Zirconium Hydrogen Phosphate in Nafion Membrane and Catalyst Layers for PEMFCs

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The proton exchange membrane fuel cell (PEMFC) is a promising type of fuel cell as an alternative to combustion engines because of low emission and high conversion efficiency. Typical membranes for low temperature PEMFC are perfluorinated sulfonic acid polymers such as Nafion™.

For optimal performance, these membranes must be well humidified to facilitate proton conduction. At elevated temperatures (above 100 ^{0}C), the effects of CO adsorption onto the platinum electrocatalyst are minimized, but the evaporation rate of water leads to membrane dehydration. Thus the membrane has been modified to enhance the performance for the uptake of water. [1-5]

In our present work, we have modified both Nafion 115 membrane and Pt electrodes (E-Tek) to incorporate zirconium hydrogen phosphate (ZHP).

In the experiments, the PEMFC with the electrodes and membrane containing ZHP showed only a small change in performance with temperature cycling between 80 and 130 ^{0}C unlike in the PEMFCs with no ZHP in the Pt electrode and/or Nafion 115 membrane (Fig.1). A possible explanation is that with the ZHP modification the stability of the membrane is improved because of an increase in the glass transition temperature of Nafion.

Performances of PEMFCs, with ZHP in the electrodes and/or in the membranes are to be discussed.

1) S. Srinivasan et al., Abstract No.85, 197th Meeting of Electrochemical Society at Toronto, Canada.
2) Yongchao Si et al., Abstract No.116, 199th Meeting of Electrochemical Society at Washington, DC.
3) Yongchao Si et al., Abstract No.418, 2001 Joint International Meeting at San Francisco, CA.
4) C. Yang et al., Electrochemical and Solid State Letters, 4 (4) A31-A34 (2001).
5) C. Yang et al., J. Power Sources 103 (1) 1-9 (2001)

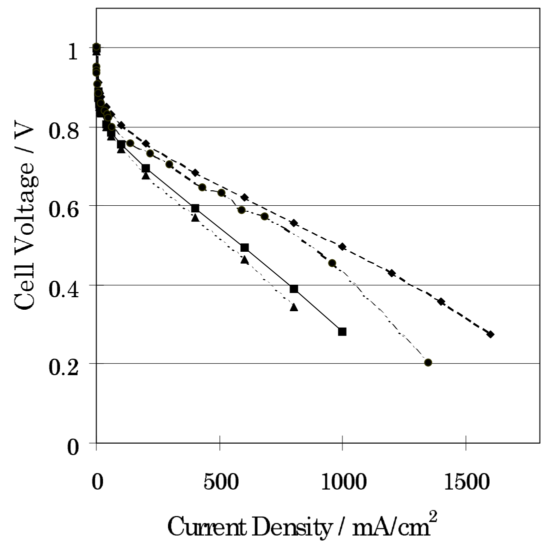

Fig.1 Polarization curves at 80 ^oC, 1atm operation before temperature cycling between 80 and 130 ^oC: (1) (■) ZHP incorporated both in electrodes and membrane; (2) (♦) ZHP only in electrode; (3) (▲) ZHP only in membrane; (4) (●) without ZHP in electrodes and membrane.

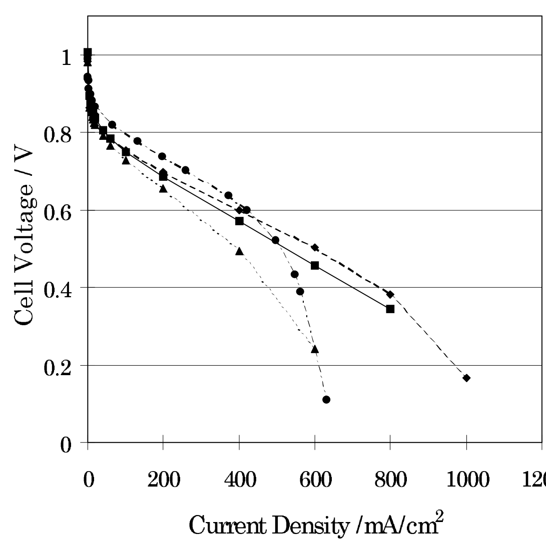

Fig.2 Polarization curves at 80 ^oC, 1atm operation after temperature cycling between 80 and 130 ^oC: (1) (■) ZHP incorporated both in electrodes and membrane; (2) (♦)ZHP only in electrode; (3) (▲) ZHP only in membrane; (4) (●) without ZHP in electrodes and membrane.