Electrochimica Acta

Tuning hydrophobic-hydrophilic balance of cathode catalyst layer to improve cell performance of proton exchange membrane fuel cell (PEMFC) by mixing polytetrafluoroethylene (PTFE)

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Abstract:

The wettability, or hydrophobic-hydrophilic balance, of cathode catalyst layer influences the performance of the proton exchange membrane fuel cell. In this paper, cathode catalyst layer with different polytetrafluoroethylene contents are prepared, and the effect of hydrophobic-hydrophilic balance on the performance of the membrane electrode assembly is investigated intensively. It is found that wettability, or hydrophobic-hydrophilic balance, of cathode catalyst layer can significantly affect the performance of membrane electrode assembly, and it can be effectively tuned by varying the loading of polytetrafluoroethylene. With the addition of polytetrafluoroethylene, the hydrophobicity of cathode catalyst layer, reflected by the contact angel, can be changed from 135.6° of that without addition of polytetrafluoroethylene to 146.5° with 70 wt.% polytetrafluoroethylene addition, and the optimal addition amount is 50 wt.%. For our optimal membrane electrode assembly with optimal addition of polytetrafluoroethylene in cathode, its current density are recorded as 990 mA cm^{-2} at 0.7 V and 1400 mA cm^{-2} at 0.6 V, respectively; its maximum power density is up to 856 mW cm^{-2}. Furthermore, our polytetrafluoroethylene-incorporated membrane electrode assembly also exhibits excellent stability, and current density only drops from 1000 mA cm^{-2} to 900 mA cm^{-2} after a continuous operation of 60 h.