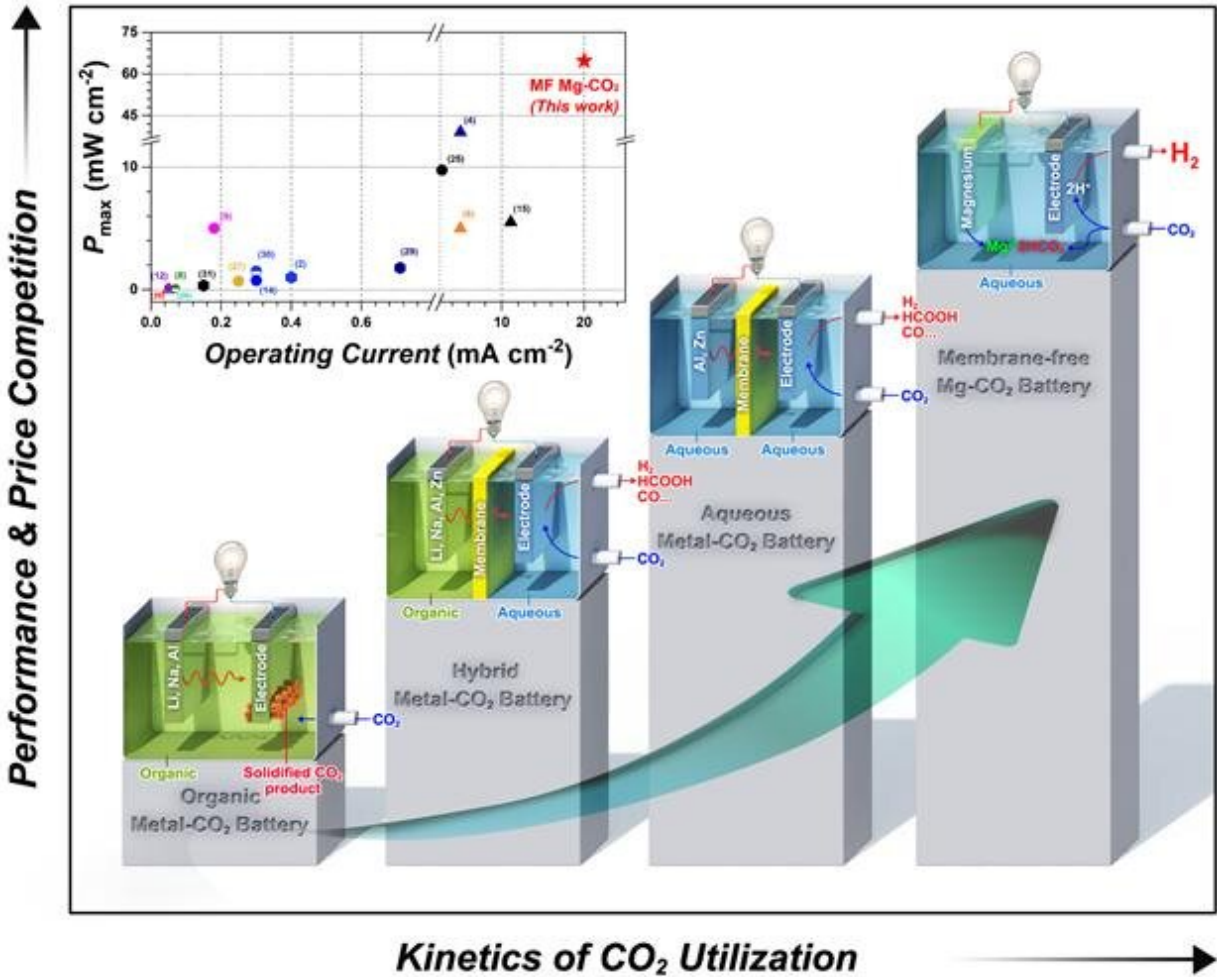


Novel battery capable of producing hydrogen and electricity quickly while eliminating carbon dioxide

March 17 2021



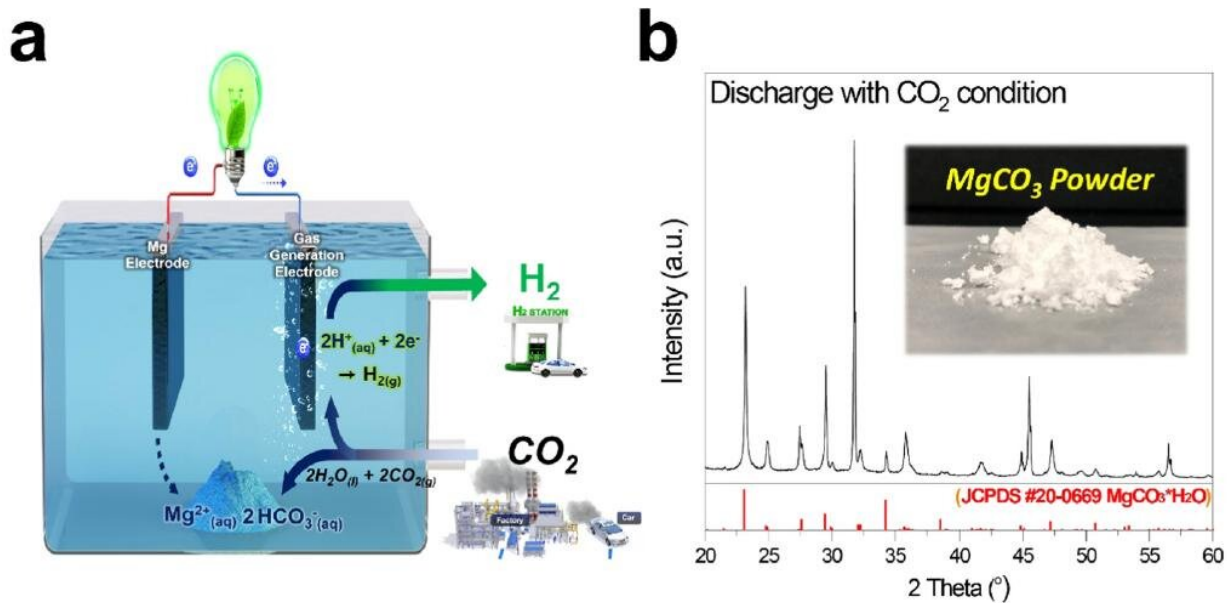
Schematic configuration and operation principle for each battery system from organic to membrane-free battery. Credit: UNIST

A recent study, affiliated with UNIST has unveiled a novel system, capable of producing hydrogen and electricity quickly and effectively while eliminating carbon dioxide (CO₂) emissions significantly.

Published in the January 2021 issue of *Nano Energy*, this breakthrough has been carried out by Professor GunTae Kim and his research team in the School of Energy and Chemical Engineering at UNIST. In this study, the research team succeeded in developing a membrane-free aqueous metal-CO₂ battery. Unlike the existing aqueous metal-CO₂ systems, the new battery is not only easier to manufacture, but also allows continuous operation with one type of electrolyte.

The research team designed a membrane-free (MF) Mg-CO₂ battery, as an advanced approach to sequester CO₂ emissions by generating [electricity](#) and value-added chemicals without any harmful by-products. According to the research team, their MF Mg-CO₂ battery operates based on the indirect utilization of CO₂ with facile hydrogen generation process. It has been also found that the [new battery](#) exhibits high faradaic efficiency of 92.0%.

"In order to translate the newly developed, laboratory-scale MF Mg-CO₂ battery technology into a commercial reality, we have envisioned an operational prototype system that produces electricity and value-added chemicals, as a cornerstone to better support sustainable human life from CO₂ and Earth-abundant renewable power (e.g., wind, solar, seawater)," noted the research team.



(a) Schematic illustration of MF Mg-CO₂ battery. (b) The XRD profile of the precipitated white solid after discharge process in CO₂ sat'd condition and N₂ sat'd condition. Credit: Ulsan National Institute of Science and Technology

The MF Mg-CO₂ battery system has a structure similar to that of [hydrogen fuel cells](#) for use in cars, since it only requires a Mg-metal negative electrode, an aqueous electrolyte, and a positive-electrode catalyst. However, unlike the existing fuel cells, they are based on aqueous electrolytes. As a result, the newly developed MF Mg-CO₂ battery had successfully sequestered CO₂ emissions by generating electricity and value-added chemicals without any harmful by-products.

"Our findings indicate great benefits for the newly developed MF Mg-CO₂ [battery](#) technology to produce various value-added chemicals of practical significance and electricity from CO₂ without any wasted by-products," noted the research team. "Through this we have opened the door to electrochemical utilization of CO₂ with indirect circulation for future alternative technologies."

More information: Jeongwon Kim et al. Indirect surpassing CO₂ utilization in membrane-free CO₂ battery, *Nano Energy* (2021). [DOI: 10.1016/j.nanoen.2020.105741](https://doi.org/10.1016/j.nanoen.2020.105741)

Provided by Ulsan National Institute of Science and Technology

Citation: Novel battery capable of producing hydrogen and electricity quickly while eliminating carbon dioxide (2021, March 17) retrieved 19 April 2024 from <https://techxplore.com/news/2021-03-battery-capable-hydrogen-electricity-quickly.html>

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