

Studies on characteristic of piezoelectric actuated micropump with check valves

楊宗樺、note

E-mail: 346485@mail.dyu.edu.tw

ABSTRACT

In this paper the design of the micropump has the characteristics of two outlet port and two inlet port, this design makes the liquid flow rate improved largely. Micropump using piezoelectric materials as actuator, stainless steel etched chamber layer, and the flow channel layer with flow channel and valve seats use of acrylic, also cantilever-type PDMS-made check valves, assembly of the above components is a new piezoelectric actuated micropump with check valves, it has the advantages of miniature size, light weight and low power consumption, later for this micropump system performance in depth study. From the experimental results indicate that the performance of the micropump is affected by driving frequency, driving voltage, chamber depth, valve thickness, flow channel size and different blocked pressure. When the drive voltage 160 Vpp, the maximum liquid flow rate 125.6ml/min for the micropump with 2.0mm flow channel, chamber depth of 300 μ m and 0.5mm valve thickness, the maximum air flow rate 102.2ml/min for the micropump with 1.0mm flow channel, chamber depth of 300 μ m and 0.5mm valve thickness.

Keywords : Piezoelectric、Actuator、PDMS、Check valve

Table of Contents

目錄 簽名頁 中文摘要.....iii	英文摘要.....iv	誌謝.....v	目錄.....vi	圖目錄.....vii	表目錄.....xii	第一章 緒論.....1
1.1 前言.....1	1.2 研究動機.....2	1.3 文獻回顧.....3	第二章 微泵浦之設計與分析.....8	2.1 壓電有閥式微泵浦之原理.....8	2.2 壓電有閥式微泵浦結構設計.....9	第三章 微泵浦結構元件製作.....13
3.1 黃光製程.....13	3.2 蝕刻製程.....14	3.3 元件製作.....15	3.4 壓電致動器之製作.....17	3.5 PDMS特性與調配.....21	3.6 閥體的製作.....21	3.7 壓電有閥微泵浦組裝.....22
第四章 實驗結果與討論.....24	4.1 閥體特性探討.....24	4.1.1 空氣對閥體特性之探討.....24	4.1.2 液體對閥體特性之探討.....27	4.2 微泵浦之流量實驗量測.....31	4.2.1 腔體深度對流量之影響.....34	4.2.2 閥體厚度對流量之影響.....42
4.2.3 操作電壓對流量之影響.....50	4.2.4 壓電材料對流量之影響.....52	4.3 微泵浦之揚程實驗量測.....54	4.4 微泵浦之空氣流量量測.....58	第五章 結論.....60	5.1 結論.....60	參考文獻.....61

[1]F. C. M. van de Pol, " A pump based on micro- engineering techniques, " Ph. D. thesis, Enschede, the Netherlands: University of Twente, 1989. [2]A. Olsson, G. Stemme, and E. Stemme, " Numerical and experimental studies of flat-walled diffuser elements for valve-less micropumps, " Sensors and Actuators A: Physical, vol. 84, pp. 165-175, 2000. [3]R. Linnemann, P.Woias, C.-D. Se&, and J. A. Ditterich, " A self-priming and bubble-tolerant piezoelectric silicon micropump for liquids and gases, " 1998 IEEE, pp. 532-537, 1998. [4]S. Guo, S. Hata, K. Sugumoto, T. Fukuda and K. Oguro, " A New Type of Capsule Micropump Using ICPF Actuator, " Micromechatronics and Human Science, 25-28 Nov, pp. 255-260, 1998. [5]Sebastian Bohm, Wouter Olthuis, Piet Bergveld, " A plastic micropump constructed with conventional techniques and materials, " Sensors and Actuators A: Physical, Vol. 77, Issue 3, pp. 223-228, 1999. [6]J. Shinohara, M. Suda, K. Furuta, T. Sakuhara, " A high pressure-resistance micropump using active and normally-closed valves, " Micro Electro Mechanical Systems, 23-27 Jan, pp. 86-91, 2000. [7]Nam-Trung Nguyen, Thai-Quang Truong, " A fully polymeric micropump with piezoelectric actuator, " Sensors and Actuators B: Chemical, Vol. 97, Issue 1, pp. 137-143, 2004. [8]Junhui Ni, Bin Wang, Beizhi Li, Qiao Lin, " A planar PDMS micropump based on in-contact low-leakage check valves, " Nano/Micro Engineered and Molecular Systems (NEMS), 20-23 Jan, pp. 608-611,2010. [9]許廷好, " 壓電致動有閥微泵浦之設計與製作 ", 大葉大學機械與自動化工程學系碩士論文, 2010.

REFERENCES

- [1]F. C. M. van de Pol, " A pump based on micro- engineering techniques, " Ph. D. thesis, Enschede, the Netherlands: University of Twente, 1989.
- [2]A. Olsson, G. Stemme, and E. Stemme, " Numerical and experimental studies of flat-walled diffuser elements for valve-less micropumps, " Sensors and Actuators A: Physical, vol. 84, pp. 165-175, 2000.
- [3]R. Linnemann, P.Woias, C.-D. Se&, and J. A. Ditterich, " A self-priming and bubble-tolerant piezoelectric silicon micropump for liquids and gases, " 1998 IEEE, pp. 532-537, 1998.
- [4]S. Guo, S. Hata, K. Sugumoto, T. Fukuda and K. Oguro, " A New Type of Capsule Micropump Using ICPF Actuator, " Micromechatronics

and Human Science, 25-28 Nov, pp. 255-260, 1998.

[5]Sebastian Bohm, Wouter Olthuis, Piet Bergveld, " A plastic micropump constructed with conventional techniques and materials, " Sensors and Actuators A: Physical, Vol. 77, Issue 3, pp. 223-228, 1999.

[6]J. Shinohara, M. Suda, K. Furuta, T. Sakuhara, " A high pressure-resistance micropump using active and normally-closed valves, " Micro Electro Mechanical Systems, 23-27 Jan, pp. 86-91, 2000.

[7]Nam-Trung Nguyen, Thai-Quang Truong, " A fully polymeric micropump with piezoelectric actuator, " Sensors and Actuators B: Chemical, Vol. 97, Issue 1, pp. 137-143, 2004.

[8]Junhui Ni, Bin Wang, Beizhi Li, Qiao Lin, " A planar PDMS micropump based on in-contact low-leakage check valves, " Nano/Micro Engineered and Molecular Systems (NEMS), 20-23 Jan, pp. 608-611,2010.

[9]許廷妤, " 壓電致動有閥微泵浦之設計與製作 ", 大葉大學機械與自動化工程學系碩士論文, 2010.