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NEWS | JULY 09 2021

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Scilight 2021, 281101 (2021)
https://doi.org/10.1063/10.0005617

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6 July 2021

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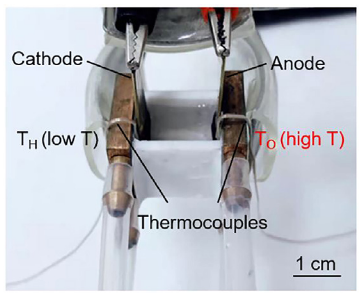
Hydrogen production by water electrolysis is a promising pathway to sustainable energy and can be enhanced by applying a temperature gradient to an electrolyzer's cathodes.



With growing awareness of the adverse environmental and health effects of fossil fuels, it is vital to find sustainable alternatives. Hydrogen is a promising candidate, especially hydrogen produced by water electrolysis to store surplus power from renewable energy resources, like photovoltaics and wind.

Typically, this process occurs in an electrolyzer whose two electrodes, where the hydrogen and oxygen evolution reactions take place, are held at the same temperature. By introducing a temperature gradient between the anode used for the oxygen reaction and the cathode used for the hydrogen reaction, Zhu et al. demonstrated significant enhancements in operating efficiency compared to the uniform temperature case, with no detriment to the electrolyzer's performance.

When the anode is set to a higher temperature than the cathode, thermodynamic effects lead to a much easier electrolysis reaction that requires less energy usage than the constant temperature case. For example, setting the anode to 333 K and the cathode to 293 K reduces electricity consumption by 5.2%, compared to the case in which both are set to 313 K, and increases the efficiency from 76% to 81%.

"This effect has not been considered before, and it may be applicable to all alkaline oxygen evolution reactions," said author Hong Jin Fan.

The improving in efficiency can lead to several potential applications, including harvesting low-grade heat waste from industrial or natural processes, and increasing the performance of water electrolysis in general. However, the current study is a proof-of-concept demonstration and requires additional optimization tests.

"For practical applications, it is necessary to employ more advanced catalysts for oxygen evolution reactions to achieve higher electrolysis performance and thermal stability," Fan said.

Source: "Boosting alkaline water electrolysis by asymmetric temperature modulation," by Qinpeng Zhu, Peihua Yang, Tao Zhang, Zehua Yu, Kang Liu, and Hong Jin Fan, *Applied Physics Letters* (2021). The article can be accessed at https://doi.org/10.1063/5.0054273.

AIP Scilight. 2021, 281101-1; https://doi.org/10.1063/10.0005617