College of Engineering, Adoor
Department of Mechanical Engineering

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Invisible solar cells

Years after the Paris Climate agreement, countries have continued to innovate on the quest to make a smooth exit from non-renewable energy and to switch to Renewable energy sources for electricity. A new study in Journal of Power Sources from Incheon National University, Korea demonstrates how they have made the first fully transparent solar cell. Led by Professor Joondong Kim, the new study boasts of their newly discovered innovative technique, specifically in the cell's heterojunction- the making of crystalline, thin films that is responsible for absorbing the light. This solar panel then converts the absorbed light into electricity. According to thestudy, it was through the combination of nickel oxide semiconductors and titanium dioxide that an effective and fully transparent solar cell has been made.

An Earth-Friendly Electricity for Tomorrow

Titanium dioxide (TiO2), being an efficient semiconductor is already currently being used in solar panel technology.Not only is it effective, but also non-toxic and environment friendly since it is an abundant element in Earth. Nickeloxide (NiO), on the other hand, is also a semiconductor with high optical transparency features. It is alsomanufactured at low industrial temperatures. The combination of this two makes for an excellent discovery of atransparent solar panel that is environment friendly, and easy to use.

According to ScieTechDaily, solar energy always had the highest hopes of making a reliable and sufficient energysource among other renewable sources such as wind, water, waves. This is also the reason why much research anddevelopment has been invested in solar energy. For years now, solar energy has been made more affordable andenvironment friendly, alongside its effective capacity to convert UV into electricity. Thus, more and more peoplehave been switching to solar energy for different homes and establishments. Not only is it cost-effective, it is also anoble cause that contributes to a carbon-free future.

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Solar Energy Made More Accessible

However, current solar cells have been limited in their integration to daily use do to their opaque qualuries. Solarpanels can only be seen in roofs, remote areas, and places that are hidden to the public eye. the recent study by theresearch team Journal of Power Sources in Korea has made a huge leap making the first fully transparent cell. Theidea is to be able to integrate it into windows, buildings, and even mobile phones in the future. With this, solarenergy will be made more accessible for public use.The unique features oftransparent photovoltaic cells could have various applications in human technology. When this discoveryprogresses, we could have more applications for solar energy.

Although this was not the first discovery for transparent solar cells, Prof. Kim's team was a pioneer for integratingthis to solar energy panels. The study, being very promising could lead us to very hopeful path for tomorrow's newsource of electricity.

State-of-the-art of Underwater Robotics

Submersible robotics have long been used to explore the underwater environment, especially for energy exploration and production and the inspection of major infrastructure, such as bridges, dams, pipelines, oil rigs, military applications, and communication structures. Underwater infrastructure is a vital part of national security that is commonly at risk, especially those elements that are exposed to harsh and corrosive ocean environments.

Using robotics to conduct underwater inspections is far safer and less expensive than using human divers. They also provide complete, detailed imagery, real-time data for 3D modeling, better precision in detecting structural weaknesses, and improved access to previously unreachable areas, such as inside pipes.

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Types of Underwater Robots

A variety of underwater robots have emerged over the last few decades to meet these challenging underwater tasks,

·**UUV**: Unmanned underwater vehicles travel in a single direction and are highly efficient at mapping large areas of seafloor.

·**ROVs**: Remotely operated vehicles are designed for omni-directional manoeuvring and are often externally powered and tele-operated using a tether cable. They are commonly used to inspect offshore structures.

·**AUVs**: autonomous underwater vehicles are typically untethered, manoeuvre themselves, and often have grasping and manipulation capabilities.

Autonomy Is Trending

The dominant trend in underwater robotics is towards autonomy instead of remote control by a human or pre-programmed trajectories.“Nowadays we are seeing more built-in autonomy that can react to the specific conditions on-site,” said Michael Kaess, associate research professor in robotics at Carnegie Mellon University.AUVs are increasingly equipped with new abilities, such as on-board feature detection, mapping, and autonomous adaptation to sensed features. Adaptation is still not standard, but it is easier to integrate than it was ten years ago. Perhaps the most exciting advancement is the development of autonomous gateways and docks for the exchange of data, a big step toward building resident autonomous systems on the seafloor, in water as deep as 3,000 meters to 4,000 meters.

A seafloor resident ROV or AUV system would remain on the seafloor and be controlled from a shore base. In 2019, Saab Seaeye, an underwater robotics company, successfully docked an AUV to a subsea docking station to recharge its batteries and download data. Underwater charging was completed with inductive connectors instead of pins—another advancement.

Essential for a seafloor resident system is the development of optic modems and high-frequency acoustics modems that “provide higher-bandwidth communications links over tens to hundreds of meters so that direct connection is not required,” said Fischell.

New sensing technologies are also being developed to improve situational awareness when underwater robots are working in close proximity to subsea structures.

What happens next?

Underwater robotics is expanding rapidly and the growth of offshore wind farms will greatly increase the need for monitoring via seafloor resident systems. Steel structures and supports, cables, and anchoring systems must all be closely monitored for corrosion.“Swarming” is a new concept for mapping that many think will be faster, more efficient, and less costly for underwater mapping projects. Instead of using a single, more expensive underwater robot to cover an area of the ocean, hundreds or even thousands of smaller, lower-cost robots can be synchronized to cover the same area in much less time. “Creating swarms of underwater vehicles will require three key technologies: inexpensive vehicles, inexpensive sensors, and a navigation/command and control scheme that allows vehicles to remain together in an area while collecting data.

Other technologies in the pipeline that might revolutionize how AUVs operate include optic and high-frequency acoustic modems (for short-range high-bandwidth communications) and situational awareness/command and control software packages. Artificial intelligence (AI) will also play a larger role in underwater robotics, where AI might actually take over the role of the ROV pilot, who tele-operates an underwater robot and evaluates its imagery.

Along these lines, there is likely to be continued momentum toward untethered vehicles and more intelligent and capable manipulation and physical intervention performed by these vehicles. The pinnacle would be reaching a point where the construction and/or decommissioning of subsea structures could be performed completely by a team of cooperating AUVs.

Department News

Faculty publications in peer-reviewed international journals in the academic year 2020-'21:

1) K.P.Venkitaraj, B.Praveen, HarjitSingh, S.Suresh, Low melt alloy blended polyalcohol as solid-solid phase change material for energy storage: An experimental study, Applied Thermal Engineering 2020, 175, 115362, ISSN 1359-4311,

2) Dr Jose Mathew, Lissen Sam, Lovin George Mathew, Merin T Edison, Pratibha Rachel John, Design and analysis of multilegged robot for environment monitoring, EPRA International Journal of Research and Development 2020, 5 (11), ISSN: 2455-7838.