

Design and Fabrication of Piezoelectric Micropump with Check Valve

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ABSTRACT

The micro-pump is a device that can provide a precise and controllable of liquid. In this study, we analyze originally dimension of piezoelectric actuator by commercial software of finite element method (ANSYS). By analysis result improvement design, and compare with measure result. We use the stainless steel etching to make structure of micro-pump and electroform a valve structure that have four beam. Bond these structure and test its performance. This method not only cost down but also enhance yield rate. The effects of different valve thickness、frequency and back pressure on the flow rate of the micro-pump are investigated. The thickness of valve is 20 μ m have maximum flow rate is 1.82 ml/min when it is driven by a sin wave of 120Vpp, 160Hz. The maximum attainable back pressure is 32kPa.

Keywords : Micropump、 Valve、 Piezoelectric、 Etching、 Electroforming

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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]A. Olsson, G. Stemme and E. Stemme, " Diffuser-element Design Investigation for Valve-less Pumps, " *Sensors and Actuators*, Vol. 57, pp. 688-695, 1996.
- [4]Michael Koch, Nick Harris, Alan G.R. Evans, Neil M. White, Arthur Brunnschweiler, " A novel micromachined pump based on thick-film piezoelectric actuation, " 1997 IEEE, pp. 353-356, 1997.
- [5]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.
- [6]Sebastian B?hm, 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.
- [7]Francis E. H. Tay, W. O. Choong, H. Liu, G. L. Xu., " An intelligent micro-fluidic system for drug delivery, " 2000 IEEE, pp. 70-75, 2000.
- [8]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.
- [9]吳鴻昀, " 壓電式薄膜微型泵的發展與應用 ", 國立台灣大學機械工程學系97碩士班論文, 2008.