Easy way to read genome

Researchers from University of Connecticut have easily sequenced the RNA of the most complicated gene known in nature, using a hand-held sequencer (MinION nanopore).

Shortest electron bunches produced

The shortest electron bunches ever produced have emerged in research by scientists at the University of Strathclyde.

The bunches were produced by focusing a high-power laser pulse into a supersonic helium gas jet. These bullets of charged particles have a length that is one 300th of the breadth of a hair and travel at a speed close to that of light. They are also 10 times shorter than those produced from conventional accelerators, crazychucks.com said.

extremetech.com

The Strathclyde research group is leading efforts to take advantage of plasma, the ubiquitous medium that makes up most of the universe, to make the significant scientific breakthrough. The work is part of the ALPHA-X (Advanced Laser-based Accelerators towards X-rays) project, led by Professor Dino Jaroszynski of Strathclyde's Department of Physics, which aims to create the first tabletop attosecond coherent X-ray source.

Jaroszynski said: "Plasma is completely broken down matter, which is separated into positively charged ions and very light and mobile electrons that respond easily to laser fields.

"This new research builds on the earlier pioneering results of the ALPHA-X project, in which laser-driven plasma waves are used to accelerate electrons to high energies, much in the same way as a surfer gains momentum from a sea wave and eventually out-surfs the wave."

One of the challenges faced by Jaroszynski and his team was to measure the duration of the very brief electron bunches from the laser wakefield accelerator. By passing the electron bunch through an ultra-thin aluminum foil, and measuring the spectrum of the light emitted from the foil as the electrons pass through it, they established that the electron bunch duration was much shorter than initially expected. The light emitted from the foil is known as Coherent Transition Radiation, which is emitted when electrons in the foil are kicked by the electrostatic field of the electron bunch as they pass by.

Researchers discover zombie solar cells

A group of researchers at Uppsala University has discovered a zombie solar cell that continues to generate electricity with unexpected effectiveness although the liquid transferring charges between the electrodes has dried out.

PHYSORG

The discovery was made by Gerrit Boschloo's group at the Department of Chemistry-Ångström Laboratory, Division of Physical Chemistry. When the researchers tested old dye-sensitized solar cells, also known as Grätzel cells, these were still active, despite the fact that the electrolyte conducting electricity between the minus and plus poles had evaporated, geekjournal.net reported.

"The dried-out solar cells worked in some cases even better than when they were liquid-filled and alive. The power conversion efficiency of specific cells had increased to eight percent, which is a record for dye-sensitized solar cells with a solid hole conductor. Our post-doc Marina Freitag who produced and studied the solar cells named them 'zombie solar cells' since they were alive although they should be dead," laughed Gerrit Boschloo.

In a Grätzel cell, an electrically conductive liquid facilitates a flow of electrons with the use of substances that can give away or take up electrons, a so called redox couple. But when this liquid dried out in 'zombie solar cell', a solid hole conducting structure was created, continuing to transport positive charge.

However, this only occurs with certain copper based redox couples. Gerrit Boschloo also pointed out that dye-sensitized solar cells with solid hole conductors have been developed before, but that the high efficiency of this 'zombie cell' had taken the researchers by surprise. To ensure the result, the project was repeated under controlled conditions.

"But it turned out to be quite difficult to produce the cell in the way we usually produce solid state solar cells. The best option was to instead make a liquid-based cell and letting it dry out slowly in order to achieve the right structure."

The advantage of a solar cell without liquid is that it hopefully becomes more stable. When the solar cell is in a solid state, it is much easier and cheaper to seal. This reduces the risk for the cell to leak and corrode the surrounding material.

Scientists convert algae into battery electrodes

DAILY MAIL

Last August, the seasonal harmful algal blooms (HABs) in Lake Erie grew so extreme that they poisoned the water system in Toledo, Ohio, leaving nearly half a million residents without drinking water. But a few researchers at the time collected some of the toxic HABs, and have now shown that, by heating them at temperatures of 700-1000°C in argon gas, the HABs can be converted into a material called 'hard carbon' that can be used as high-capacity, low-cost electrodes for sodium-ion (Na-ion) batteries.

"Harmful algal blooms, caused by cyanobacteria (or so called 'blue-green algae'), severely threaten humans, livestock, and wildlife, leading to illness and sometimes even death," Dr. Da Deng, lead author and professor at Wayne State University in Detroit, told Phys.org.

As Deng explained, Na-ion battery technology is still in its infancy compared to Li-ion batteries. One of the challenges in developing Na-ion batteries is to find a reliable electrode material. While graphite is often used in the electrodes of Li-ion batteries, the larger Na-ions do not fit as well into the graphite structure as the smaller Li ions do. Instead, Na-ions fit better into hard carbon, which is more disordered than graphite and contains a greater number of large defects and voids that can store the larger Na-ions.

This study is the first time that HABs (specifically blue-green algae) have been directly converted into carbon for Na-ion batteries. HABs have advantages in that they grow quickly and don't require land or soil. And as the researchers showed here, HABs can easily be converted into hard carbon by simple heat treatment, without the need for purification or other additional processes.

After heating the algae, the researchers made the electrodes out of a mixture of 80 percent hard carbon derived from algae, 10 percent carbon black (to enhance conductivity) and 10 percent binder. After drying this slurry overnight, they assembled it into coin cells with sodium foil as the counter electrode. Tests showed that the electrodes start out with a high capacity of up to 440 milliAmpere hours per gram (mAh/g), but suffer from an irreversible capacity loss after the first cycle, bringing the capacity down to about 230 mAh/g. The electrodes then have good capacity retention from the second cycle onward.

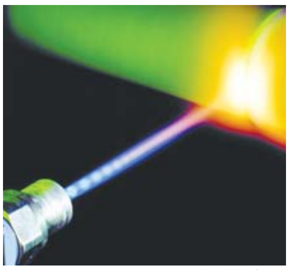
Using optical fiber to generate a two-micron laser

Lasers with a wavelength of two microns could move the boundaries of surgery and molecule detection. Researchers at Ecole polytechnique fédérale de Lausanne (EPFL)) in Switzerland, have managed to generate such lasers using a simple and inexpensive method.

In recent years, two-micron lasers (0.002 millimeter) have been of growing interest among researchers. In the areas of surgery and molecule detection, for example, they offer significant advantages compared to traditional, shorter-wavelength lasers.

A team of Camille Brès at EPFL showed a way to design these lasers at a lower cost, by changing the way optical fibers are connected to each other. Thanks to the new configuration, they were able not only to produce very good two-micron lasers, but also to do without an expensive and complex component that is normally required, sciencenewsline.com wrote.

Two-micron spectral domain has potential applications in medicine, environmental sciences and industry. At these wavelengths, the laser light is easily absorbed by water molecules, which are the main constituents of human tissue.



theoriginof.com

Two-micron lasers are also very useful for detecting key meteorological data over long distances through the air. Not to mention that they are highly effective in the processing of various industrial materials.

To create a two-micron fiber-laser, light is usually injected into an optical-fiber ring containing a gain region which amplifies two-micron light. The light circulates in the ring, passing through the gain region many times thus gaining more and more power, until becoming a laser. For optimal operation, these systems include a costly component called isolator, which forces the light to circulate in a single direction.

At PHOSL, researchers built a thulium-doped fiber laser that works without an isolator. Their idea was to connect the fibers differently, to steer light instead of stopping it. "We plug a kind of deviation that redirects the light heading in the wrong direction, putting it back on track," said Camille Brès.

This means no more need for the isolator, whose job is to stop light moving in the wrong direction, sort of like a traffic cop. "We replaced the traffic cop with a detour," said Svyatoslav Kharitonov, the lead author.

Scientists paint quantum electronics with beams of light

A team of scientists from the University of Chicago and the Pennsylvania State University have accidentally discovered a new way of using light to draw and erase quantum-mechanical circuits in a unique class of materials called topological insulators.

In contrast to using advanced nanofabrication facilities based on chemical processing of materials, this flexible technique allows for rewritable optical fabrication of devices. This finding is likely to spawn new developments in emerging technologies, such as low-power electronics based on the spin of electrons or ultrafast quantum computers, according to newsunited.com

"This observation came as a complete surprise," said David D. Awschalom, Liew Family Professor and deputy director in the Institute of Molecular Engineering at UChicago. "It's one of those rare moments in experimental science where a seemingly random event — turning on the room lights — generated unexpected effects with potentially important impacts in science and technology."

The electrons in topological insulators have unique quantum properties that many scientists believe will be useful for developing spin-based electronics and quantum computers. However, making even the simplest experimental circuits with these materials has proved difficult because traditional semiconductor engineering techniques tend to destroy their fragile quantum properties. Even a brief exposure to air can reduce their quality.

The researchers report the discovery of an optical effect that allows them to tune the energy of electrons in these materials using light, and without ever having to touch the material itself. They have used it to draw and erase p-n junctions — one of the central components of a transistor — in a topological insulator for the first time.

The researchers found that the surface of strontium titanate, the substrate material on which they had grown their samples, becomes electrically polarized when exposed to ultraviolet light, and their room lights happened to emit at just the right wavelength. The electric field from the polarized strontium titanate was leaking into the topological insulator layer, changing its electronic properties.

Awschalom and his colleagues found that by intentionally focusing beams of light on their samples, they could draw electronic structures that persisted long after the light was removed.