INTERNATIONAL

Solar cell with high efficiency

A collaborative project between the U.S. Department of Energy's National Renewable Energy Laboratories and researchers from two Swiss centers has tested a range of multi junction cells in tandem configuration, and achieved efficiencies of up to 35.9%. These researchers from the U.S. Department of Energy's National Renewable Energy Laboratories (NREL), the Swiss Center for Electronics and Microtechnology (CSEM) and the École Polytechnique Fédérale de Lausanne (EPFL) have been testing a variety of materials based on III-V elements, in stacked, tandem configurations with silicon bottom cells.

As their latest progress a dual-junction solar cell, combining an NREL-engineered gallium arsenide (GaAs) top cell and a silicon heterojunction cell developed by CSEM, was measured at 32.8%, while a triple junction cell also incorporating a layer of indium gallium phosphate (GaInP) achieved 35.9% efficiency.

Efficiency of 32.8% represents a new record high for dual-junction III-V/Si solar cells, breaking the same research group's previous record of 29.8% set in 2016. "This achievement is significant because it shows, for the first time, that silicon based tandem cells can provide efficiencies competing with more expensive multi-junction cells consisting entirely of III-V materials," says NREL scientist Adele Tamboli. "It opens the door to develop entirely new multi-junction solar cell materials and architectures."

NREL goes on to note that, if costs for a III-V solar cell cannot be brought down to these levels, then cheaper materials will need to be sought. The researchers still stress though, that this breakthrough serves as proof of concept for the use of silicon cells in tandem with other high efficiency materials, and the researchers mention that CSEM is also studying the use of perovskite to optimize solar's cost/efficiency ratio.

https://pv-magazine-usa.com

ASIA-PACIFIC

INDIA

New technology to manufacture biofuel

Researchers at Indian Institute of Technology (IIT) Kharagpur have developed a new technology that will make biofuel manufacturing process cheaper, quicker and pollution-free. The 'soil-to-soil' manufacturing technology developed at the P.K. Sinha Centre for bio-energy at IIT-Kgp is in the process of being patented, an IIT-KGP spokesperson said.

"2gm bioethanol can be produced from various naturally available ligno-cellulosic components. But to do so it needs to be treated chemically. Because of chemical treatment the process contributes to polluting the environment," professor in Department of Agricultural and Food Engineering, Dr. Rintu Banerjee said. Lignocellulose refers to plant dry matter (biomass). "We have replaced this chemical treatment with enzymes which degrade the lignin specifically there by making the manufacturing process pollution free," Banerjee said.

"The technique that we are suggesting will ensure relatively quicker production of biofuel and that the process is completely green thereby not creating any secondary pollution. This, we feel can change the future of biofuel manufacturing in India and make it more cost effective," Banerjee said.

http://www.livemint.com

Device mimics leaf to create fuel

Scientists have developed an artificial leaf that absorbs sunlight to generate hydrogen fuel from water, an advance that may provide clean energy for powering eco-friendly cars in the future. The ultra-thin wireless device mimics plant leaves to produce energy using water and sunlight. "It is known that hydrogen generation from renewable resources will be the ultimate solution to our energy and environment problems," said Chinnakonda S Gopinath, a senior principal scientist at the Council of Scientific and Industrial Research (CSIR)-National Chemical Laboratory in Pune.

The device consists of semiconductors stacked in a manner to simulate the natural leaf system. When visible light strikes the semiconductors, electrons move in one direction, producing electric current. The current almost instantaneously splits water into hydrogen - which researchers believe is one of the cleanest forms of fuel as its main byproduct is water.

In view of pressing energy and environmental issues, it was important to produce hydrogen from natural resources such as sunlight and water, Gopinath said. "In the present work, we have made an attempt to generate solar hydrogen. The preparation method reported is simple and practicable and hence there is a very good possibility of scaling it up," he said.

The research, published in the *Scientific Reports*, an online, open-access journal from the publishers of Nature, states that the device of an area of 23 square centimetres could produce 6 litres of hydrogen fuel per hour. The work has been produced in the lab so far and a lot was still needed on the project, he said.

http://www.business-standard.com

Catalyst to make biofuel

Scientists from the Indian Institute of Technology (IIT) Jodhpur, have shown that oil extracted from algae can be converted into diesel by using sand from Rajasthan. "We have developed a catalyst using sand, nickel and cobalt to convert algae oil into diesel," said Dr Rakesh Kumar Sharma, head of chemistry department at the IIT, who pioneered the study. Dr Vineet K Soni, a post-doctoral fellow, assisted Dr Sharma on the project.

"What we have developed is low cost because sand is abundant and nickel and cobalt are cheap metals. We have shown at the laboratory level that the cost of biodiesel produced using this technology will be half the current price of the fuel," the scientist said.

The two scientists, who worked on the innovation, received rave reviews at the 'Bioenergy Urja Utsav' in Pune organized by the Union Ministry of Petroleum last week. Dr Sharma said he has published the innovation in American Chemical Society's Sustainable Chemistry and Engineering, a top international journal of chemistry, in May this year

Will this innovation work only with sand from Rajasthan? Dr Sharma said sand has two types of structure at the nano level — pillar and layered. "Rajasthani sand can be tuned for both types of structures. For the current study, pillared clay has been used. We filled nano particles of nickel and cobalt between those pillars to make the catalyst. So this will work with any sand which has pillar structure," he explained.

http://www.hindustantimes.com

JAPAN

Electricity from ocean currents

Scientists have developed a new turbine that can harness energy from ocean currents to produce low-cost and sustainable electricity. Researchers from the Okinawa Institute of Science and Technology Graduate University (OIST) in Japan began a project titled "Sea Horse," which aims to harness energy from the Kuroshio ocean current that flows from the eastern coast of Taiwan and around the southern parts of Japan.

It uses submerged turbines anchored to the sea floor through mooring cables that convert the kinetic energy of sustained natural currents in the Kuroshio into usable electricity, which is then delivered by cables to the land. The initial phase of the project was successful. However, the OIST researchers also desired an ocean energy source that was cheaper and easier to maintain.

Tetrapods concrete structures shaped somewhat like pyramids that are often placed along a coastline to weaken the force of incoming waves and protect the shore from erosion - "Thirty per cent of the seashore in mainland Japan is covered with tetrapods and wave breakers," said Tsumoru Shintake from OIST.

Replacing these with "intelligent" tetrapods and wave breakers with turbines attached to or near them, would both generate energy as well as help to protect the coasts, researchers said. "Using just one per cent of the seashore of mainland Japan can generate about 10 gigawats of energy, which is equivalent to 10 nuclear power plants," Shintake said. In order to tackle this idea, the OIST researchers launched The Wave Energy Converter (WEC) project in 2013. It involves placing turbines at key locations near the shoreline, such as nearby tetrapods or among coral reefs, to generate energy. Each location allows the turbines to be exposed to ideal wave conditions that allow them not only to generate clean and renewable energy, but also to help protect the coasts from erosion while being affordable for those with limited funding and infrastructure.

The turbines themselves are built to withstand the forces thrust upon them during harsh wave conditions as well as extreme weather, such as a typhoon. The blade design and materials are inspired by dolphin fins - they are flexible, and thus able to release stress rather than remain rigid and risk breakage. The supporting structure is also flexible, "like a flower. The stem of a flower bends back against the wind," Shintake said.

The turbines too bend along their anchoring axes. They are also built to be safe for surrounding marine life - the blades rotate at a carefully calculated speed that allows creatures caught among them to escape. Researchers have completed the first steps of this project and are preparing to install the turbines for their first commercial experiment. The project includes installing two WEC turbines that will power LEDs for a demonstration.

http://www.firstpost.com

Flexible, water proof solar cell

Scientists have developed a new type of water-proof solar cell which can provide electricity even after being soaked in water or stretched and compressed. The finding could open the way for wearable solar cells, which will provide power to devices such as health monitors incorporated into clothing, researchers said. These could include sensors that record heartbeats and body temperature, for example, providing early warning of medical problems, they said.

Researchers, including those from the University of Tokyo in Japan, developed extremely thin and flexible organic photovoltaic cells, coated on both sides with stretchable and waterproof films, based on a material called PNTz4T. They deposited the device in an inverse architecture onto a one-micrometre-thick parylene film. The ultra-thin device was then placed onto acrylic-based elastomer and the top side of the device was coated with an identical elastomer, giving it a coating on both sides to prevent water infiltration.

The elastomer, while allowing light to enter, prevented water and air from leaking into the cells, making them more long-lasting than previous experiments. The researchers then subjected the device to a variety of tests, finding first that it had a strong energy efficiency. To test its resistance to water, they soaked it in water for two hours, and found that the efficiency decreased by just 5.4 per cent.

To test the durability of the solar cell, they subjected it to compression, and found that after compressing by nearly half for twenty cycles while placing drops of water on it, it still had 80 per cent of the original efficiency. "We were very gratified to find that our device has great environmental stability while simultaneously having a good efficiency and mechanical robustness," researchers said. The study was published in the journal *Nature Energy*.

http://www.firstpost.com

REPUBLIC OF KOREA

Solar cell out of flourine

A group of Republic of Korean scientists have developed highly stable and cheap solar cells made out of flourine, a state-run institute said. The team led by Kim Jin-young from the Ulsan National Institute of

Science and Technology (UNIST) developed the edged-selectively fluorine functionalized graphene nanoplatelets with structure of perovskite solar cells that can achieve a stability of 82 percent.

A perovskite solar cell is a type of cell which includes a perovskite structured compound, considered a next-generation technology with the potential of achieving even higher efficiency. However, low instability and high production costs have been cited as factors that block such technology from becoming commercially viable.

"This study overcame weakness of perovskite solar cells that have high efficiencies but low stability," Kim said, adding that the technology would help the commercialization of the solar cells. Their findings were published in the latest edition of the journal, "*Nano Letters*."

http://english.yonhapnews.co.kr

EUROPE

GERMANY

Multicrystalline solar cell

Fraunhofer Institute for Solar Energy Systems ISE has achieved a record conversion efficiency for lab-sized multicrystalline solar cells of 22.3%. Fraunhofer ISE said that its researchers had succeeded in decreasing the efficiency gap with monocrystalline solar cells, pushing beyond the magical threshold of 22%, confirming greater prospects of multicrystalline materials and solar cells reaching their maximum potential.

As a starting material, the researchers used hyperpure polysilicon from Wacker Chemie with an optimized plasma texture dubbed, 'Tunnel Oxide Passivated Contact Technology (TOPCon),' developed at Fraunhofer ISE for back side contacting. The TOPCon technology is known for applying electrical contacts over the entire rear surface of the cell without patterning, which reduces charge-carrier losses and leads to higher electrical efficiencies.

Martin Hermle, Department Head of Advanced Development of High-Efficiency Silicon Solar Cells at Fraunhofer ISE said, "The key to our success was the holistic approach which enabled us to optimize all steps, from the crystallization up to the individual solar cell fabrication processes. The close and continual cooperation between the characterization, crystallization and the solar cell technology research teams at ISE allowed us to reduce the loss mechanisms step by step and successfully develop an optimized process chain."

The new world record solar cell will be presented at the European Photovoltaic Solar Energy Conference (EUPVSEC) on September 28, 2017 in Amsterdam by Dr. Jan Benick in his talk "Approaching 22% Efficiency with Multicrystalline n-Type Silicon Solar Cells."This record was said to have been achieved within the 'multiTOP' project, which ran until March 2017 and was financed by the German Federal Ministry for Economic Affairs and Energy BMWi.

https://www.pv-tech.org

NORWAY

Cheaper biofuel from trees

Filling your gas tank with biofuels made from soybeans or corn is controversial. But researchers at the Norwegian University of Life Sciences have developed an approach that could result in a cheaper, more effective way to fuel your car. In an article published this week in the journal Nature Chemical Biology, a research group at the Norwegian University of Life Sciences (NMBU) describes a key process in an enzyme discovered at the university in 2010. This process could lead to a new and cheaper way of making biofuel from trees.

In 2010, researchers at NMBU discovered a new method of breaking down the cellulose in trees and plants. At the time, the method was hailed as a breakthrough in part because it was much faster than previous methods. The discovery was based on a brand new class of enzymes called LPMOs. Today, LPMOs are widely used in modern bioethanol production. The enzymes make the breakdown of cellulose from wood and other plant residues much more effective. This creates what is called second-generation bioethanol. Nevertheless, commercial companies that want to use the method face major challenges. The problem is that LPMOs can be unstable and difficult to control in a large-scale industrial context.

The new method that NMBU researchers discovered does not need oxygen to work. Instead, it can use cheap and readily available hydrogen peroxide. By controlling the supply of hydrogen peroxide, it has also become much easier to stabilize and control the entire process. The researchers believe that this will allow the conversion of cellulose to sugar on a much larger scale than before. Part of the surprise in the researchers' findings is that they go against the conventional understanding among biochemists regarding how LPMOs break down cellulose.

According to a press release from NMBU, scientists have in fact discovered a whole new type of chemistry in the breakdown of cellulose. They believe this approach can be used in biofuel production, and have already started discussing collaborative projects with industrial partners.

http://sciencenordic.com

SPAIN

Efficient production of hydrogen

A team of Scientists from the Universitat Jaume I de Castelló, the Institute of Chemical Technology of the Universitat Politècnica de València-CSIC and the University of Zaragoza, coordinated by Professor José Antonio Mata of the UJI, have created and patented an innovative process for efficient production, storage and safe transportation of hydrogen for use in fuel cells via the use of chemical reagents. The new technology is based on the use of liquid hydrogen organic carriers (LOHC). The Researchers have explored different hydrogen-bearing organic liquids in order to attain a novel hydrogen storage system

based on a chemical coupling reaction between an alcohol and a hydrosilane catalyzed by a ruthenium compound supported in graphene.

With respect to the already established systems, the contributions of the new process are multiple. Firstly, it is a chemically versatile process because various combinations of alcohols and hydrosilanes can be used. Secondly, the process can be carried out very fast and elevated temperatures are not required because the Researchers have also developed ruthenium catalysts that are extremely efficient for this reaction. Thirdly, the process is reversible as the product formed in the coupling between an alcohol and a hydrosilane is a silyl ether that can be transformed further into the original product by a reductant.

Among its key benefits, it forms an energy system whose only by-product is water and, at the same time, it is reversible, by enabling users to store and produce hydrogen according to requirement. It can be easily customized to non-static energy generation and employ systems, such as automobiles; the use of silane-alcohol as LOHC allows operation at low temperatures in achieving the gas and the technology avoids the safety problems of hydrogen storage.

There are four large blocks involved in the overall energy generation process. The first one is production and its challenge would be to achieve hydrogen from alternative energies such as wind or solar, in a quasi-sustainable method; as that would be desirable that the by-products derived were obtained in an industrial center where the generation was fully controlled. In the second (transportation) and third (distribution) blocks, which do not require any innovation in the scientific or industrial field, the proposed system could employ the existing infrastructure for both transportation and distribution of petroleum products. The fourth block contemplates the chemical reaction for achieving hydrogen and its use in fuel cells. The initial results showed that the reaction is very fast and can occur even at room temperature, which corresponds to sufficient kinetics for the production and immediate use of hydrogen.

http://gearsofbiz.com

NORTH AMERICA

USA

Solar power to produce clean fuels

Researchers at the Lawrence Berkeley National Laboratory have developed a new system that can generate fuel using solar power. The new system represents reaching another milestone in efforts to use renewable energy to produce sustainable fuels. Researchers based their efforts on several previews endeavors, many of which involved mimicking photosynthesis in order to turn sunlight into electrical power. This electricity is then used to trigger chemical reactions.

According to researchers, this new system is the first of its kind that has successfully demonstrated that it can convert these fuel precursors into actual, usable fuels. Currently, the fuels that the new system is able to produce are ethanol and ethylene. Researchers note that these fuels are generated at energy conversion rates that rival naturally occurring processes.

http://www.hydrogenfuelnews.com

Solar-thermal conversion

Researchers at Columbia Engineering, along with colleagues at the Department of Chemistry at Columbia University, and Stanford University have developed a new, scalable, and low-cost "dip and dry" method for fabricating a solar absorber (SSA) that can harness and convert sunlight to heat for use in a wide range of energy-related applications, from heating water and generating steam to residential heating. The team, led by Yuan Yang, explained the methods used in a paper published in the August 28, 2017, issue of *Advanced Materials*.

Working with instruments and facilities in Columbia Engineering laboratory space and the Columbia Nano Initiative (CNI), the researchers were able to fabricate metal-based plasmonic SSAs using an inexpensive process that can tune the SSAs to suit different operating conditions.

With its wide angle, the SSA addressed another long-standing problem faced by solar-absorbing surfaces: the ability to absorb sunlight throughout the day from sunrise to sunset. In tests, the resulting SSAs showed a significantly higher solar absorption at all angles (~97% absorption when the sun is above, ~80% when near the horizon) than existing designs.

https://www.renewableenergymagazine.com

Low-cost battery for storing renewable energy

A new low-cost, high-performance battery could provide an inexpensive storage solution for solar power, which is abundant during the day but must be stored for use at night. Developed by Stanford chemistry Professor Hongjie Dai and doctoral candidate Michael Angell, the battery is nonflammable and contains electrodes made from abundant aluminum and graphite. Its electrolyte's main ingredient, urea, is already industrially produced by the ton for plant fertilizers.

In 2015, Dai's lab was the first to make a rechargeable aluminum battery. This system charged in less than a minute and lasted thousands of charge-discharge cycles. The lab collaborated with Taiwan's Industrial Technology Research Institute (ITRI) to power a motorbike with this older version, earning Dai's group and ITRI a 2016 R&D 100 Award. However, that version of the battery had one major drawback: it involved an expensive electrolyte.

The newest version includes a urea-based electrolyte and is about 100 times cheaper than the 2015 model, with higher efficiency and a charging time of 45 minutes. It's the first time urea has been used in a battery. According to Dai, the cost difference between the two batteries is "like night and day." The team recently reported its work in *Proceedings of the National Academy of Sciences*.

http://news.stanford.edu