直接甲醇燃料電池之性能模擬

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摘 要

本研究以直接甲醇燃料電池為研究對象，建立了直接甲醇燃料電池之理論模型，並對其進行數值模擬，藉以瞭解在不同的參數條件下(溫度、壓力、甲醇濃度)，直接甲醇燃料電池其之性能變化情形。此外，本研究亦探討了各個參數對甲醇Crossover之影響。 模擬結果顯示增加溫度與壓力可有效提升燃料電池之性能，甲醇濃度亦對其性能有決定性的影響，最佳的甲醇供應濃度約為2M。在甲醇Crossover方面，增加陰極壓力、降低甲醇濃度或使用較厚的質子交換膜均可抑制甲醇之Crossover。但在高電流密度時，降低甲醇濃度或使用較厚的質子交換膜，會導致濃度過電位與歐姆過電位的增加，對燃料電池之性能產生不良的影響。

關鍵詞 : 直接甲醇燃料電池、燃料電池、性能模擬

目錄

參考文獻

1Karl Kordesch, G?nter Simader,“ Fuel Cells and Their Applications ”, VCH Verlagsgesellschaft mbH, Weinhein,1996. 2萬其超，“電化學”，商務印書局，1992. 3鄭耀宗、徐耀昇，“燃料電池技術的現況分析”，八十八年節約能源論文發表會論文專輯，409~422，1999. 4J. Kim, S. Lee, S. Srinivasan,“ Modeling of Proton Exchange Membrane Fuel Cell Performance with an Empirical Equation ”, Journal of the Electrochemical Society, Vol.142 , No.8, 2670~2674,1995. 5D.Bevers, M. Wohr, K. Yasuda, K. Oguro,“ Simulation of a Polymer Electrolyte Fuel Cell Electrode ”, Journal of Apply Electrochemistry, Vol.27, No.11 ,1254~1264,1997. 6K. Broka, P. Ekdunge,“ Modelling the PEM Fuel Cell Cathode ”, Journal of Apply Electrochemistry, Vol.27, No.3, 281~289, 1997. 7D.M. Bernardi, M.W. Verbrugge,“ Mathematical Model of a Gas Diffusion Electrode Bonded to a Polymer Electrolyte ”, AIChE Journal, Vol.37, No.8, 1151~1163,1991. 8T.V. Nguyen, R.E. White,“ A Water and Heat Management Model for Proton-Exchange-Membrane Fuel Cells ”, Journal of the Electrochemical Society, Vol. 140,No.8,2178~2186,1993. 9J.J. Baschuk, X. Li,“ Modelling of Polymer Electrolyte Membrane Fuel Cells with Variable Degrees of Water Flooding ”, Journal of Power Sources, 86, 181~196,2000. 10P. Argyropoulos, K. Scott, W.M. Taama,“ Gas Evolution and Powerperformance in Direct Methanol Fuel Cells ”, Journal of Apply Electrochemistry, Vol.29, No.6, 1999. 11Tom Koppel,“ Powering the Future ”, John Wiley &Sons,1999. 12K. Scott, W.M. Taama, P. Argyropoulos,“ Material Aspects of the Liquid Feed Direct Methanol Fuel Cell ”, Journal of Apply Electrochemistry, Vol.28,1389.1998. 13A.S. Arico, P.Crety, V.Baglio, E.Modica, V.Antonucci ,“ Influence of Flow Field Design on the Performance of a Direct Methanol Fuel Cell ”, Journal of Power Sources, 91,202~209,2000. 14T.V. Nguyen,“ A Gas Distributor Design for Proton-Exchange-Membrane Fuel Cells ”, Journal of the Electrochemical Society , Vol.143 , No.5, L103~L105,1996. 15Narayanan, S.R.; Kindler, A.; Jeffries-Nakamura, B.; Chun, W.; Frank, H.; Smart, M.; Valdez, T.I.; Surampudi, S.; Halpert, G.; Kosek, J.; Cropley, C.“ Recent Advances in PEM Liquid-Feed Direct Methanol Fuel Cells ”, Battery Conference on Applications and Advances, Eleventh Annual , 113 – 122, 1996. 16J. Cruickshank, K. Scott,“ The Degree and Effect of Methanol Crossover in the Direct Methanol Fuel Cell ”, Journal of Power Sources, 70, 40~47,1998. 17A.Heinzel, V.M.Barragan, "A Review of the State-of-the-art of the Methanol Crossover in Direct Methanol Fuel Cells", Journal

of Power Sources, 84, 70~74, 1999. 18K.Scott, W.M.Taama, J. Cruickshank, “ Performance and Modelling of a Direct Methanol Solid Polymer Electrolyte Fuel Cell ”, Journal of Power Sources , 65, 159~171, 1997. 19K.Scott, P.Argyropoulos, K.Sundmacher, “ A Model for the Liquid Feed Direct Methanol Fuel Cell ”, Journal of Electroanalytical Chemistry, Vol.477, 97~ 110, 1999. 20S.F. Baxter, V.S. Battaglia, R.E. White, “ Methanol Fuel Cell Model: Anode ” , Journal of the Electrochemical Society , Vol.146 , No.2, 437-447, 1999. 21John S. Newman, “ Electrochemical Systems-2nd ed. ” ,Prentice-Hall Inc., 1991 22Meyers, Jeremy Patrick, “ Simulation and Analysis of the Direct Methanol Fuel Cell ”, Ph.D. Thesis, University of California. Berkeley, 1998. 23K. Sundmacher, T. Schultz, S. Zhou, K. Scott, M. Ginkel, E.D. Gilles, “ Dynamics of the Direct Methanol Fuel Cell(DMFC): Experiments and Model-Based Analysis ”, Chemical Engineering Science, Vol.56, 333-341, 2001. 24T. Okada, G. Xie, M. Meeg, “ Simulation for Water Management in Membranes for Polymer Electrolyte Fuel Cells ”, Electrochimica Acta, Vol.43, Nos.14-15, 2141-2155,1998. 25S. Fukada, “ Analysis of Oxygen Reduction Rate in a Proton Exchange Membrane Fuel Cell ”, Energy Conversion and Management, Vol.42, 1121-1131, 2001. 26H. Dohle , J. Divisek, R. Jung, “ Process engineering of the direct methanol fuel cell ”, Journal of Power Sources , Vol.86 , 469-477, 2000. 27T.E. Springer, M.S. Wilson, S. Gottesfeld, “ Modeling and Experimental Diagnostics in Polymer Electrolyte Fuel Cells ”, Journal of the Electrochemical Society , Vol.140, No.12, 3513-3526, 1993.