

High-performance membrane electrode assembly with multi-functional Pt/SnO₂-SiO₂/C catalyst for proton exchange membrane fuel cell operated under low-humidity conditions

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Abstract

A novel self-humidifying membrane electrode assembly (MEA) with homemade multifunctional Pt/SnO₂-SiO₂/C as the anode was developed to improve the performance of a proton exchange membrane fuel cell under low humidity. The MEAs' performance was evaluated at various temperatures and relative humidity levels. One MEA with a Pt/SnO₂-SiO₂/C anode catalyst achieved excellent low-humidity performance at a cell temperature of up to 60 degrees C: the current density reached 600 mA cm² at 0.7 V and 1050 mA cm² at 0.6 V with 10% RH; after 96 h of continuous operation under the same conditions, the current density decreased by only 16% (to ~880 mA cm²), whereas the current density of an MEA with JM Pt/C as the anode degraded by more than 60% within 10 h. The contact angle of the Pt/SnO₂-SiO₂/C anode was much lower than that of the Pt/C anode, indicating the former's excellent wettability. The high performance of the MEA with the Pt/SnO₂-SiO₂/C anode is attributable to the wettability of the doped binary oxide, especially of silicon oxide, and the promotion of tin oxide, which caused an interaction between the Pt and the oxide, resulting in enhanced performance under low humidification.