Surface Engineering of Stainless Steel Current Collector for Industrial Application in PEMFC/PEMWE

Hengxu Gu[1], Yifan Yang[1], Yu Huang[3], Lan Sun[1], Huabing Tao[1,2], **Changjian Lin**[1,2,3]

[1]*College of Chemistry and Chemical Engineering, and State Key Laboratory of Physical Chemistry of Solid Surfaces, Xiamen University, Xiamen, China*

[2] *Tan Kah Kee Innovation Laboratory, Xiamen, China*

[3] *College of Energy, Xiamen University, Xiamen, China*

cjlin@xmu.edu.cn

Abstract Proton exchange membrane water electrolysis (PEMWE) and proton exchange membrane fuel cells (PEMFC) are most attractive approaches for green production and utilization of hydrogen energy. The current collector (CC), known as bipolar plate, is one of the most crucial components in PEMFC and PEMWE. The CC should have relatively low cost, good mechanical qualities, high electrical conductivity and strong corrosion resistance to meet the commercial demand. In terms of cost, mechanical strength and manufactures, stainless steel can be a favorable CC material compared to traditional graphite material. However, the electrical conductivity and corrosion resistance of stainless steel are usually not sufficient in PEMWE and PEMFC working environment. In this work, we focused on the development of advanced surface engineering to largely increase corrosion resistance and decrease contact resistance of stainless steel for CC in PEMWE and PEMFC. Firstly, an electrochemical superpassivation was developed to enhance the corrosion resistance of various grades of stainless steels. It is indicated that the electrochemical superpassivation is able to reduce the corrosion current density of stainless steel from 6.08 μA/cm^2 to 0.042/μA/cm^2 in the same testing solution, due to the favorable chemical composition and structure of the passive film. In order to low the contact resistance for stainless steel, a dispersive film of platinum nanoparticles was electrodeposited onto the elelctrochemically superpassivated stainless steel. It is demonstrated that the interfacial contact resistance (ICR) of the stainless steel with platinum deposited for 60 s was as low as 10 mΩ·cm² at 1.4 MPa compression force, which is promising to be adapted in PEMFC working environment.

Keywords Key Words: Current collector; Stainless steel; Corrosion resistance; Interfacial contact resistance; Surface engineering

Reference

[1] Hengxu Gu,Optimization and Evaluation of Conductivity and Anti-corrosion Performance of Stainless Steel Current Collector in PEMFC/PEMWE, Dissertation, Xiamen University, 2024.