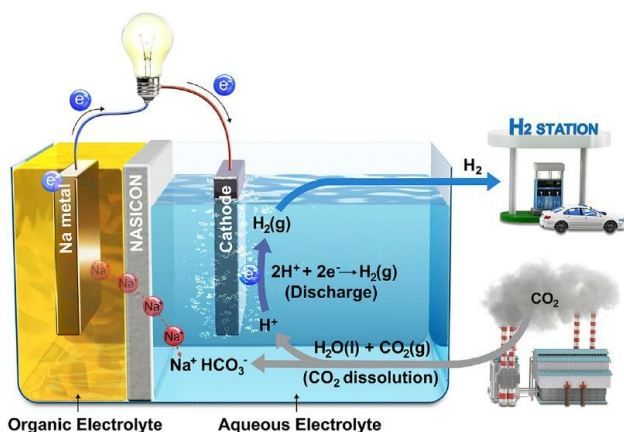


Scientists turn carbon emissions into usable energy

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Schematic illustration of Hybrid Na-CO₂ System and its reaction mechanism. Credit: UNIST

A recent study affiliated with UNIST has developed a system that produces electricity and hydrogen (H₂) while eliminating carbon dioxide (CO₂), the main contributor of global warming. This breakthrough has been led by Professor Guntae Kim in the School of Energy and Chemical Engineering at UNIST in collaboration with Professor Jaephil Cho in the Department of Energy Engineering and Professor Meilin Liu in the School of Materials Science and Engineering at Georgia Institute of Technology.

In this work, the research team presented a hybrid Na-CO₂ system that can continuously produce electrical [energy](#) and hydrogen through efficient CO₂ conversion with stable operation for over 1,000 hours from spontaneous CO₂ dissolution in aqueous solution.

"Carbon capture, utilization, and sequestration (CCUS) technologies have recently received a great deal of attention for providing a pathway in dealing with global climate change," says Professor Kim. "The key to that technology is the

easy conversion of chemically stable CO₂ molecules to other materials." He adds, "Our new system has solved this problem with CO₂ dissolution mechanism."

A percentage of human CO₂ emissions is absorbed by the ocean and turned into acid. The researchers focused on this phenomenon and came up with the idea of melting CO₂ into water to induce an electrochemical reaction. If acidity increases, the number of protons increases, which in turn increases the power to attract electrons. A [battery system](#) based on this phenomenon can produce electricity by removing CO₂.

Their Hybrid Na-CO₂ System, just like a [fuel cell](#), consists of a cathode (sodium metal), separator (NASICON), and anode (catalyst). Unlike other batteries, catalysts are contained in water and are connected by a lead wire to a cathode. When CO₂ is injected into the water, the reaction starts, eliminating CO₂ and creating electricity and H₂. The conversion efficiency of CO₂ is 50 percent.

"This hybrid Na-CO₂ cell, which adopts efficient CCUS technologies, not only utilizes CO₂ as the resource for generating [electrical energy](#) but also produces a clean energy source, hydrogen," says Jeongwon Kim in the Combined M.S/Ph.D. in Energy Engineering at UNIST, the co-first author for the research.

This system has shown stability to the point of operating for more than 1,000 hours without damage to electrodes. The system can be applied to remove CO₂ by inducing voluntary chemical reactions. "This research will lead to more derived research, and will be able to produce H₂ and electricity more effectively when electrolytes, separator, system design and electrocatalysts are improved," said Professor Kim.

More information: Changmin Kim et al, Efficient CO₂ Utilization via a Hybrid Na-CO₂ System Based

on CO₂ Dissolution, *iScience* (2018). DOI:
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