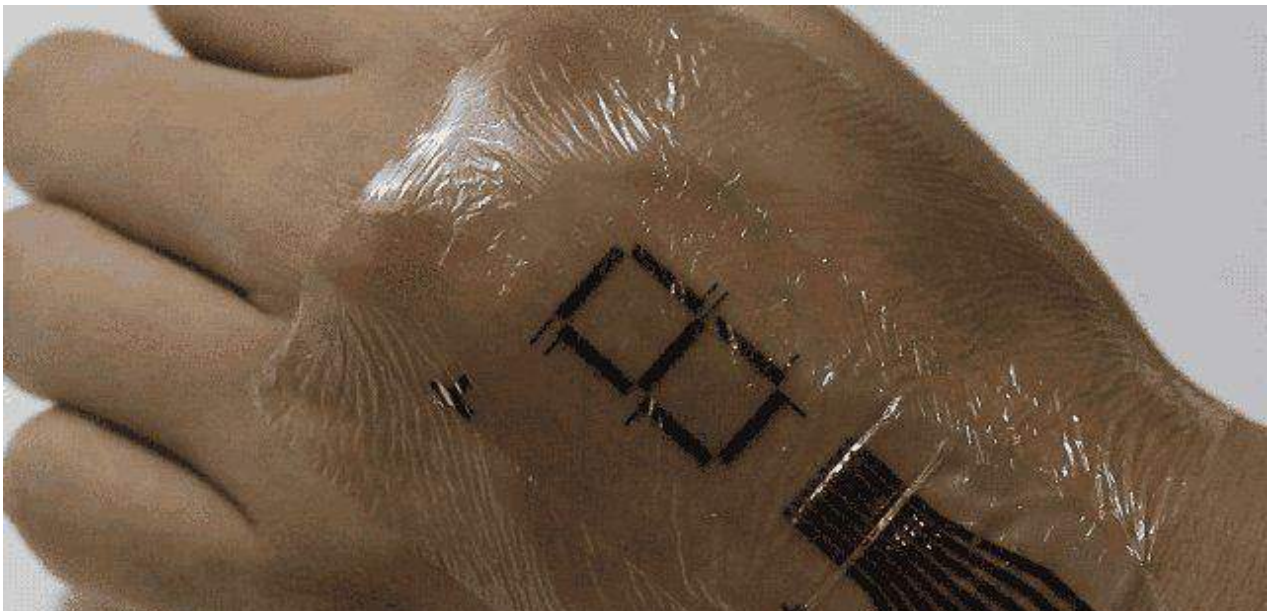
Industries:	Transport Systems and Vehicles



A THIN LIGHT-EMITTING DEVICE OPENS THE POSSIBILITY FOR 'INVISIBLE' DISPLAYS

A bright-light emitting device that is millimeters wide and fully transparent when turned off has been developed by the researchers at UC Berkeley. The light emitting material in this device is a monolayer semiconductor, which is just three atoms thick. The device opens the door to invisible displays on walls and windows, displays that would be bright when turned on but see-through when turned off, or in futuristic applications such as light-emitting tattoos.

The materials are so thin and flexible that the device can be made transparent and can conform to curved surfaces. The new work overcame fundamental barriers in utilizing LED technology on monolayer semiconductors, allowing for such devices to be scaled from sizes smaller than the width of a human hair up to several millimeters. That means that researchers can keep the thickness small, but make the lateral dimensions (width and length) large, so that the light intensity can be high.

Light-emitting device opens the possibility for 'invisible' displays
source - shutterstock.com

Commercial LEDs consist of a semiconductor material that is electrically injected with positive and negative charges, which produce light when they meet. Typically, two contact points are used in a semiconductor-based light emitting device; one for injecting negatively charged particles and one injecting positively charged particles. Making contacts that can effectively inject these charges is a fundamental challenge for LEDs, and it is particularly challenging for monolayer semiconductors since there is so little material to work with.

The Berkeley research team engineered a way to circumvent this challenge by designing a new device that only requires one contact on the semiconductor. By laying the semiconductor monolayer on an insulator and placing electrodes on the monolayer and underneath the insulator, the researchers could apply an AC signal across the insulator.

During the moment when the AC signal switches its polarity from positive to negative (and vice versa), both positive and negative charges are present at the same time in the semiconductor, creating light.

A new device can be used for light-emitting tattoos
source - shutterstock.com

The researchers demonstrated that this mechanism works in four different monolayer materials, all of which emit different colors of light. This device is a proof-of-concept, and much research still remains, primarily to enhance efficiency. Measuring this device's efficiency is not straightforward, but the researchers believe it's about 1 percent efficient. Commercial LEDs have efficiencies of around 25 to 30 percent. The concept may be applicable to other devices and other kinds of materials, the device could one day have applications in a number of fields where having invisible displays are warranted. That could be an atomically thin display that's imprinted on a wall or even on human skin.

A lot of work remains to be done and a number of challenges need to be overcome to further advance the technology for practical applications. However, this is one step forward by presenting a device architecture for easy injection of both charges into monolayer semiconductors.

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Regions:	United States
Industries:	Electronics
Source links:	Berkeley News

NEW DIRECTION FOR HALTING THE CITRUS GREENING EPIDEMIC

A new way to fight citrus greening disease has been developed by the researchers at Boyce Thompson Institute. Citrus greening, also known as huanglongbing, is a serious disease dramatically affecting citrus production all over the world. Trees with this disease are unable to get enough nutrients from the soil, their leaves turn yellow, young twigs die back, and fruit remains small, green and unsuitable for sale. After only a few years the trees die completely.

These symptoms are associated with a bacterium called 'Candidatus Liberibacter asiaticus,' referred to as CLas for short, which is spread from tree to tree by its tiny insect vector, the Asian citrus psyllid. Today, citrus greening has been detected in every citrus-producing county in Florida, throughout the southern citrus growing states and in isolated spots of southern California. Growers have tried many strategies to combat the disease, but none have been efficient enough or long-lasting.

Citrus growers are running out of time
source - shutterstock.com

The researchers among many investigators working to find a solution, and their recent publication sheds light on a significant strategy for controlling the spread of CLas. The bacteria are sucked up when a psyllid feeds on an infected tree, replicate inside the insect, and after that infect healthy trees as the psyllid feeds throughout a grove. Without hitching a ride in the insect, CLas would not be able to infect new trees, and that is why no new trees would succumb to citrus greening disease. With the long-term goal to disrupt this interaction, researchers have focused on an important point: not all psyllids are equal in their ability to spread CLas.

Research has demonstrated over and over that nymphs are able to acquire the bacteria from the plant much better than adults. To effectively be spread by psyllids, CLas must pass through the cells lining the insect's gut. The team of researchers has previously shown that the gut cells of adult ACP experience a severe stress response when infected by CLas. The cell nuclei become fragmented, and some cells will even undergo apoptosis -

auto-induced cell suicide. In their recent publication, the researchers report a much different response in the young psyllid nymphs. To accommodate the beneficial bacteria, the nymph gut cells may actively avoid cell suicide, which, the authors hypothesize, might help CLas get in and multiply at the same time.

Diaphorina citri nymph is feeding on a citrus leaf
source - btiscience.org

The next step will be to identify the mechanism for resistance in the nymphs so that it might be reversed to halt the spread of CLas. An important clue lies in how psyllids interact with symbiotic bacteria in its gut. Citrus growers will be in a much better situation in terms of disease control and saving the U.S. citrus industry. There are still many unanswered questions about CLas, how it is acquired and transmitted via the Asian citrus psyllid and how it causes the disease. The more the researchers learn about CLas and its vector, the closer they will get to moving citrus production past the threat of citrus greening.

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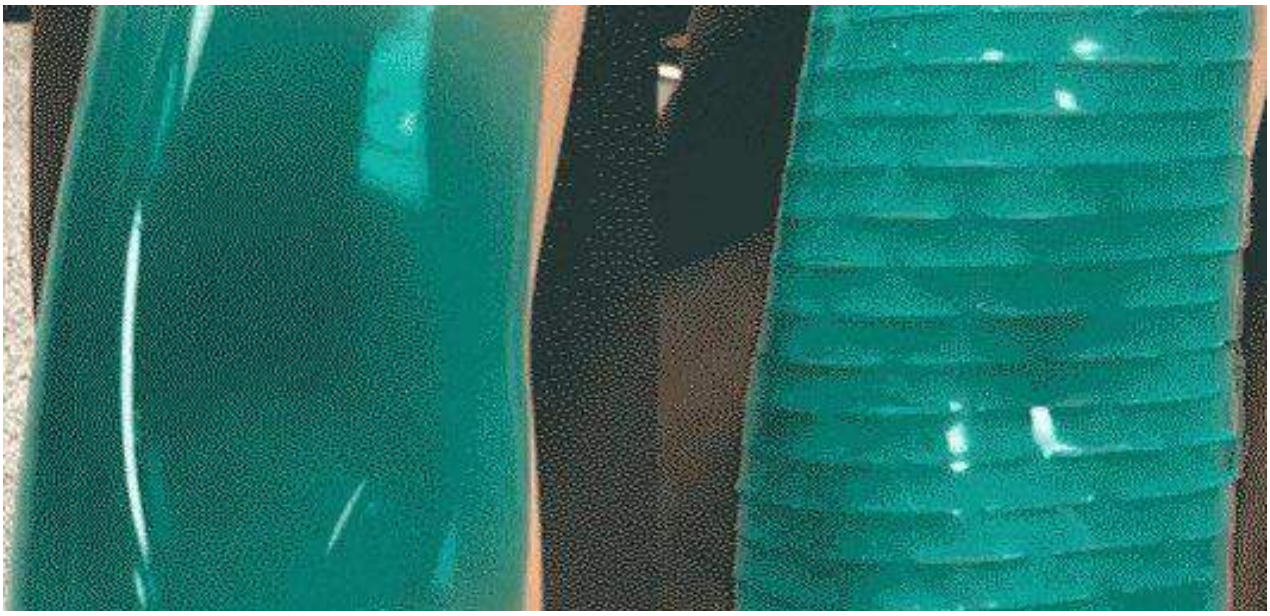
Industries:	Environment
Source links:	USDA News



A NEW TYPE OF ' BANDAGE'

A thin, lightweight, rubber-like film for scraped up knees and elbows has been developed by the researchers at MIT. The adhesive film can stick to highly deformable regions of the body, such as the knee and elbow, and maintain its hold even after 100 bending cycles. The key to the film's clinginess is a pattern of slits that the researchers have cut into the film, similar to the cuts made in a paper-folding art form known as kirigami.

The researchers attached the 'kirigami film' to a volunteer's knee and found that each time she bent her knee, the film's slits opened at the center, in the region of the knee with the most pronounced bending, while the slits at the edges remained closed, allowing the film to remain bonded to the skin. The kirigami cuts give the film not only stretch, but also better grip. The cuts that open release tension that would otherwise cause the entire film to peel away from the skin.

Kirigami-patterned adhesives may enable a whole swath of products
source - mit.edu

To demonstrate potential applications, the group fabricated a kirigami-patterned adhesive bandage, as well as a heat pad consisting of a kirigami film threaded with heating wires. With the application of a 3-volt power supply, the pad maintains a steady temperature of 100 degrees Fahrenheit. The group has also engineered a wearable electronic film outfitted with light-emitting diodes. All three films can function and stick to the skin, even after 100 knee bends. Kirigami-patterned adhesives may enable a whole swath of products, from everyday medical bandages to wearable and soft electronics.

To find out why kirigami cuts improve a material's adhesive properties, the researchers first bonded a kirigami film to a polymer surface, after that subjected the material to stretch tests. They measured the amount of stretch a kirigami film can undergo before peeling away from the polymer surface - a measurement they used to calculate the material's critical 'energy-release rate,' a quantity to evaluate detaching. They found that this energy-release rate varied throughout a single film. When they pulled the film from

either end like an accordion, the slits toward the middle exhibited a higher energy-release rate and were first to peel open under less stretch. In contrast, the slits at either end of the film continued to stick to the underlying surface and remained closed.

Scraped up knees and elbows are tricky places to securely apply a bandage
source - shutterstock.com

The team identified three main parameters that give kirigami films their adhesive properties: shear-lag, in which shear deformation of film can decrease the strain on other parts of the film; partial debonding, in which the film segments around an open slit maintain a partial bond to the underlying surface; and inhomogenous deformation, in which a film can maintain its overall adhesion, even as parts of its underlying surface may bend and stretch more than others. The team is now branching out to explore other materials on which to pattern kirigami cuts. The existing films are purely elastomers. The researchers want to change the film material to gels, which can directly diffuse medicine into the skin.

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Regions:	United States
Industries:	Electronics, Healthcare
Source links:	MIT News

A NEW WAY TO FIND BETTER BATTERY MATERIALS

A new approach to analyzing and designing new ion conductors, a main component of rechargeable batteries, has been developed by the researchers at MIT. This approach could accelerate the development of high-energy lithium batteries, and possibly other energy storage and delivery devices such as fuel cells. It relies on understanding the way vibrations move through the crystal lattice of lithium ion conductors and correlating that with the way they inhibit ion migration. This provides a way to discover new materials with improved ion mobility, allowing rapid charging and discharging.

At the same time, the method can be used to decrease the material's reactivity with the battery's electrodes, which can shorten its useful life. These two characteristics, better ion mobility and low reactivity, have tended to be mutually exclusive. The initial thinking on a new design started with the approach the group has used to understand and control catalysts for water splitting, and applying it to ion conduction - the process that lies at the heart of not only rechargeable batteries, but also other key technologies such as fuel cells and desalination systems.

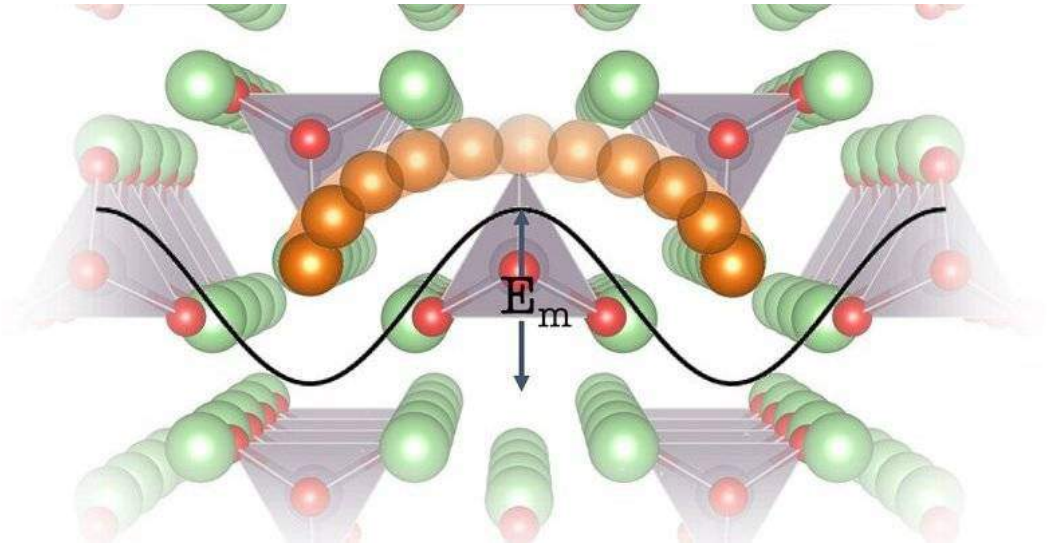

Diagram illustrates the crystal lattice of a proposed battery electrolyte material called Li3PO4
source - mit.edu

Typically, that electrolyte is a liquid. A lithium salt dissolved in an organic liquid is a common electrolyte in today's lithium-ion batteries. But that substance is flammable and has sometimes caused these batteries to catch fire. The search has been on for a solid material to replace it, which would solve that issue. A variety of perspective solid ion conductors exist, but none is stable when in contact with both the positive and negative electrodes in lithium-ion batteries. That is why looking for new solid ion conductors that have both high ion conductivity and stability is critical. But sorting through the many various structural families and compositions to find the most perspective ones is a classic needle in a haystack problem. That's where the new design principle comes in.

The idea is to find materials that have ion conductivity comparable to that of liquids, but with the long-term stability of solids. The key was to look at the lattice properties of these solid materials' crystalline structures. This governs how vibrations such as waves of heat and sound, known as phonons, pass through materials. This new way of looking at the

structures turned out to allow accurate predictions of the materials' actual properties. The researchers observed a good correlation between the lattice properties determined using the model and the lithium-ion conductor material's conductivity.

Design principles could point to better electrolytes for next-generation lithium batteries
source - shutterstock.com

They found, particularly, that the vibrational frequency of lithium itself can be fine-tuned by tweaking its lattice structure, using chemical substitution or dopants to subtly change the structural arrangement of atoms. The new concept can now provide a powerful tool for developing new, better-performing materials that could lead to significant improvements in the amount of power that could be stored in a battery of a given size or weight, as well as improved safety.

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On market since:	-
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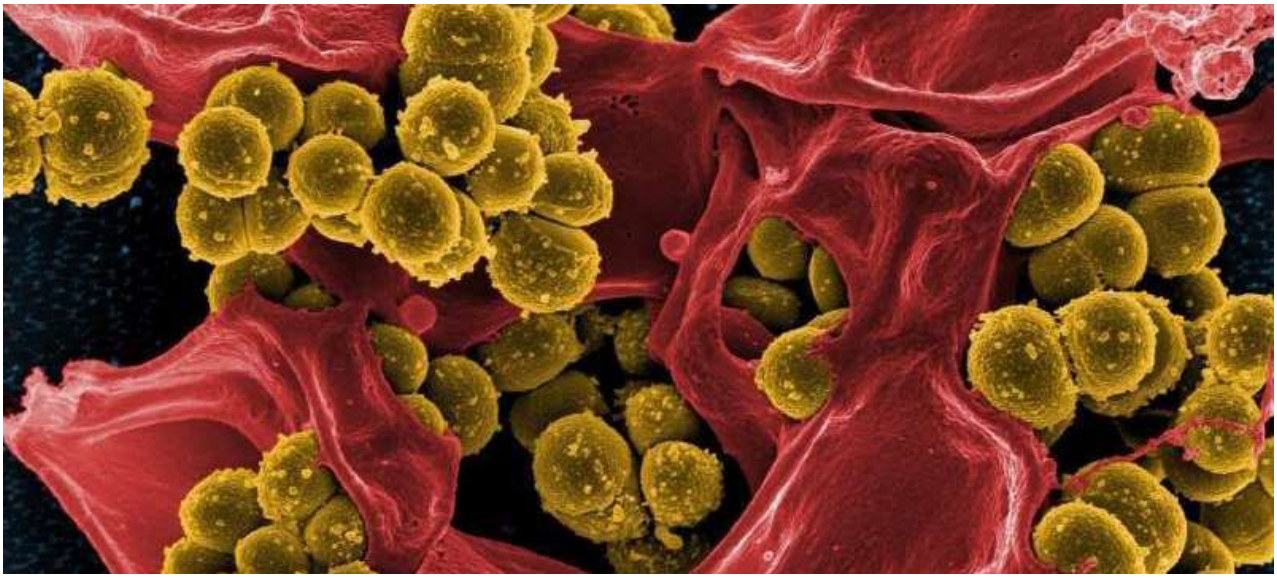
Industries:	Electronics
Source links:	MIT News

FIRST PROOF A SYNTHESIZED ANTIBIOTIC IS CAPABLE OF TREATING SUPERBUGS

A novel antibiotic which is capable of killing superbugs has been successfully synthesized and utilized to treat an infection for the first time has been developed by the researchers at the University of Lincoln. It could lead to the first new class of antibiotic drug in 30 years. The breakthrough is another major step forward on the journey to develop a commercially viable drug version based on teixobactin - a natural antibiotic discovered by US scientists in soil samples in 2015 which has been heralded as a 'gamechanger' in the battle against antibiotic resistant pathogens.

Researchers have successfully created a simplified, synthesized form of teixobactin which has been used to treat a bacterial infection in mice, demonstrating the first proof that such simplified versions of its real form could be used to treat real bacterial infection as the basis of a new drug. The team developed a library of synthetic versions of teixobactin by replacing key amino acids at specific points in the antibiotic's structure to make it easier to recreate. After these simplified synthetic versions were shown to be highly potent against superbug-causing bacteria in vitro - or test tube experiments.



A 'game changing' antibiotic that kills superbugs
source - lincoln.ac.uk

As well as clearing the infection, the synthesized teixobactin also minimized the infection's severity, which was not the case for the clinically-used antibiotic, moxifloxacin, used as a control study. It has been predicted that by 2050 an additional 10 million people will succumb to drug resistant infections each year. The development of new antibiotics which can be used as a last resort when other drugs are inefficient is therefore a crucial area of study for healthcare researchers around the world.

Translating the success with these simplified synthetic versions from test tubes to real cases is a quantum jump in the development of new antibiotics, and brings the researchers closer to realizing the therapeutic potential of simplified teixobactin. When teixobactin was discovered, it was groundbreaking in itself as a new antibiotic which kills bacteria without detectable resistance including superbugs such as MRSA, but natural teixobactin was not created for human use. A significant amount of work remains in the development of teixobactin as a therapeutic antibiotic for human use, the researchers are

probably about six to ten years off a drug that doctors can prescribe to patients, but this is a real step in the right direction and now opens the door for enhancing the team's in vivo analogues.

The researchers need sophisticated armor to combat antibiotic-resistant pathogens. Drugs that target the fundamental mechanism of bacterial survival, and also decrease the host's inflammatory responses are the need of the hour. The team's preliminary studies suggest that the modified peptide decreases the bacterial burden as well as disease severity, potentially enhancing the therapeutic utility this way. The team will develop a bigger library of simplified synthetic versions which can be used as a diverse number of applications, advancing the goal of a clinical drug.

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Regions:	United Kingdom
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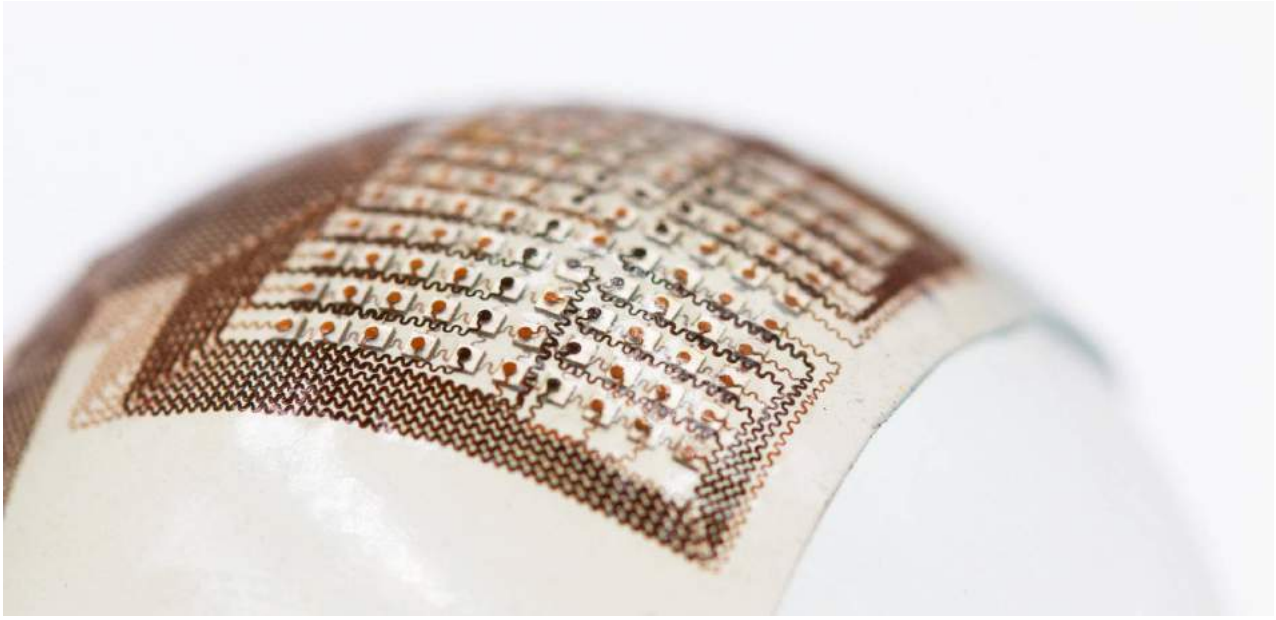
Source links:	University of Lincoln Latest News

AN ULTRASOUND PATCH MAKES IT EASIER TO INSPECT DAMAGE IN ODD-SHAPED STRUCTURES

A stretchable, flexible patch that could make it easier to perform ultrasound imaging on odd-shaped structures, such as reactor pipe elbows, turbines, engine parts, and railroad tracks - objects that are complicated to examine using conventional ultrasound equipment, has been developed by the researchers at the University of California, San Diego. The ultrasound patch is a versatile and more convenient tool to inspect machine and building parts for defects and damage deep below the surface.



Flexible patch
source - ucsd.edu

The novel device overcomes a limitation of the existing ultrasound devices, which are complicated to use on objects that don't have perfectly flat surfaces. Conventional ultrasound probes have flat and rigid bases, which can't maintain good contact when scanning across curved, wavy, angled and other irregular surfaces. That's a considerable limitation. Nonplanar surfaces are prevalent in daily routine.

Corners, elbows and other structural details happen to be the most critical areas in terms of failure - they are high stress areas. Conventional rigid, flat probes aren't ideal for imaging internal imperfections inside these areas. Oil, water or gel is typically utilized to create better contact between the probe and the surface of the object it's examining. But too much of these substances can filter some of the signals. Conventional ultrasound probes are also bulky, making them impractical for inspecting hard-to-access parts. If a car engine has a crack in a hard-to-reach location, an inspector will need to take apart the entire engine and immerse the parts in water to get a full 3D image.

The researchers have created an ultrasound probe that can work on odd-shaped surfaces without gel, oil or water. The probe is a thin patch of silicone elastomer patterned with what's called an 'island-bridge' structure. This is significantly an array of small electronic parts (islands) that are each connected by spring-like structures (bridges). The islands contain electrodes and devices called piezoelectric transducers, which produce ultrasound waves when electricity passes through them. The bridges are spring-shaped

copper wires that can stretch and bend, allowing the patch to conform to nonplanar surfaces without compromising its electronic functions.

The patch could make it easier to inspect damage deep inside odd-shaped structures
source - ucsd.edu

The patch can easily conform to odd-shaped surfaces such as pipe elbows and wheel edges
source - ucsd.edu

Researchers verified the device on an aluminum block with a wavy surface. The block contained defects two to six centimeters beneath the surface. Researchers placed the probe at different spots on the wavy surface, collected data and after that reconstructed the images. The probe was able to image the 2-millimeter-wide holes and cracks inside the block. It would be neat to be able to stick this ultrasound probe onto an engine, airplane wing or various parts of a bridge to continuously monitor for any cracks. The device is still at the proof-of-concept stage. In the future, the researchers hope to integrate

both power and a data processing function into the soft ultrasound probe to enable wireless, real-time imaging, and videoing.

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Industries:	Electronics
Source links:	UC San Diego News Center

A NEW METHOD FOR BOOSTING GROWTH OF MUSCLE AND BLOOD VESSELS

A novel way to reverse the age-related endurance muscles loss has been developed by the researchers at MIT. The study found that the compound, which re-activates longevity-linked proteins called sirtuins, promotes the growth of blood vessels and muscle, boosting the endurance of elderly mice by up to 80 percent. If the findings translate to humans, this restoration of muscle mass could help to combat some of the effects of age-related frailty, which often lead to osteoporosis and other debilitating conditions.

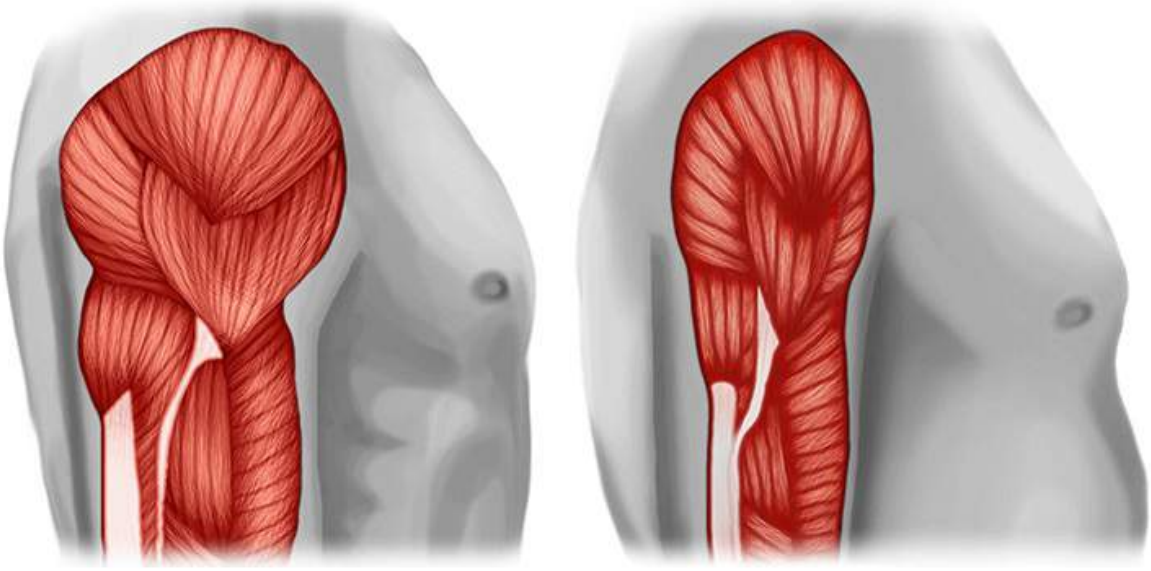
Sirtuins, a class of proteins found in nearly all animals, protect against the effects of aging in yeast. Since then, similar effects have been seen in many other organisms. In their latest study, the researchers decided to explore the role of sirtuins in endothelial cells, which line the inside of blood vessels. To do that, they deleted the gene for SIRT1, which encodes the major mammalian sirtuin, in endothelial cells of mice. They found that at 6 months of age, these mice had decreased capillary density and could run only half as far as normal 6-month-old mice.

The team reversed age-related endurance loss in mice by treating them with a compound that promotes new blood vessel growth
source - iStock.com

After that the team decided to see what would happen if they boosted sirtuin levels in normal mice as they aged. They treated the mice with a compound called NMN, which is a precursor to NAD, a coenzyme that activates SIRT1. NAD levels normally drop as animals age, which is believed to be caused by a combination of reduced NAD production and faster NAD degradation. After 18-month-old mice were treated with NMN for two months, their capillary density was restored to levels typically seen in young mice, and they experienced a 56 to 80 percent improvement in endurance. Beneficial effects were also seen in mice up to 32 months of age (comparable to humans in their 80s).

In normal aging, the number of blood vessels goes down, so people lose the capacity to deliver nutrients and oxygen to tissues like muscle, and that contributes to decline. The effect of the precursors that boost NAD is to counteract the decline that occurs with

normal aging, to reactivate SIRT1, and to restore function in endothelial cells to give rise to more blood vessels. These effects were improved when the researchers treated the mice with both NMN and hydrogen sulfide, another sirtuin activator.



The researchers may actually be able to rescue muscle mass in an aging population
source - iStock.com

The researchers also found that SIRT1 activity in endothelial cells is critical for the beneficial effects of exercise in young mice. In mice, exercise generally stimulates growth of new blood vessels and boosts muscle mass. However, when the researchers knocked out SIRT1 in endothelial cells of 10-month-old mice, after that put them on a four-week treadmill running program, they found that the exercise did not produce the same gains seen in normal 10-month-old mice on the same training plan. If validated in humans, the findings would suggest that boosting sirtuin levels may help older people retain their muscle mass with exercise. Studies in humans have demonstrated that age-related muscle loss can be partially staved off with exercise, especially weight training.

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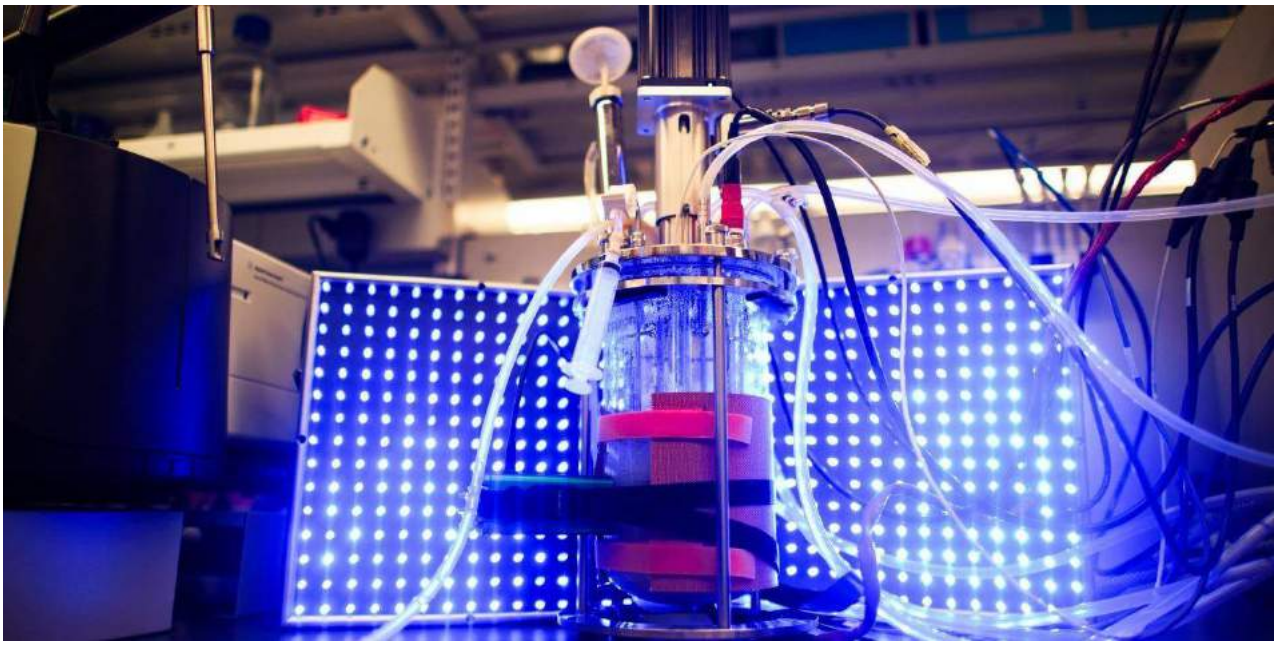
Industries:	Healthcare
Source links:	MIT News

A NEW METHOD TO TURN YEAST INTO BIOCHEMICAL FACTORIES

A novel way to control genetically-modified yeast and increase its output of commercially valuable chemicals has been developed by researchers at Princeton University. The results offer scientists a powerful new tool to probe and understand the inner working of cells. This technique allows the researchers to control the metabolism of cells in an unprecedented way. It opens the door to controlling metabolism with light.

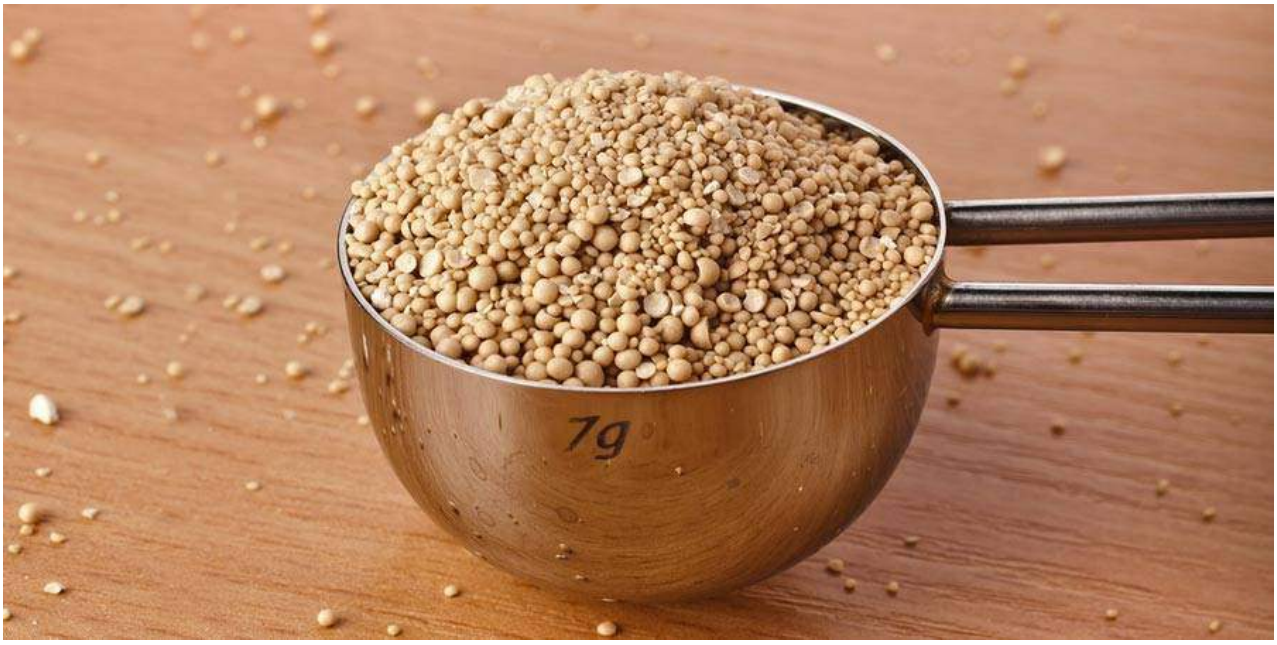
Yeast has been used for centuries to make bread, wine, and beer. Through fermentation, yeast cells transform sugar into chemicals that make bread rise and turn grape juice into wine. Using their new technique, the researchers have now used fermentation and genetically-engineered yeast to produce other chemicals including lactic acid, used in food production and bioplastics, and isobutanol, a commodity chemical and an advanced biofuel.



In experiments, researchers used light to control yeast
source - princeton.edu

Light played a key role in the experiment because it allowed the researchers to switch on genes that they had added to the yeast cells. These particular genes are sensitive to light, which can trigger or suppress their activity. In one case, turning on and off a blue light caused the special yeast to alternate between producing ethanol, a product of normal fermentation, and isobutanol, a chemical that normally would kill yeast at sufficiently high concentration.

The achievement of producing these chemicals was significant, but the researchers were intrigued by the development of light's broader role in metabolic research. It provides a new tool with the ability to do sophisticated experiments to determine how metabolism works and how to engineer it. The researchers reported that they used light to increase yeast's production of the chemical isobutanol as much as 5 times higher than previously reported levels in peer-reviewed studies. The researchers used a genetically modified strain of the yeast Saccharomyces cerevisiae in the experiments.



Yeast has been used to make bread, wine and beer for many years
source - iStock.com

Isobutanol is an alcohol used in products such as gasoline and jet fuel replacements, and plastics. With good compatibility with gasoline infrastructure, isobutanol has properties that could make it a direct substitute for gas as a vehicle fuel. However, most attempts to create isobutanol biofuel have run into difficulties involving cost or scaling production to an industrial level. Although natural yeast fermentation produces isobutanol, it does so in miniscule amounts. Instead, yeast makes high volumes of ethanol (the alcohol in beer and wine) and carbon dioxide (a gas that makes bread rise).

The researchers sought to overcome this barrier. They managed to suppress the yeast's evolutionary self-interest by genetically engineering it to produce large quantities of isobutanol. But they faced a major problem. Isobutanol is toxic to yeast and over time kills yeast colonies that produce it in any significant quantity. The researchers predicted they could use a combination of genetic engineering and light to fine tune isobutanol production. Using their light-switch technique, the researchers set out to keep the yeast alive while maximizing isobutanol production. Using light to control yeast's chemical production offers several benefits over techniques involving pure genetic engineering or chemical additives.

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Industries:	Biotechnology
Source links:	Princeton University All News

BRAIN STETHOSCOPE TO DETECT SILENT SEIZURES

A new technology that turns brain waves into sound has been developed by the researchers at Stanford University. When a doctor or nurse suspects something is wrong with a patient's heart, there's a simple way to check: put a stethoscope over the heart and listen to the sounds it makes. Doctors and nurses can use the same diagnostic tool to figure out what's going on with the lungs, stomach, heart and more, but not the brain – although that could change with a new device.

Now, the team has demonstrated that medical students and nurses, non-specialists, in other words, can listen to the brain stethoscope and reliably detect so-called silent seizures - a neurological condition in which patients have epileptic seizures without any of the associated physical convulsions.

Brain stethoscope
source - stanford.edu

This technology will enable nurses, medical students, and physicians themselves to actually assess their patient right there and they will be able to determine if the patient is having silent seizures. The desire for a brain stethoscope stems from a basic problem with treating epileptic seizures – namely, a great many of them may go undetected and untreated. Technically, a seizure is a neurological problem, in which ordinarily calm electrical brain waves go haywire. That erratic activity can cause convulsions, but not always.

People might think that all seizures must cause some sort of convulsions, namely a patient who's having a seizure must fall down and shake on the ground. But that's actually not the case, especially in critically ill patients in the intensive care units. Close to 90 percent of those patients will have silent seizures, and though not visible they can still damage the brain if they are prolonged.

On top of that, diagnosing silent seizures can be a drawn-out process, even during regular hours at a major hospital like Stanford's. First, a trained technician comes in, sets up sensors on a patient's skull to record the brain's electrical activity, after that makes a recording and sends it to a neurology specialist for analysis. By the time the diagnosis

comes in, hours may have passed. After hours or in smaller hospitals, the process can take even longer - for one thing, a technician may have to come from hours away just to set up the equipment.

The researchers needed to see if non-specialists could hear the difference between normal brain activity and a seizure. Despite having no training in the diagnosis of epilepsy, medical students and nurses were remarkably good at discerning seizures and seizure-like events from normal brain waves. The ability of an untrained medical student or nurse to read an EEG is pretty dismal - it's 50 percent. But by listening to that EEG transformed into sound, medical students and nurses could accurately detect seizures more than 95 percent of the time. Medical students and nurses also correctly identified samples with seizure-like features about three-quarters of the time and they correctly identified normal activity at similar rates.

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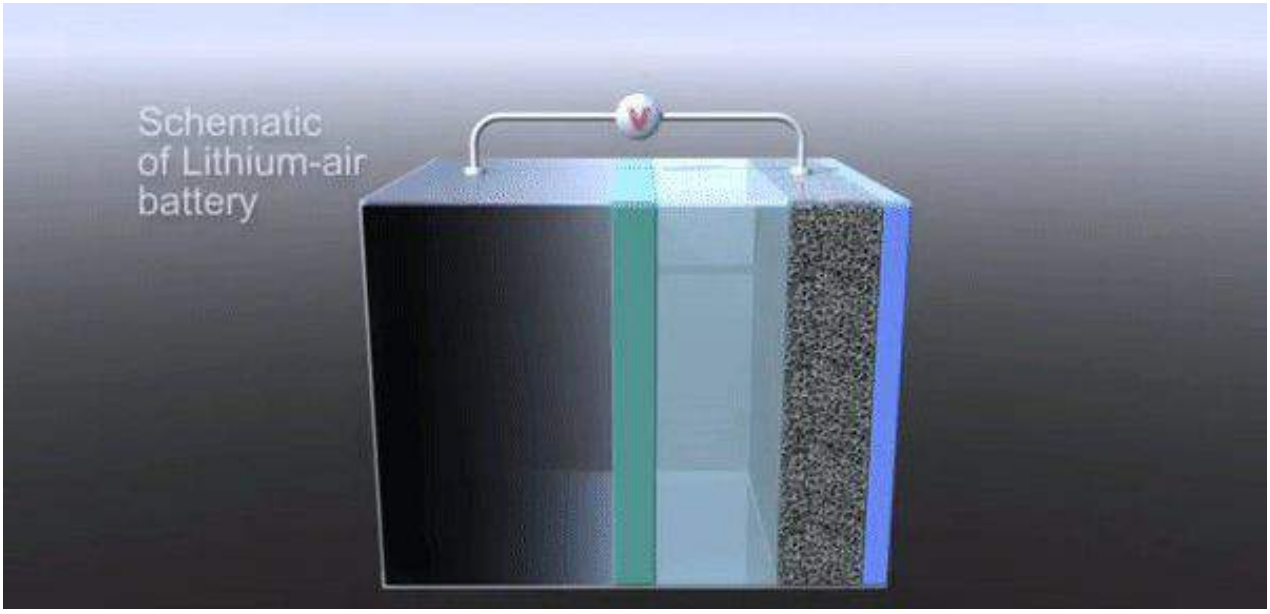
Industries:	Healthcare
Source links:	Stanford News



A NEW LITHIUM-AIR BATTERY

A novel lithium-air battery that works in a natural-air environment and still functioned after a record-breaking 750 charge and discharge cycles has been developed by the researchers at the University of Illinois at Chicago and at Argonne National Laboratory. This lithium-air battery design represents a revolution in the battery community. This first demonstration of a true lithium-air battery is an essential step toward what the researchers call 'beyond lithium-ion' batteries, but they have more work to do in order to commercialize it.

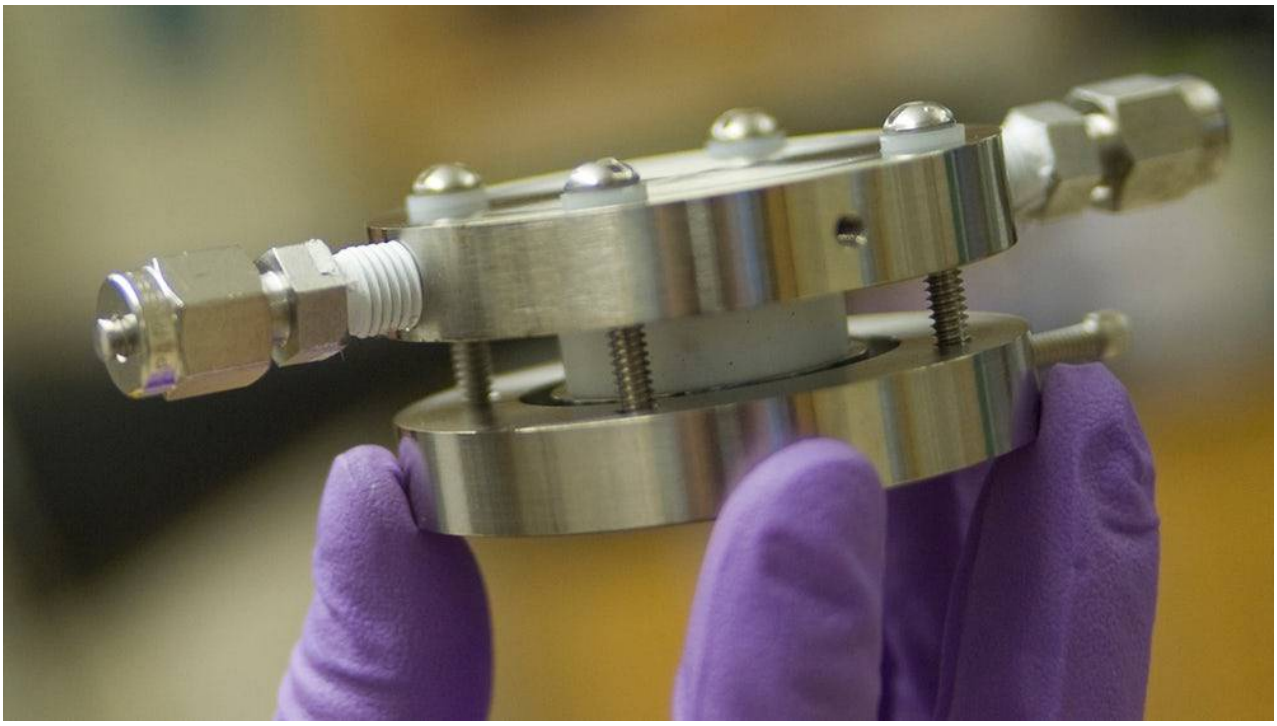
Lithium-air batteries, believed to be able to hold up to five times more energy than the lithium-ion batteries that power our laptops, phones, and electric vehicles, have been tantalizing to battery researchers for years. But several obstacles have plagued their development. The batteries would work by combining lithium present in the anode with oxygen from the air to produce lithium peroxide on the cathode during the discharge phase. The lithium peroxide would be broken back down into its lithium and oxygen compounds during the charge phase.

The experimental lithium-air battery
source - uic.edu

Unfortunately, experimental designs of such lithium-air batteries have been unable to operate in a true natural-air environment due to the oxidation of the lithium anode and production of undesirable byproducts on the cathode that result from lithium ions combining with carbon dioxide and water vapor in the air. These byproducts gum up the cathode, which over time becomes completely coated and unable to function. These experimental batteries have relied on tanks of pure oxygen, which limits their practicality and poses serious safety risks due to the flammability of oxygen.

The researchers overcame these challenges by using a unique combination of anode, cathode and electrolyte, the three key components of any battery, to prevent anode oxidation and buildup of battery-killing byproducts on the cathode and allow the battery to operate in a natural-air environment. They coated the lithium anode with a thin layer of lithium carbonate that selectively allows lithium ions from the anode to enter the

electrolyte while preventing unwanted compounds from reaching the anode.



A new design is a revolution in battery community
source - iStock.com

In a lithium-air battery, the cathode is simply where the air enters the battery. In experimental designs of lithium-air batteries, oxygen, together with all the other gases that make up air, enters the electrolyte through a carbon-based spongy lattice structure. The researchers coated the lattice structure with a molybdenum disulfate catalyst and utilized a unique hybrid electrolyte made of ionic liquid and dimethyl sulfoxide, a common component of battery electrolytes, that helped facilitate lithium-oxygen reactions, minimize lithium reactions with other elements in the air and boost efficiency of the battery. The complete architectural overhaul the researchers performed on this battery by redesigning every part of it, helped them enable the reactions they wanted to occur and prevent or block those that would ultimately cause the battery to go dead.

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Source links:	UIC News

A NEW METHOD TO PRODUCE CREAMIER, LONGER LASTING ICE CREAM

A novel way that could slow ice-cream melting, increase shelf life and potentially replace fats used to make the tasty treat has been developed by the researchers at American Chemical Society. No doubt about it, ice cream is a great treat on a hot day. That is, until it drips down the sides of a cone or turns into soup in a bowl. Now scientists believe they are closing in on a cool solution to this sticky problem. They've found that adding tiny cellulose fibers extracted from banana plant waste to ice cream could solve this problem.

These findings suggest that cellulose nanofibers extracted from banana waste could help enhance ice cream in several ways. Particularly, the fibers could lead to the development of a thicker and more palatable dessert, which would take longer to melt. As a result, this would allow for a more relaxing and enjoyable experience with the food, especially in warm weather.

Tiny fibers extracted from banana plant rachis could help slow ice cream melting
source - iStock.com

In 2016, American dairies produced more than 1.3 billion gallons of ice cream, according to the U.S. Department of Agriculture. And each year, the average American consumes about 23 pounds of this dessert, according to the International Dairy Foods Association. Despite its popularity, ice cream does have some drawbacks that food scientists have struggled to overcome. Most obviously, it can melt when exposed to heat. In recent years, researchers have tried using wood pulp extracts to tackle this issue. In 2017, scientists in Japan developed a melt-resistant ice cream based on polyphenol compounds found in strawberries. The researchers have been investigating a different approach using banana plants, which are considered waste once the fruit is harvested. In particular, the researchers wanted to determine if they could slow down melting and extend the shelf life of ice cream using a fibrous extract from banana fruit stems, or rachis.

The team of researchers extracted cellulose naoofibrils (CNFs), which are thousands of

times smaller than the width of a human hair, from ground-up banana rachis. After that they mixed the CNFs into ice cream at varying concentrations, ranging from zero up to three-tenths of a gram per 100 grams of the dessert. Using a variety of analytical tools, including a rheometer, which measures how much force is needed to move a fluid, as well as a texturometer, which measures the hardness of ice cream, the researchers evaluated the effects that CNFs had on the popular frozen treat.

The fibers could lead to a thicker and more palatable dessert, which wouldn't melt so fast
source - iStock.com

They found that ice creams mixed with CNFs tended to melt much more slowly than traditional ice creams. They also determined that CNFs could increase shelf life of ice cream, or at least decrease its sensitivity to temperature changes that occur when moved to and from the freezer. In addition, CNFs increased the viscosity of low-fat ice cream, which enhanced the creaminess and texture of the product. The team of researchers believes that CNFs could help stabilize the fat structure in ice creams. As a result, CNFs could potentially replace some of the fats, and perhaps decrease calories, in these desserts. Moving forward, the researchers plan to explore how different types of fat, such as coconut oil and milk fat, affect the behavior of CNFs in other frozen treats.

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Industries:	Food and Drink
Source links:	American Chemical Society News

MAKING FRAGRANCES LAST LONGER

A new way to get fragrances to stick to the skin longer rather than washing down the drain immediately after being applied has been developed by the researchers at American Chemical Society. From floral perfume to fruity body wash and shampoos, scents heavily influence consumer purchases. But for most, the smell doesn't last long after showering before it fades away. Companies incorporate a lot of fragrance oils in wash-off products, such as face washes and body scrubs, but the majority of these oils get washed away. The team wants to help other companies amplify the efficiency, add to the allure and make sure the integrity of the retention of these fragrance notes in their products for skin and hair.

After consumers take a shower, they want their friends and loved ones to notice whatever scent they are wearing. This is why consumers are willing to spend a lot of money on these products but many are left dissatisfied and disappointed because the scent doesn't even last the average time of a commute.The goal of this research is to increase the efficiency of the fragrance oils. Fragrance oils are expensive, and maintaining a scent is a complex process. There are three categories, the top note, middle note and base note. Each of these has a purpose, and some scents are meant to evaporate during the shower while others are meant to remain on the skin even after toweling off. These factors play a critical role in determining whether a consumer will repurchase a product.

A sensor commonly used in the food industry can detect how long fragrances last on skin
source - acs.org

To develop fragrance profiles, researchers use panels of people who have an exceptional sense of smell. But this practice is time consuming and costly. Every time a technician blends a fragrance, the oil is sent to evaluators. Each change made to the perfume means the formula must be remade and re-evaluated by the panelists until the final product is perfected. In addition, the evaluators provide an impression of the overall fragrance, so they might miss some faint fragrance notes.

To overcome this challenge, the team of researchers has adapted a device known as the twister bar headspace sorption extraction sensor, commonly used in the food industry to detect chemicals that could contribute to off-flavors or scents. The sensor absorbs trace amounts of volatile fragrances deposited on the skin after a shower. Combined with gas

chromatography-mass spectrometry, the team can gather a profile of the scents that remain on skin after rinsing off. After that, fragrance evaluators are only brought in at the last step to validate and verify the results.

A new way to get fragrances to stick to the skin longer
source - iStock.com

The researchers also looked at ways to ensure the fragrances lasted longer by mixing them with various polymers, which help the scents remain on the skin. Polymers impact different fragrances in diverse ways. By studying synthetic and naturally derived polymers, manufacturers can select the types of polymers they want to use that will correspond with the fragrance notes they want to prevail. The group used the sensor to assess which fragrances still lingered on the skin several hours after the scents were applied. The researchers plan to continue to optimize and refine these methods.

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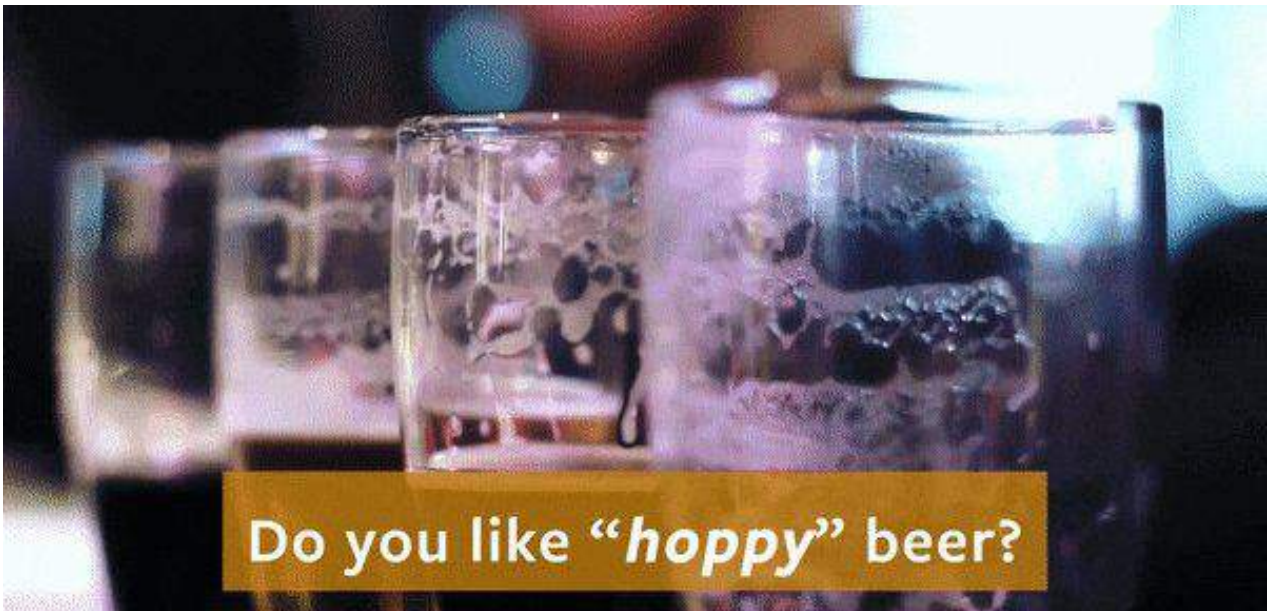
Source links:	American Chemical Society



BREWING HOPPY BEER WITHOUT THE HOPS

A novel method to create beer unique flavors and aromas without using hops has been developed by the researchers at the University of California, Berkeley. Hoppy beer is all the rвge among craft brewers and beer lovers. The researchers created strains of brewer's yeast that not only ferment the beer but also provide two of the prominent flavor notes provided by hops. In double-blind taste tests, employees of Lagunitas Brewing Company in Petaluma, California, characterized beer made from the engineered strains as more hoppy than a control beer made with regular yeast and Cascade hops.

Growing hops uses lots of water, not to mention fertilizer and energy to transport the crop, all of which could be avoided by using yeast to make a hop-forward brew. A pint of craft beer can require 50 pints of water merely to grow the hops, which are the dried flowers of a climbing plant.Hops' flavorful compounds, or essential oils, are also highly variable from year to year and plot to plot, so using a standardized yeast would allow uniformity of flavor. And hops are expensive.

A more sustainable pint of craft beer possibly coming to a pub near you
source - iStock.com

The engineered yeast strains were altered using CRISPR-Cas9, a simple and inexpensive gene-editing tool invented at UC Berkeley. The researchers inserted four new genes plus the promoters that regulate the genes into industrial brewer's yeast. Two of the genes - linalool synthase and geraniol synthase - code for enzymes that produce flavor components common to many plants. In this instance, the genes came from mint and basil. Genes from other plants that were reported to have linalool synthase activity, such as olive and strawberry, were not as easy to work with.

The two other genes were from yeast and boosted the production of precursor molecules needed to make linalool and geraniol, the hoppy flavor components. All of the genetic components - the Cas9 gene, four yeast, mint and basil genes and promoters - were inserted into yeast on a tiny circular DNA plasmid. After that the yeast cells translated the Cas9 gene into the Cas9 proteins, which cut the yeast DNA at specific points. Then yeast repair enzymes spliced in the four genes plus promoters.

The classic ingredients of beer, hops and barley, are combined with water and yeast to produce a refreshing brew source - iStock.com

The researchers utilized a specially designed program to get just the right mix of promoters to produce linalool and geraniol in proportions similar to the proportions in commercial beers produced by Sierra Nevada Brewing Company, which operates a tap room not far from the spinoff. The researchers brewed a beer from three of the most perspective strains, using hops only in the initial stage of brewing - the wort - to get the bitterness without the hoppy flavor. Hop flavor was supplied only by the new yeast strains. They also brewed a beer with standard yeast and hops, and conducted a blind comparison taste test with 27 brewery employees. This was one of very first sensory tests, so being rated as hoppier than the two beers that were actually dry-hopped at conventional hopping rates was very encouraging. In the end, the team was able to drink their research project, and continue to do so at their spinoff as they ferment batches of beer to test new strains of yeast.

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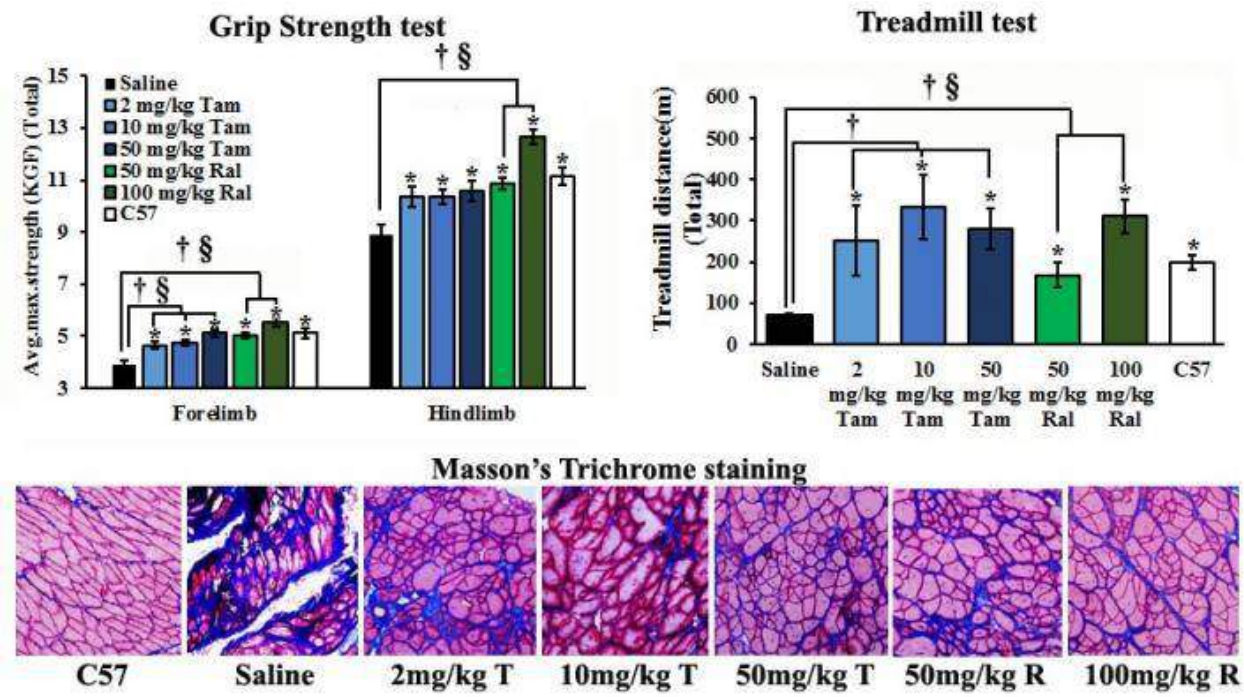
Industries:	Food and Drink
Source links:	Berkeley News

POSSIBLE LONG-TERM TREATMENT FOR MUSCULAR DYSTROPHY

A new treatment approach using the selective estrogen receptor modulators (SERMs) tamoxifen and raloxifene has been developed by the researchers at Carolinas Medical Center. It significantly enhanced cardiac, respiratory, and skeletal muscle functions and increased bone density in both male and female mice with the same gene defects as a subset of patients with MD. The results demonstrate that there are two significant advantages of tamoxifen and raloxifene treatment over steroids, which have limited benefits for patients with MD.

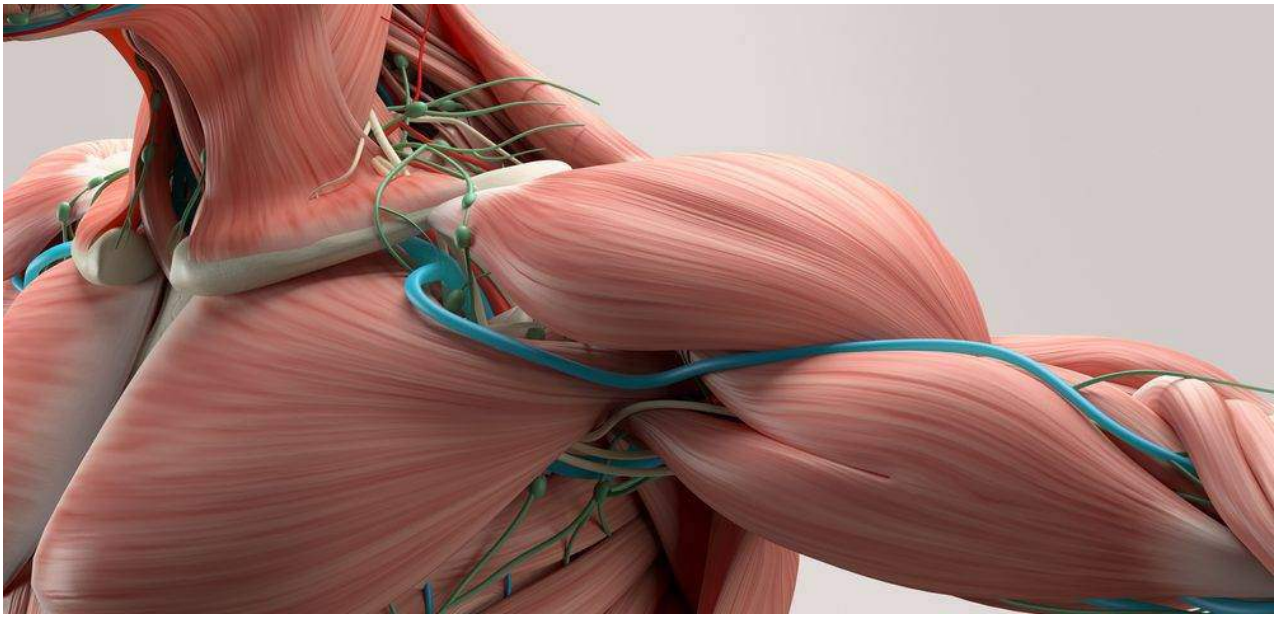
First, the SERMs improve both histology and function of all muscles, although steroids improve histology, they improve function to a much lesser extent. Second, SERMs enhance bone density, whereas steroids exacerbate osteoporosis and increase the risk for fractures. The mice used in this study have the identical gene defects and show almost the same disease manifestation as patients with MD and are therefore an excellent model for therapeutic evaluation. Investigators administered tamoxifen (2, 10, or 50 mg/kg), raloxifene (50 or 100 mg/kg), or saline to mutant mice with dystroglycanopathy, a form of MD, for up to a year, beginning at three weeks of age.



This is the effect of one year of tamoxifen and raloxifene treatment on muscle function
source - carolinashealthcare.org

The investigators found several indicators that tamoxifen and raloxifene delay or even halt disease progression. Within one month, treatment with either SERM reduced muscle pathology with significant reduction in the numbers of degenerating fibers. After a year, control mice demonstrated high variation in fiber size with focal inflammatory infiltrations, but these dystrophic changes were much less evident after tamoxifen or raloxifene. A noticeable reduction in collagen accumulation in limb muscles for all treatment groups and controls was observed. Importantly, treatment with SERMs clearly mitigates muscle damage and enhances functions of both respiratory and cardiac muscles in addition to the limb muscles.

Other advantages were also observed. Control mice showed progressive muscle degeneration and regeneration in the diaphragm, accompanied by increasing fibrosis and infiltration, as well as significant impairment in respiration. Both tamoxifen and raloxifene eliminated focal infiltration and reduced the extent of fibrosis in the diaphragm, increased mass, and improved breathing ability. Both treatments also improved bone density in the tibia and femur, potentially reducing the risk of fracture, a major threat to patients as MD progresses. These histological changes were accompanied by functional improvements. For instance, SERM treatment improved grip strength of both forelimb and hindlimb muscles and enhanced running ability on a treadmill test depending on the dose.



A new approach increased bone density
source - shutterstock.com

Sex-related differences in the effects of tamoxifen and raloxifene warrant careful consideration if the drugs are to be administered clinically for MD. This is not surprising since SERMs act on estrogen receptors and interact both as estrogen-receptor agonists and antagonists. SERM therapy has great potential to significantly delay or halt MD progression.

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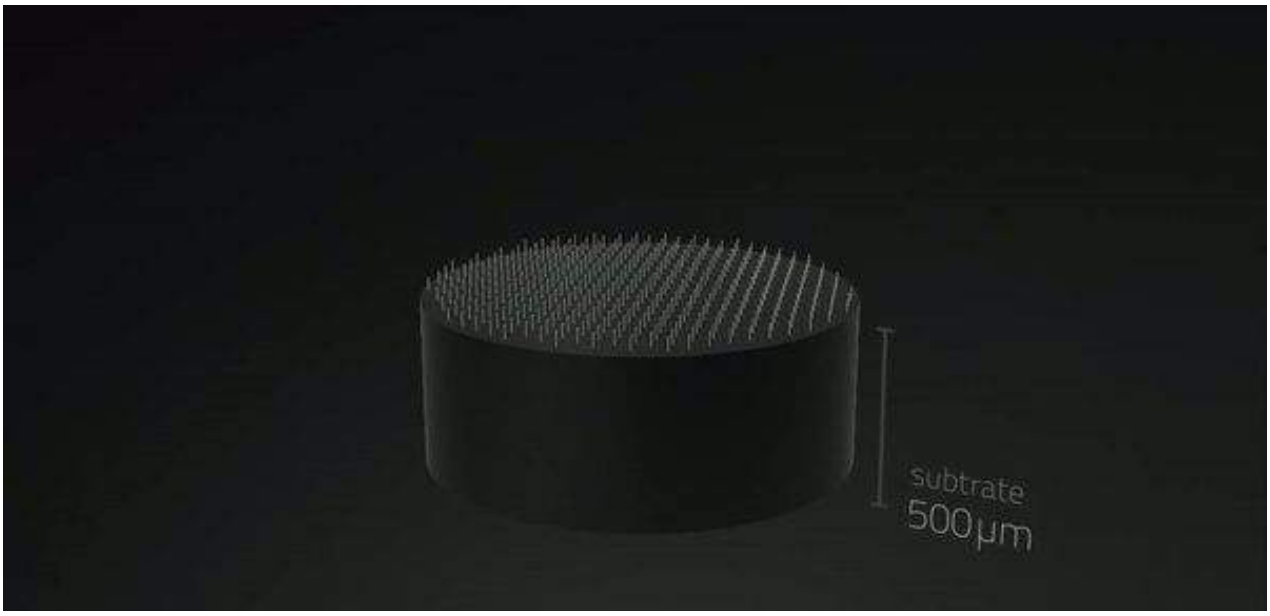
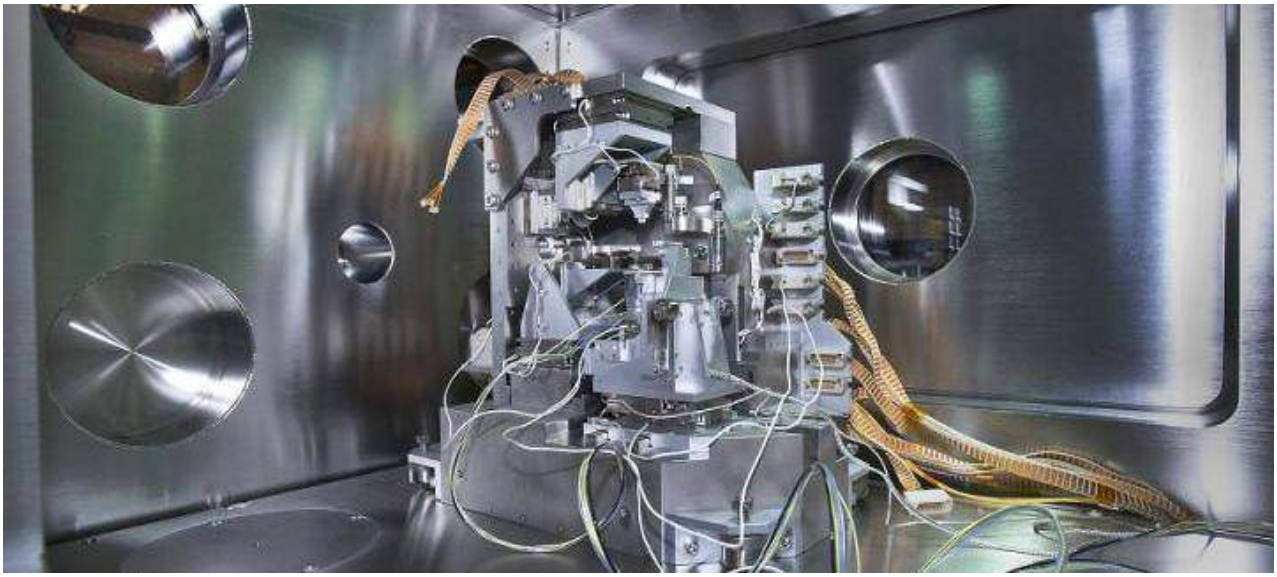
Industries:	Healthcare
Source links:	Carolinas Medical Center News



A NEW WAY TO GAUGE THE GROWTH OF NANOWIRES

A novel method of measuring the growth of nanowires has been developed by the researchers at Argonne National Laboratory. The researchers observed the formation of two kinds of defects in individual nanowires, which are smaller in diameter than a human hair. These nanowires, made of indium gallium arsenide, could be helpful for a wide range of applications in a field scientists have termed optoelectronics, which encompasses devices that work by converting light energy into electrical impulses. Fiber optic relays are a good example.

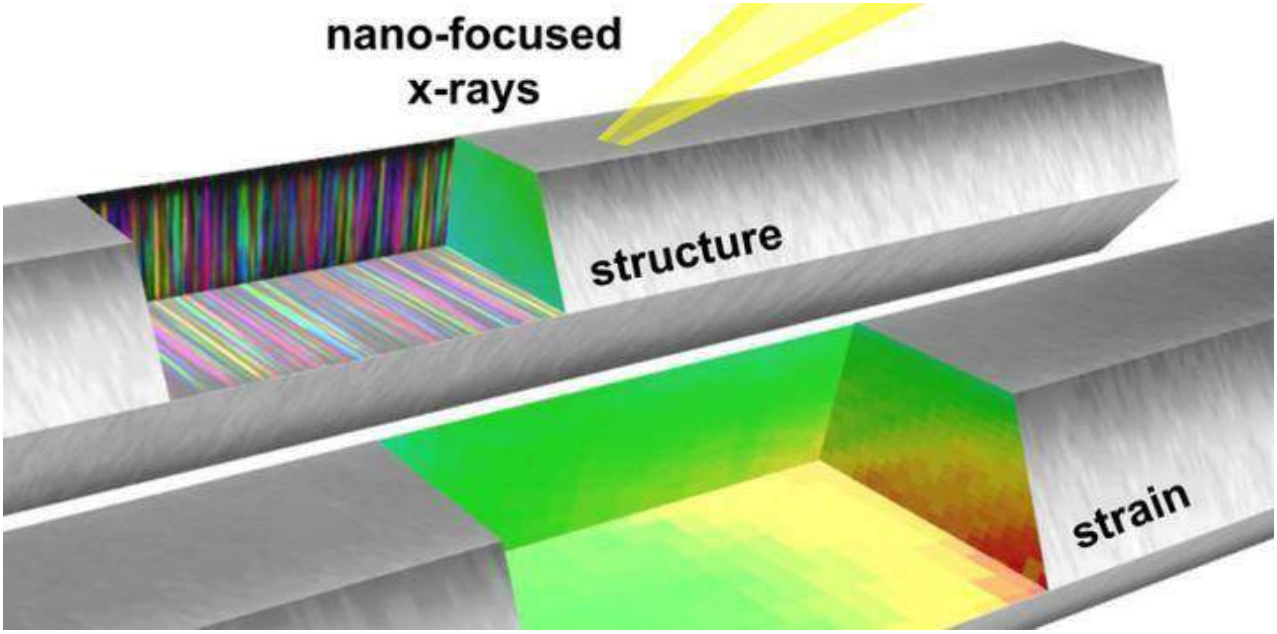
The effectiveness of these devices can be affected by small defects in their compounds. These defects, which can change both the optical and electronic properties of these materials, interest scientists who look for tailoring them to boost the functionality of future optoelectronics, including materials that will be able to manipulate quantum information.



Researchers used this instrument to observe the nanowire defects
source - anl.gov

In the study, the team, which also involved collaborators from Northwestern University and two European universities, observed two kinds of defects in a single nanowire. The first kind of defect, caused by strain, affects the entire nanowire, preventing it from growing perfectly straight. The second kind of defect, called a stacking fault, occurs close to the atomic level, as individual planes of atoms are laid down to lengthen the nanowire.

To visualize the difference between stacking faults and strain, shuffling a deck of cards can be used. A stacking fault occurs when a card from the deck is shuffled imperfectly, as if two cards come from the right hand before one can come from the left. Because stacking faults and strain occur at such different scales, understanding how they interact to change a nanowire's characteristics requires scientists to use sophisticated imaging technology and complex mathematical algorithms. By using a technique called Bragg ptychography to observe the defects, the researchers developed a method they could use to see the nanowire within its operating environment.



The researchers observed two kinds of defects forming in individual nanowires
source - anl.gov

The team has developed a technique that allows them to investigate the actual local structure in the material. The method provides a missing link between nanoscale defect structure and variations in strain on longer length scales that will enable the researchers to better control the optoelectronic properties of nanowires.

In Bragg ptychography, researchers shine an X-ray beam at a series of overlapping spots all over the material, like a stagehand slowly moving a spotlight across a stage. Rather than having to use a spot-by-spot grid-based approach as done in earlier ptychographic studies, the researchers could move their X-ray beam around more freely, collecting helpful information from across their sample. This flexibility has another benefit: it allows researchers to illuminate smaller features using a smaller spot size. These zone plates are a diffractive optic that consists of several radially symmetric rings, called zones, which alternate between opaque and transparent. They are spaced so that light transmitted by the transparent zones constructively interferes at the desired focus.

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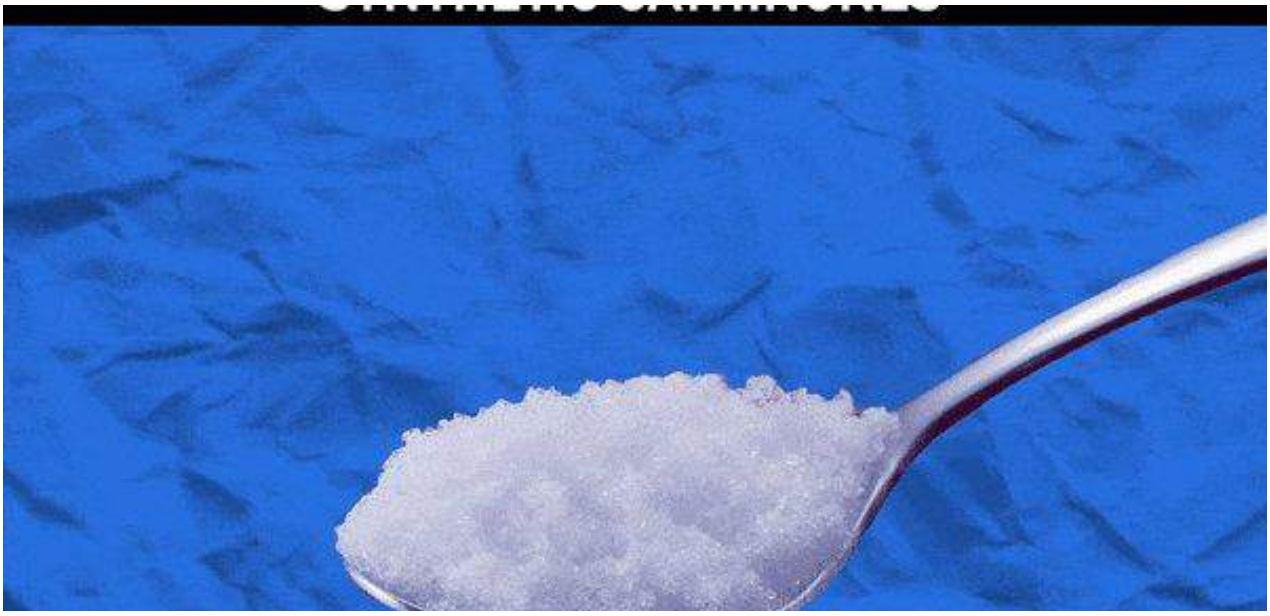
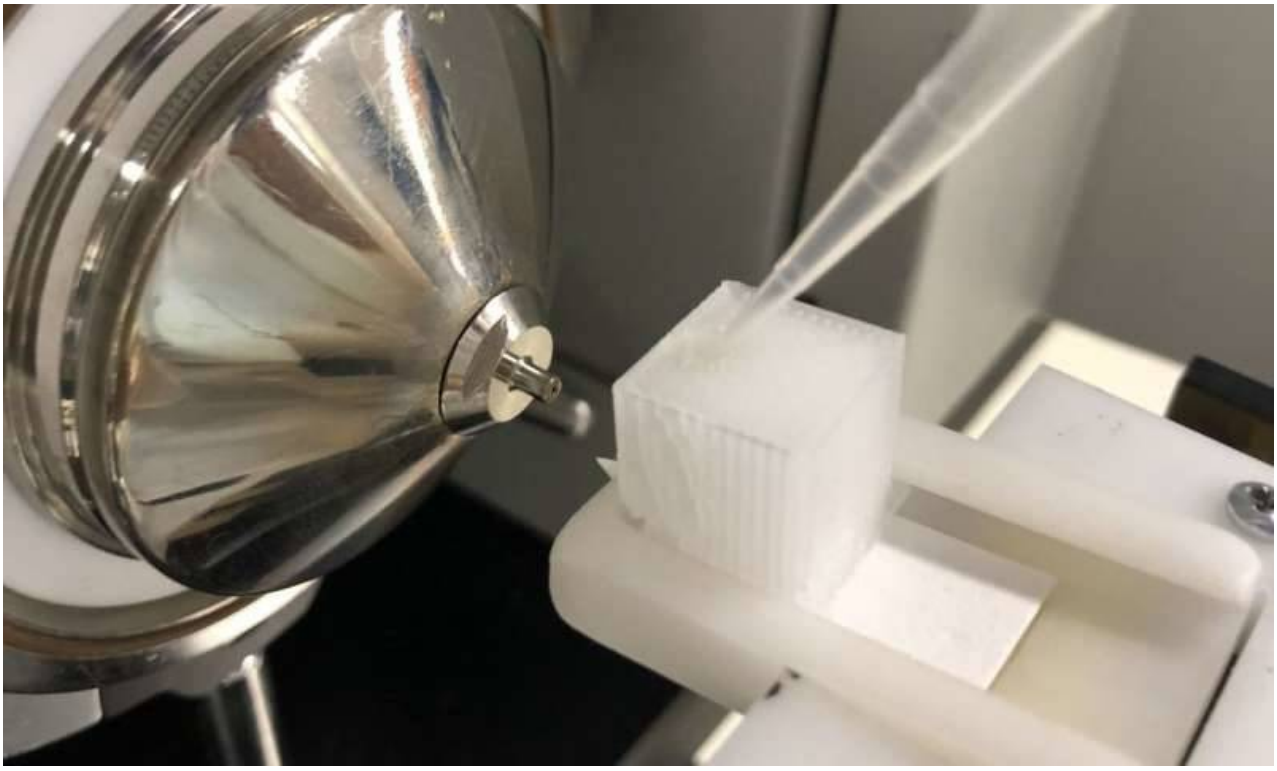
On market since:	-
Regions:	United States
Industries:	Electronics
Source links:	Argonne National Laboratory News Room



IDENTIFYING 'DESIGNER' DRUGS TAKEN BY OVERDOSE PATIENTS

A novel test that can identify drugs has been developed by the researchers at American Chemical Society. Drug overdoses are taking a huge toll on public health, with potent synthetic drugs posing a particular threat. Medical professionals are scrambling to meet the growing demand for emergency room treatment, but they're hampered by the lack of a quick and easy test to screen patients for these ‘designer’ drugs. Chemists have now developed such a test and are refining it with the hope that hospitals could over time use it to choose the appropriate treatment.

Hospitals can test for some drugs, like methamphetamine or cocaine, and those tests are pretty fast. But for the new drugs, like fentanyl and synthetic cannabinoids, they would have to collect a blood sample and ship it to a toxicology lab. They wouldn't get the results back for weeks. In a life-or-death situation, that won't work, so they never do the test. The team hopes their developmental screening system could someday be used in emergency departments to identify the drugs responsible for a patient's overdose within one or two minutes.



Drugs released from the test cartridge are identified by a mass spectrometer
source - acs.org

The need is clearly growing. Overdose deaths from all opioids, which are responsible for two-thirds of drug overdose deaths, more than doubled from 2006 to 2016, according to the U.S. Centers for Disease Control and Prevention. More specifically, the impact of synthetic opioids such as the prescription painkillers fentanyl and tramadol is even more devastating, with deaths increasing six-fold over that same period.

The new test could help medical staff counter these trends. The main component is a small, inexpensive and relatively simple disposable cartridge that contains a solid-phase extraction medium. When a small amount of plasma is placed on the cartridge, the medium pulls any drugs out of the plasma and concentrates them. The drugs are removed

from the extraction medium by a drop of solvent, and after that they are ionized to produce an array of molecular fragments. Each type of drug produces a different assortment of fragments that serve as a distinctive chemical signature for that particular compound. A mass spectrometer detects the fragments. The whole process takes less than five minutes.

Hospitals can test for some drugs, like methamphetamine or cocaine, and those tests are pretty fast
source - shutterstock.com

With the device, the researchers are analyzing blood samples from Indianapolis emergency room patients who appeared to have overdosed on drugs. At the ACS meeting, the team is announcing their first results on those clinical samples. The test successfully identified drugs in the samples, including fentanyl and its synthetic analogs, synthetic cannabinoids, and traditional drugs such as methamphetamine and lorazepam. That's a major achievement because some of these drugs are so potent that users only take a tiny amount, so the drug concentration in blood is very low. In some cases, the test couldn't distinguish between drugs with very similar molecular structures. To enhance those distinctions, the researchers are adjusting the way they analyze data from the mass spectrometer.

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Regions:	United States
Industries:	Healthcare
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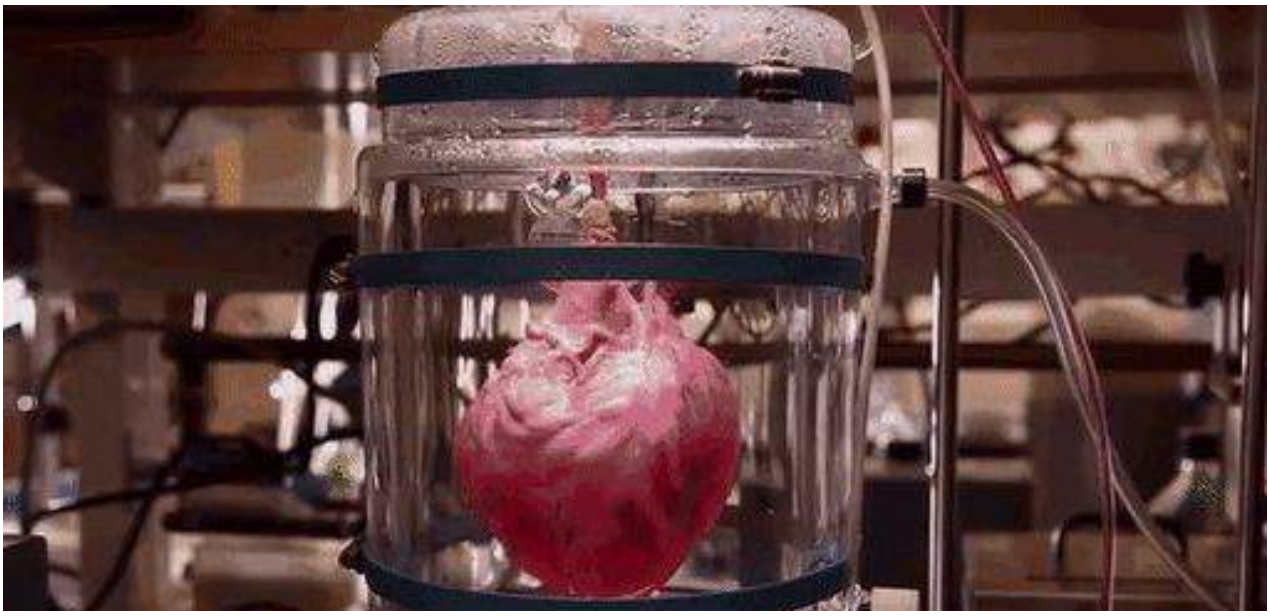


3-D TISSUE MODEL OF DEVELOPING HEART FOR DRUG SAFETY TESTING FOR PREGNANT

A process that combines biomaterials-based cell patterning and stem cell technology to make a 3D tissue model that could mimic early stage human heart development has been developed by the researchers at Syracuse University. The heart is the first organ to develop in the womb and the first cause of concern for many parents. The researchers have been working with human induced pluripotent stem cells to study tissue regeneration, regenerative medicine and stem cell engineering. This type of stem cell has the ability to generate all the different cells in a human body, because it was derived from humans.

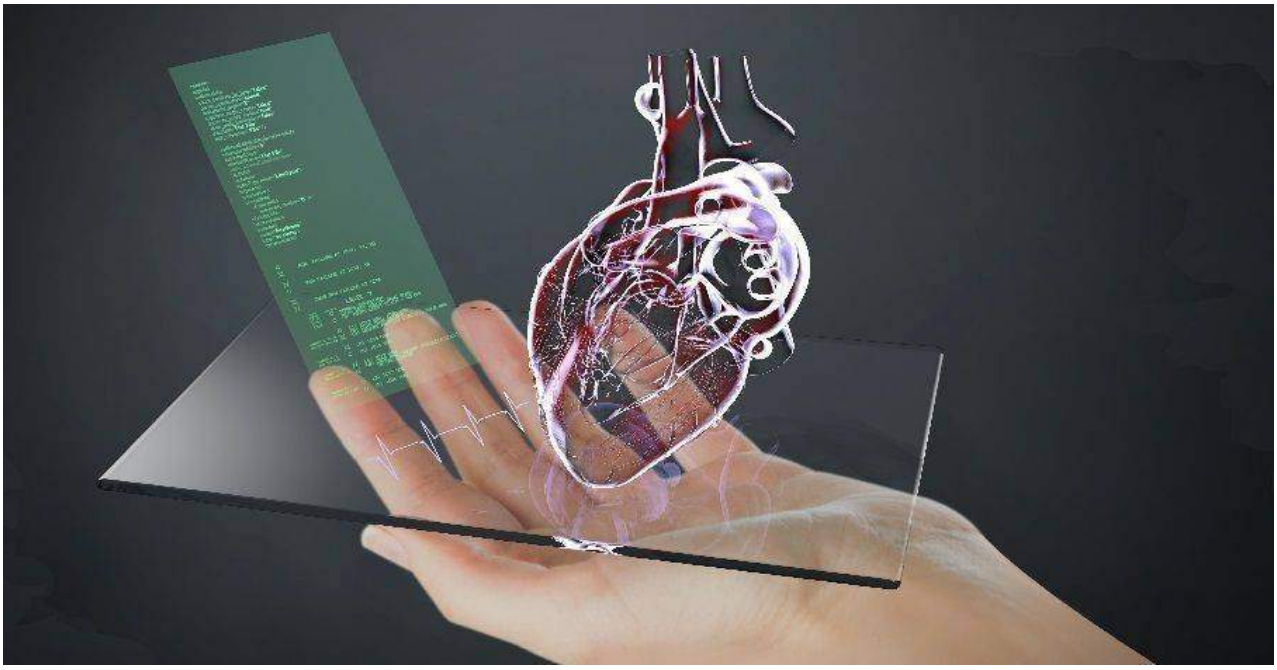
For expecting mothers, the excitement of pregnancy is often offset by anxiety over medication they require. Parents and doctors often have to consider the mother's health as well as the potential risk regarding how medication could affect their baby. The U.S. Food and Drug Administration requires certain drugs to be labeled with pregnancy exposure and risk. Some drugs are labeled to show that testing on animals has failed to demonstrate a risk but there are no adequate and well-controlled studies of pregnant women.

New technology can aid safety testing on expecting mothers
source - shutterstock.com

By starting with a layer of polymer in a tissue culture dish and etching tiny patterns in the polymer, the stem cells will only attach within those patterns. Since the stem cells do not attach to the polymer, they grow within the patterns and over time develop into a three-dimensional structure that has distinct tissue types. The process developed by the team of researchers focused on cardiac tissue but other labs could adapt it to other tissue types and even organ tissues. The platform allows tissue to form during the cell differentiation process instead of building tissue out of already established heart cells. Tissue that forms during the differentiation process has more layers and more accurately represents how tissue naturally develops in humans. Using the cell lines the researchers use, they are human based so the researchers know they will affect human tissue in a certain way as opposed to the uncertainty that comes with an animal model.

Some pregnant women avoid taking drugs they need to manage chronic conditions but if the mother's health suffers, that can also affect her baby. More reliable test results could

provide more confidence for both patients and doctors. Embryotoxicity is just one potential use of the modeling platform developed by the team. Countless other human tissues could also be cultured using the process. It could also allow for individualized drug toxicity testing for humans. Different people can have different reactions to the same drug but personalized testing using someone's stem cells could help determine if a drug is safe for them before they take it.



3-D tissue model of developing heart
source - shutterstock.com

The traditional way of screening, they take a patient history and after that test a patient on a drug for a month or two and they assess again the patient after that. By using this model the researchers can test for multiple drugs at once so if there is a series of drugs that will potentially benefit the patient, the team can test all of them at once as opposed to one at a time that takes longer.

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On market since:	-
Regions:	United States
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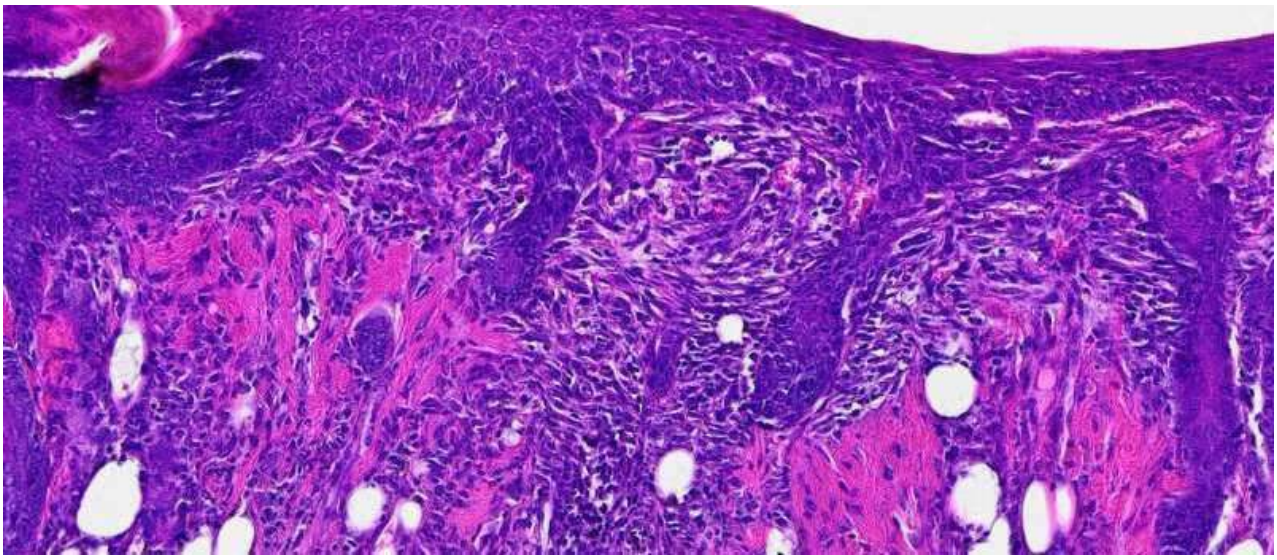
Source links:	Syracuse University

NANOFIBER DRESSINGS HEAL WOUNDS AND PROMOTE REGENERATION

The novel wound dressings that significantly accelerate healing and enhance tissue regeneration have been developed by the researchers at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) and the Wyss Institute for Biologically Inspired Engineering. The two different types of nanofiber dressings, described in separate papers, use naturally-occurring proteins in plants and animals to promote healing and regrow tissue. This fiber manufacturing system was developed specifically for the purpose of developing therapeutics for the wounds of war.

Wounds incurred before the third trimester left no scars. This opened a range of possibilities for regenerative medicine. But for decades, researchers have struggled to replicate those unique properties of fetal skin. Unlike adult skin, fetal skin has high levels of a protein called fibronectin, which assembles into the extracellular matrix and promotes cell binding and adhesion. Fibronectin has two structures: globular, which is found in blood, and fibrous, which is found in tissue. Even though fibrous fibronectin holds the most promise for wound healing, previous research focused on the globular structure, in part because manufacturing fibrous fibronectin was a major engineering challenge.



Hair follicle regeneration
source - seas.harvard.edu

The researchers made fibrous fibronectin using a fiber manufacturing platform called Rotary Jet-Spinning (RJS), developed by Parker's Disease Biophysics Group. RJS works likes a cotton candy machine - a liquid polymer solution, in this case globular fibronectin dissolved in a solvent, is loaded into a reservoir and pushed out through a tiny opening by centrifugal force as the device spins. As the solution leaves the reservoir, the solvent evaporates and the polymers solidify. The centrifugal force unfolds the globular protein into small, thin fibers. These fibers, less than one micrometer in diameter, can be collected to form a large-scale wound dressing or bandage. The dressing integrates into the wound and acts like an instructive scaffold, recruiting different stem cells that are relevant for regeneration and assisting in the healing process before being absorbed into the body.

A new wound dressing promotes faster regeneration
source - shutterstock.com

In vivo testing, the researchers discovered that wounds treated with the fibronectin dressing showed 84 percent tissue restoration within 20 days, compared to 55.6 percent restoration in wounds treated with a standard dressing. The researchers also demonstrated that wounds treated with the fibronectin dressing have close to normal epidermal thickness and dermal architecture, and even regrew hair follicles, often considered one of the biggest challenges in the field of wound healing.

This is an essential step forward. Most work done on skin regeneration to date involves complex treatments combining scaffolds, cells and even growth factors. The researchers were able to demonstrate tissue repair and hair follicle regeneration using an entirely material approach. The group demonstrated a soy-based nanofiber that also enhances and promotes wound healing. Both kinds of dressing have advantages in the wound-healing space.

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Patent status:	+
On market since:	-
Regions:	United States
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Source links:	Harvard John A. Paulson SEAS News

ULTRASHORT LASER PULSES MAKE GREENHOUSE GAS REACTIVE

A novel way to create a highly reactive form of carbon dioxide with the help of laser pulses has been developed by the researchers at the University of Bonn. It is a long-cherished dream - eliminating the inert greenhouse gas carbon dioxide from the atmosphere and using it as a basic material for the chemical industry. This could address two major problems at once by containing climate change and at the same time reducing the dependence on oil.

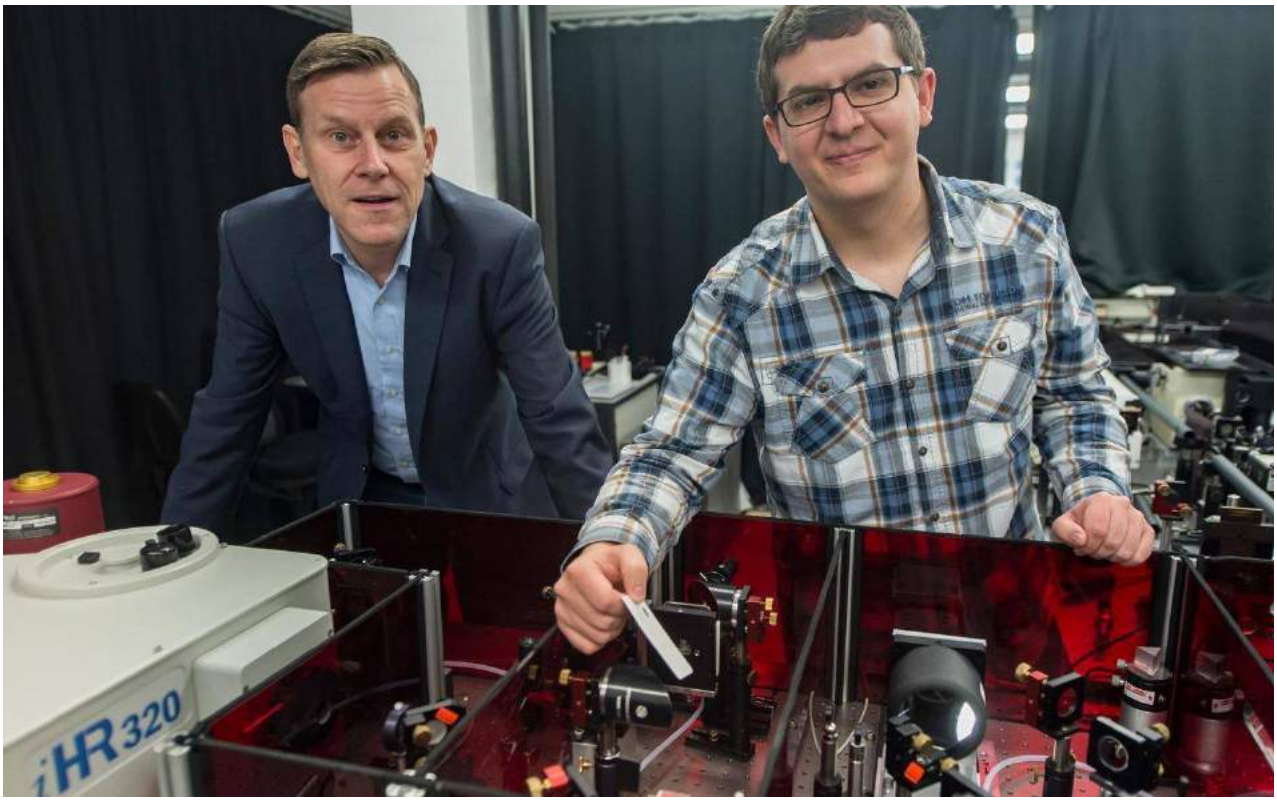
The researchers have discovered a novel way of generating a highly reactive variant of the inert and hard-to-bind greenhouse gas. The team used a so-called iron complex. The center contains a positively charged iron atom, to which the constituents of the carbon dioxide are already bound multiple times. The scientists shot ultrashort laser pulses of ultraviolet light onto this iron complex, which broke certain bonds. The resulting product was a so-called carbon dioxide radical, which also forms new bonds with a certain radicality.

Researchers use light to produce a highly reactive variant of carbon dioxide
source - shutterstock.com

Such radicals have a single electron in their outer shell that urgently wants to bind permanently to another molecule or atom. It is this unpaired electron that distinguishes the reactive radical anion bound to the central iron atom from the inert carbon dioxide and makes it pespective for chemical processes. The radicals could, in turn, be the building blocks for interesting chemical products, such as methanol as a fuel, or urea for chemical syntheses, and salicylic acid as a pain medication.

With their laser and infrared spectrometer, a large apparatus in the basement of the institute, the scientists watch the molecules at work. The spectrometer measures the characteristic vibrations of the molecules, and this ‘fingerprint’ allows them to identify the bonds between different atoms. The formation of the carbon dioxide radical within the

iron complex changes the bonds between the atoms, which decreases the frequency of the characteristic carbon dioxide vibration.



The team of researchers
source - uni-bonn.de

With forensic instinct, the scientists were able to prove that the laser pulses really do produce the reactive carbon dioxide radical. First, the team simulated the vibrational spectra of the molecules, after that compared the calculations to the measurements. The result is simulation and experiment were indeed an excellent match. Like a ‘molecular motion picture’, the spectrometer took ‘snapshots’ in the unimaginable temporal resolution of millionths of a billionth of a second. On the basis of the spectra, which correspond to the individual images of a film, that is why it can be revealed - essentially in slow motion - how the iron complex deforms under pulsed laser illumination over several stages, the bonds break up and finally the radical is formed.

These findings have the potential to fundamentally change ideas about how to extract the greenhouse gas carbon dioxide from the atmosphere and use it to produce significant chemical products. The results provide clues as to how such a catalyst would have to be designed.

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Patent status:	-
On market since:	-
Regions:	Germany
Industries:	Chemicals, Environment
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