High corrosion resistant multilayer C/Metal coated bipolar plates used in proton exchange membrane fuel cells

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Abstract Developing a conductive and corrosion-resistant coating is essential to promote the application of metal bipolar plates in proton exchange membrane fuel cells (PEMFCs). A multilayer coating that C and Ti alternatively dominated the sublayers is fabricated on SS316L (C/Ti/SS). Multiple diffusional interfaces optimize the potential distribution across the coating and improve significantly transpassive potential to 1.6 V, and thus offers full protection within the entire working potential range of fuel cells. After cyclic polarizations simulated the high cathodic transient potentials, a conductive TiO_2 nanofilm forms on the surface to mitigating the continuous dissolution. And C/Ti/SS achieves a noticeable interfacial contact resistance (ICR) of 9.43 mΩ·cm^2, highlighting the remarkable commercial application. Correspondingly, the long-term cyclic dynamic potential polarizations based on New European Driving Cycle (NEDC) are investigated on the multilayer C/Cr coated SS316L (C/Cr/SS) bipolar plates. C/Cr/SS achieves superior small ICRs and low corrosion rate with E_{peak} up to 1.12 V. As a result of Cr dissolution at the heterogeneous interface, mild local corrosion occurs at 1.16 V and accelerates at 1.22 V. Both of them experience stages of pitting initiation, cavity, delamination, and finally collapse. After the dynamic potential polarizations, the ICR values are all below 10 mΩ·cm^2, which is attributed to the well reserved surface a-C layer. These works offer the multilayer coating structure and combine the actual conditions experienced by the bipolar plate, promoting the application for metal bipolar plates used in PEMFCs.

Keywords metal bipolar plates

Reference

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