Investigation of Commercial Tungsten Carbide as an HER Electrocatalyst in PEMWE

Xiaofeng Xie, Lanshan Liu, Shusheng Chen, Yuanquan Zhou, Xiaohong Hu*

Hubei Key Lab of Electrochemical Power Source, College of Chemistry and Molecular Sciences, Wuhan University, Wuhan Hubei, 430072, China

*E-mail: xhhu88@whu.edu.cn

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Proton electrolyte membrane water electrolysis (PEMWE) is a promising hydrogen generation method limited by the high cost, such as those costs associated with noble electrocatalysts. Herein, we investigate commercial tungsten carbide (WC), a potential substitute for Pt, as a hydrogen evolution reaction (HER) electrocatalyst in PEMWE. We adopted two sizes of WC, 400 nm and 1 μm , optimized the electrode fabrication method and running conditions. The results show that the smaller WC does not provide stable performance and operating at high current density and low temperature is more competitive with Pt-based electrolysis. In addition, the most serious drawback is the increased cell voltage on restart after long-term power-off due to considerable WC oxidation, which leads to a decrease in the catalytic carbide carbon. Luckily, this can be offset by effective O₂ isolation in the cathode, such as H₂O sealing or pumping with H₂. WC is an economic alternative as a HER electrocatalyst in PEMWE with optimized conditions and an O₂ isolation strategy during an interrupted operation. We provide a practical method to reduce the cost of the HER electrocatalyst.

Keywords: Proton electrolyte membrane water electrolysis; Tungsten carbide; Hydrogen evolution reaction; Protection strategy.

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