以陽極除水法提高質子交換膜燃料電池性能之研究

陳玠汶、鄭錕燦

E-mail: 9126599@mail.dyu.edu.tw

摘 要

質子交換膜燃料電池(PEFC)具有能量密度高、容易起動與關機、壽命長等優點，是現今低溫燃料電池 中，最有發展潛力的一種燃料電池。它適合使用於電動車輛、筆記型電腦、行動電話等裝置，無疑地它 將會成為未來主要行動電力的來源。質子交換膜燃料電池的『水管理』對其性能影響甚大，若『水管理 』做得好則燃料電池的效率與性能就會較佳，因此『水管理』是質子交換膜燃料電池的關鍵技術之一， 本論文即在於探討燃料電池的『水管理』的相關問題。 本研究建構了一個質子交換膜燃料電池的數學模型，並依據此一數學模型發展出一電腦模擬程式，該 電腦模擬程式即用以模擬燃料電池的運轉。燃料電池的運轉過程中，質子交換膜含水量的變化、陰極水 份泛溢的情形，皆在探討之列。此外，利用陽極除水法將陰極的積水移除，以減少陰極的氧氣質傳阻礙 ，提升燃料電池的性能，亦是本論文的探討重點。

關鍵詞 : 質子交換膜燃料電池、陽極除水法、水管理、泛溢、性能

目錄

參考文獻

1.鄭雅堂,"燃料電池發電技術"汽電共生報導,第十四期,1998 2.田中正三郎著,賴耿陽譯,"應用電化學",復漢出版社P43 3.KARL KORDESCH, GUNTER SIMADER, "FUEL CELLS AND THEIR APPLICATIONS" WENHEIM.NEW YORK.BAS -EL.CAMBRIDGE.TOKYO, PP.45 4.KARL KORDESCH GUNTER SIMADER, "FUEL CELLS AND THEIR APPLICATIONS" WENHEIM.NEW YORK.BASE -L.CAMBRIDGE.TOKYO, PP.29 5.D.M. BERNARDI, M.W.VERBRUGGE, "MATHEMATICAL MODEL OF A GAS DIFFUSION ELECTRODE BONDED T -O A POLYMER ELECTROLYTE", AICHE JOURNAL, VOL.37, NO.8, PP.1151~1163,1991. 6.T.E. SPRINGER, M.S. WILSON, S. GOTTESFELD, "MODELING AND EXPERIMENTAL DIAGNOSTICS IN PO -LYMER ELECTROLYTE FUEL CELLS", JOURNAL OF THE ELECTROCHEMICAL SOCIETY , VOL.140 , PP. 3513~3526, 1993. 7.J.J. BASCHUK ,X.LI,"MOLDELLING OF POLYMER ELECTRLYTE MEMBRANE FUEL CELL WITH VARIABLE D -EGREES OF WATER FLOODING",JOURNAL OF POWER SOURCES, 86,181~196,2000 8.T. OKADA,GANG XIE AND MORTEN MEEG "SIMULATION FOR WATER MANAGEMENT IN MEMBRANES FOR PO -LYMER ELECTROLYTE FUEL CELL", ELECTROCHIMICA ACTA VOL. 43, NOS. 14-15, PP. 2141-2155, 1998 9.C. MARR,X. LI,"COMPOSITION AND PERFORMANCE MODELING OF CATALYST LAYER IN A PROTON EXCHA -NGE MEMBRANE FUEL CELL", JOURNAL OF POWER SOUECES,VOL.77,PP.17-27,1999 10.H. H. VOSS, D. P. WILKNSION, P. G. PICKUP, M. C. JOHNSON, V. BASURA,"ANODE WATER REMOVE -AL: A WATER MANAGEMENT AND DIGNOSTIC TECHNIQUE FOR SOLID POLYMER FUEL CELL",ELECTROCHI -MICA ACTA. VOL.40, NO.3, PP. 321-328,1995 11.HISNG, I., FUTERKO, P., "TWO-DIMENSIONAL SIMULATION OF WATER TRANSPORT IN POLYMER ELECT -ROLYTE FUEL CELLS," CHEMICAL ENGINEERINGSCIENCE, VOL. 55, PP. 4209-4218, 2000. 12.T.E.SPRINGER, T. A. ZAWODZINSKI, AND S. GOTTESFELD "POLYMER ELECTROLYTE FUEL CELL MODEL "JOURNAL OF THE ELECTROCHEMICAL SOCIETY, VOL. 138 NO.8 P2334~P2342,1991 13.D.STASCHEWSKI, "INTERNAL HUMINDIFYING OF PEM FUEL CELL", INT. J. HYDROGEN ENERGY, VOL. 21, NO.5 PP. 381-385,1996 14.M.ISE, K.D. KREUER, J. MAIER, "ELECTROOSMOTIC DRAG IN POLYMER ELECTROLYTE MEMBRANES: AN ELECTROPHORETIC NMR STUDY" SOLID STATE IONIC VOL. 125, PP. 213-223,1999 15.TATSUHIOR OKADA, STEFFEN MOLLER-HOLST,ODDVAR GORSETH, SIGNE KJELSTRUP "TRANSPORT AND EQ -UILIBRIUM PROPERTIES OF NAFIONR MEMBRANES WITH H+ AND NA+ IONS" JOUNAL OF ELECTROANALY -TICAL CHEMISTRY VOL.442, PP.137-145, 1998 16.X. GONG, A. BANDIS, A. TAO, G. MERESI, Y.

WANG, P.T. INGLEFIELD, A.A. JONES, W.-Y. WEN "SELF-DIFFUSION OF WATER, ETHANOL AND DECAFLUROPENTANE IN PERFLUOROSULFONATE IONOMER BY PULSE FIELD GRADIENT NMR" POLYMER 42, PP.6485-6492, 2001 17.D. RIVIN, C.E. KENDRICK, P.W. GIBSON, N.S. SCHNEIDER "SOLUBILITY AND TRANSPORT BEHAVIOR OF WATER AND ALCOHOLS IN NAFIONTM " POLYMER VOL.42, PP.623-635, 2001 18.KYOUNG-HWAN CHOI, DONG-HYUN PECK, CHANG SOO KIM, DONG-RYUL SHIN, TAE-HEE LEE, "WATER TR -ANSPORT IN POLYMER MEMBRANES FOR PEMFC" JOURNAL OF POWER SOURCES VOL.86, PP.197-201, 2000 19.THOMAS F. FULLER AND JOHN NEWMAN "EXPERIMENTAL DETERMINATION OF THE TRANSPORT NUMBER OF WATER IN NAFION 117 MEMBRANE" J. ELECTROCHEM. SOC., VOL.139 ,NO.5 ,MAY 1992 20.FELIX N. BUCHI AND GUNTHER G. SCHERER "INVESTIGATION OF THE TRANSVERSAL WATER PROFILE I -N NAFION MEMBRANESIN IN POLYMER ELECTROLYTE FUEL CELLS" JOURNAL OF THE ELECTROCHEMICAL SOCIETY, VOL.148(3) A183-A188 ,2001 21.THOMAS A. ZAWODZINSKI,JR.,CHARLES DEROUIN,SUSAN RADZINSKI,RUTH J. SHERMAN,VAN T. SMITH, THOMAS E. SPRINGER, AND SHIMSHON GOTTESFELD "WATER UPTAKE BY AND TRANSPORT THROUGH NAFF -IONR 117 MEMBRANES" J. ELECTROCHEM. SOC., VOL. 140, NO.4, APRIL 1993 22.XIAOMING REN, WESLEY HENDERSON, AND SHIMSHON GOTTESFELD "ELECTRO-OSMOTUC DRAG OF WATER IN IONOMERIC MEMBRANES" J. ELECTROCHEM. SOC., VOL. 144, NO. 9, SEPTEMBER 1997 23.SATHYA MOTUPALLY, AARON J. BECKER,AND JOHN W. WEIDNER "DIFFUSION OF WATER IN NAFION 115 MEMBRANES" JOURNAL OF THE ELECTROCHEMICAL SOCIETY, VOL. 147(9),PP. 3171-3177,2000 24.THOMAS A. ZAWODZINSKI, JOHN DAVEY, JUDITH VALERIO, AND SHIMSHON GOTTESFELD "THE WATER C -ONTENT DEPENDENCE OF ELECTRO-OSMOTIC DRAG IN PROTON-CONDUCTING POLYMER ELECTROLYTES" E -LECTROCHIMICA ACTA, VOL.40 NO.3, PP.297-302, 1995 25.TRUNG V. NGUYEN AND RALPH E. WHILE "A WATER AND HEAT MANAGEMENT MODEL FOR PROTON-EXCHAN -GE MEMBRANES FUEL CELLS" J. ELECTROCHEM. SOC., VOL. 140, NO. 8, AUGUST 1993 26.THOMAS A. ZAWODZINSKI, JR., THOMAS E. SPRINGER, JOHN DAVEY, ROGER JESTEL,CHUZ LOPEZ,AND SHIMSHON GOTTESFELD "A COMPARATIVE STUDY OF WATER UPTAKE BY AND TRANSPORT THOUGH IONOME -RIC FUEL CELL MEMBRANES" J. ELECTROCHEM. SOC., VOL. 140, NO. 7, JULY 1993 27.JAMES T. HINATSU, MINORU MIZUHATA, AND HIROYASU TAKENAKA "WATER UPTAKE OF PERFLUOROSULF -ONIC ACID MEMBRANES FROM LIQUID WATER AND WATER VAPOR", J. ELECTROCHEM. SOC., VOL.141, NO. 6, JUNE 1994 28.YONG WOO RHO, OMOURTAG A. VELEV, AND SUPRAMANIAM SRINIVASAN, "MASS TRANSPORT PHENOMENA IN PROTON EXCHANGE MEMBRANE FUEL CELLS USING O2/HE, O2/AR AND O2/N2 MIXTURES" J. ELECTR -OCHEM. SOC., VOL.141.NO.8, PP.2084~2088, AUGUST1994 .