

OXYGEN EVOLUTION REACTION

Potential to stabilize

Angew. Chem. Int. Ed. **58**, 5054–5058 (2019)

Under the acidic conditions of proton-exchange membrane water electrolyzers, there are few stable electrocatalysts to promote the oxygen evolution reaction (OER) — one half of the overall process to make hydrogen. The best catalysts are typically those composed of precious metals, like iridium; finding cheaper alternatives, such as manganese-based materials, that can operate stably on the timescale of months is particularly challenging. Now, Hongxian Han, Ryuhei Nakamura and colleagues in China and Japan have identified conditions under which γ -MnO₂ can catalyse the OER without deactivation over thousands of hours of operation at pH 2.

To investigate the activity and stability of the catalyst, the researchers used in situ ultraviolet-visible spectroelectrochemical measurements, monitoring the species present in the γ -MnO₂ electrode and the electrolyte. They found that as the applied potential is increased up to 1.6 V versus RHE (reversible hydrogen electrode), the amount of Mn³⁺ in the catalyst increases, coinciding with the onset of OER activity. The researchers increase the potential further to 1.8 V versus RHE and observe an absorption in the electrolyte attributable to MnO₄⁻, which indicates dissolution of the γ -MnO₂ electrode via this species. Interestingly, this potential is about 220 mV higher than would be expected from thermodynamic calculations. Reasoning that these events define a window in which the catalyst can operate stably, the researchers performed electrolysis at 1.73 V versus RHE and a current density of 10 mA cm⁻² and found no deactivation over 8,000 h of operation. However, increasing the potential slightly to 1.8 V versus RHE caused complete loss of activity after 120 h, demonstrating the sensitivity of the system to small deviations in applied potential.

James Gallagher

Published online: 11 April 2019

<https://doi.org/10.1038/s41560-019-0379-1>