Study and Implementation of Power Converter for Fuel Cell Electric Vehicle

周育綸、曾國境 ; 陳昭翰

E-mail: 9806470@mail.dyu.edu.tw

ABSTRACT

In this thesis, the source of the power system uses proton exchange membrane fuel cell (PEMFC) and lithium-iron-phosphate batteries, through the switching power conversion technology, to realize design and development in the power supply system of the hybrid fuel cell electric vehicle. The experiment confirmed that this thesis, the boost-flyback power converter with high voltage gain, high conversion efficiency, applicable to high-power products and the use of the advantages of low power components, and changes in the load to achieve a stable output state to achieve hybrid electric vehicle design effective energy conversion

Keywords : proton exchange membrane fuel cell、lithium-iron-phosphate batteries、hybrid electric vehicle、boost-flyback power converter

Table of Contents

REFERENCES

[1] Al Gore, An Inconvenient Truth, Rodale Pre, Oct. 2006.
[2] 蔡宜良，「全球電動車車輛發展概況與台灣新契機」，車輛研測資訊，pp.1-8，民國98年4月。
[3] 黃鎮江，「綠色能源」，全華科技圖書股份有限公司，民國97年。
[4] 衣寶廉，「燃料電池原理與應用」，五南書局，2005年。
[5] 黃鎮江，「燃料電池」，全華科技圖書股份有限公司，2005年。
[6] 本間 琢也 監修 /王建義 編譯，「圖解燃料電池百科」，全華書局，2004年。
[7] M. A. Laughton, " Fuel cells, " IEE Engineering Science and Education Journal, Vol. 11, no.1, pp. 7-16, Feb. 2002.
[8] 洪永杰，「質子交換膜式燃料電池膜電極組(MEA)-專利地圖與專利分析」，元智大學，2005 年。
[9] 顏煒庭，「具即時監測燃料電池與充電電池混合供電系統之研製」，國立成功大學電機工程學系碩士論文，2007 年。
[10] 劉家和，「質子交換膜燃料電池系統控制」，國立台灣科技大學化學工程系碩士論文，2005 年。
[11] A. J. Appleby and F. R. Foulkes, Fuel Cell Handbook, Van Nostrand Reinhold, New York, NY, 1989.
[12] 翁芳柏、徐耀昇，「燃料電池實驗教材」，燃料電池股份有限公司， 2006 年。
[13] 陳昭翰、曾國境、周育綸，「小型燃料電池供電系統之高效能應用研究」，第三屆全國氫能與燃料電池學術研討會，vol. FC078，2008年11月。
[14] P. Thounthong and P. Sethakul, " Analysis of a Fuel Starvation Phenomenon of a PEM Fuel Cell, " in IEEE Power Conversion Conference - Nagoya, 2007. PCC '07, pp. 731-738, April 2007.
[15] P. Rodatz, G. Paganelli, A. Sciarretta and L. Guzzella, " Optimal power management of an experimental fuel cell / supercapacitor- powered hybrid vehicle, " Control Engineering Practice Vol.13, pp.41-53, Jan. 2005.
[16] Ke Jin, Xinbo Ruan, Ming xiang Yang and Min Xu, " A Hybrid Fuel Cell Power System, " IEEE of Industrial Electronics, Vol. 56, pp.1212-1222, April 2009 .
[17] J. Bauman and M. Kazerani , " A Comparative Study of Fuel-Cell – Battery, Fuel-Cell – Ultracapacitor, and Fuel-Cell – Battery – Ultracapacitor Vehicles, " IEEE Trans. on Vehicular Technology, vol. 57, no. 2, March 2008.
[18] P. Thounthong, S. Rael, B. Davat and I. Sadli, " A Control Strategy of Fuel Cell/Battery Hybrid Power Source for Electric Vehicle Applications, " 37th IEEE of Power Electronics Specialists Conference, pp. 1 – 7, June 2006.
[19] B.Fuchs, Lafond, O. Rondineau, S. and Himdi, M., " An Analytical Optimization Method for Improved Fuel Cell-Battery- Ultracapacitor Powertrain, " IEEE Transactions on Microwave Theory and Techniques,vol. 54, pp.2292 – 2300, June 2006.
[20] G. E. Blomgren, " Current Status of Lithium Ion and Lithium Polymer Secondary Batteries, " in Proceeding of the 15th Annual, Battery Conference on Applications and Advances, pp.97-100, Jan. 2000.
[21] 楊模樺，「鋰電池材料技術發展」，工業材料雜誌第237期， pp.135-144，2006年9月。

[22] 楊家論、鄭賢豪，「二次鋰離子電池的安全性」，工業材料雜 誌第117期，pp.71-77，1996年9月。
[23] W. Jacobi and G. Eichinger ,“ Lithium Rechargeable Batteries forPortable Telecommunication Appliances-Basic Concepts and Recent Developments ”, in Proceeding of the 3rd International Conference on TELESCON, pp.123-127, May 2000.
[24] V. L. Teofilo , L. V. Merritt, and R. P. Hollingsworth,“ Advanced Lithium Ion Battery Charger, ”IEEE Conference on Aerospace and Electronic System Magazine, pp.30, Jan. 1997.
[25] 楊家論，“ 二次鋰離子電池性能介紹 ”，工業材料雜誌第126期，pp.115-123，1997年6月。
[26] Okura, K.,“ Development and Future Issues of High Voltage Systems for FCV, ” Proceedings of the IEEE,vol.95, pp.790-795, April 2007.
[27] X. Yu, M.R. Starke, L. M. Tolbert and B. Ozpineci,“ Fuel cell power conditioning for electric power applications: a summary, ” Electric Power Applications, IET , pp. 643-656, Sept. 2007.
[28] Kong, X., Choi, L.T., and Khambadkone, A.M.,“ Analysis and control of isolated current-fed full bridge converter in fuel cell system , ”IEEE Ind. Electron. Soc. Annu. Conf., pp.2825 – 2830, March 2004.
[29] R. W. Erickson and D. Maksimovic, Fundamental of Power Electronics. 2nd edition, New York: John Wiley, 1950.
[30] Ned Mohan, T. M.“ Undeland, and W. P. Robbins, Power Electronics:Converters, Applications, and Design, ” 3nd edition, New York:John Wiley & Sons, Inc. 2003.
[31] D. W. Hart,“ Introduction to Power Electics, ” 2nd edition, New York:Prentice-Hill, 1964.
[32] D. Czarkowski and M. K. Kazimierczuk,“ Linear circuit models of PWM flyback and buck/boost converters, ” IEEE Transactions on Circuits and Systems I: Fundamental Theory and Applications, vol. 39, pp. 688-693, Aug. 1992.
[33] K. C. Tseng and T. J. Liang,“ Novel High-Efficiency Step-Up Converter ”, IEE Proceedings - Electric Power Applications, vol. 151, pp.182-190, March 2004.
[34] T. J. Liang and K. C. Tseng,“ Analysis of Integrated Boost-Flyback Step-Up Converter, ” IEE Proceedings - Electric Power Applications, vol. 152, no. 2, pp. 217-225, March 2005.