

Study of Two-Dimensional Array Piezoelectric Inkjet Head

徐同勳、鄭江河

E-mail: 9608235@mail.dyu.edu.tw

ABSTRACT

In science and technology change with each passing day of the modern society, it is Inkjet printing technology, in last few years change more diverse, the level that it apply will more is extensive, as modern style fuel system, liquid crystal display, the optical communication equip and MEMS devices etc, can by this technique to reduce cost and raise the efficiency of manufacturing process. In many kinds of inkjet printing technology, an important type of inkjet printing technology is the piezoelectric driven printing technology. In this report, the adoption drives meeting with shear to transform mode with the round radial of PZT, will this with the result that move a two-dimensional array piezoelectric Inkjet head and can be all spraying all nozzle mouths liquid drop in the meantime to insure this to press to give or get an piezoelectric Inkjet head, to this with the result that spray all nozzle mouths if can control together in a r two-dimensional array piezoelectric Inkjet head after, will design a drive wave form, to control the make it can reach single signal to drive to reach inkjet make to move, and ability jet the whole slice of 5*5 arrays are single of liquid drop.

Keywords : Piezoelectric, Array, Inkjet Head, Waveform

Table of Contents

第一章 緒論 1.1 研究背景與動機 1.2 文獻回顧 1.2.1 國外目前研究現況 1.2.2 國內目前研究現況 1.3 研究目標及方向 第二章 二維陣列壓電噴墨頭之設計分析 2.1 二維陣列壓電噴墨頭結構設計 2.2 壓電材料簡介 2.2.1 壓電特性 2.2.2 剪切型壓電理論 2.3 壓電致動器之設計分析 2.4 壓電致動模組結構之設計分析 第三章 二維陣列壓電噴墨頭之製作與組裝 3.1 壓電致動器之製程 3.2 壓電噴墨頭之結構製作流程 3.2.1 製作流程 3.2.2 光罩設計 3.2.3 黃光製程 3.2.4 振動版製程 3.2.5 中間流道製程 3.2.6 噴嘴片製程 3.3 壓電噴墨頭之結構組裝 第四章 實驗方法與特性量測 4.1 實驗設備 4.2 壓電致動器的極化條件測試 4.3 壓電致動器模態量測 4.4 驅動波形設計 4.5 二維陣列噴墨頭之暫態量測 4.6 二維陣列壓電噴墨頭之觀測 第五章 結論 5.1 結論 參考文獻

REFERENCES

- [1] D. Wallace, H.-J. Trost and U. Eichenlaub, "Multi-fluid Ink-Jet Array for Manufacturing of Chip-Based Microarray Systems", Second International Conference on Microreaction Technology, March, 1998.
- [2] T. Goldmann and J. S. Gonzalez, "DNA-Printing: Utilization of a Standard Inkjet Printer for the Transfer of Nucleic Acids to Solid Supports", J. Biochem. Biophys. Methods 42, 105-110, 2000.
- [3] T. Laurell, L. Wallman and J. Nilsson, " Design and development of a silicon microfabrication flow-through dispensor for on-line picolitre sample handling, " J. Micromech. Microeng. 9, 369-376, 1999.
- [4] D. Wallac, " Ink-jet based fluid microdispensing in biochemical applications ", Lab. Automation News 1 (5), 6-9, 1996.
- [5] A. V. Lemmo, J. T. Fisher, H. M. Geysen and D. J. Rose, " Characterization of an inkjet chemical microdispenser for combinatorial library synthesis ", Anal. Chem. 69, 543-541, 1997.
- [6] J. Nilsson and P. Szecsi, " A flow-through microsampling device applied to an ion exchange chromatography system ", J. Biochem. Biophys. Methods 27, 181-190, 1993.
- [7] S. P. Swierkowski, " Micromachined chemical jet dispensor ", U.S Patent. No.5877580. 1999.
- [8] W. R. Cox, T. Chen, and D. J. Hayes, " Micro-optics Fabrication by Ink-jet Printing, " Optics & Photonics News, June 2001 pp. 32-35.
- [9] Qingbin Liu, Ming C. Leu, " Amplitude modulated droplet formation in high precision solder droplet printing, " International Symposium on Advanced Packaging Materials 2001 pp.123-128.
- [10] H. P. Le, " Progress and Trends in Ink-jet Printing Technology, " J. imaging sci. technol, Vol. 42, pp. 49-62, 1998.
- [11] C. W. Hansell, " Measuring Instrument of Recording Type, " U.S. Patent 2512743, 1950.
- [12] Bartky, et al., " Multi-channel array pulsed droplet deposition apparatus, " U.S. Patent 4992808, 1991.
- [13] Vincent Ferrer, " Operational properties of Piezoelectric Shear-Mode Actuator, " Condensed Matter Physics Department of Microelectronics and Information Technology.
- [14] Yong Zhou, " Applications of Page Wide Piezo Inkjet Printing to Commercial and Industrial Market, " Spectra Inc., www.spectra-inc.com

- [15] D. Wallace, H. J. Trost, and U. Eichenlaub, " Multi-fluid Ink-Jet Array for Manufacturing of Chip-Based Microarray Systems, " MicroFab Technologies, Inc.
- [16] Kotaro Yoshimura, Mitsura Kishimoto, Toshiro Suemune, " Inkjet Printing Technology, " OKI Technical Review Vol. 64, August, 1998.
- [17] J. Brunahl, Alex, and M. Grishin, " Piezoelectric shear mode drop-on-demand inkjet actuator, " Sensor and Actuator A 101, pp. 371-382, 2002.
- [18] R. G. Sweet, " High frequency recording with electrostatically deflected ink-jets, " Rev. Sci. Instrum. Vol. 36, pp. 131, 1965.
- [19] R. G. Sweet, " Signal apparatus with fluid drop recorder, " U.S. Patent 3596275, 1971.
- [20] W. L. Buehner, J. D. Hill, T. H. Williams, and J. W. Woods, " Application of ink-jet technology to a word processing output printer, " IBM J. Res. Dev. Vol. 21, 1968-1977.
- [21] John S. Eow, M. Ghadiri, A. Sharif, " Deformation and break-up of aqueous drops in dielectric liquids in high electric, " Journal of Electrostatics 51-52 463-469, 2001 [22] J. Heinzl, Printing with ink droplets from a multi-nozzle device, in Adv. in Non-Impact Printing Technologies for Computer and Office Applications, Joseph Gaynor, Ed., 1981, pp. 1191 – 1201.
- [23] T. E. Johnson and K. W. Bower, Review of the drop on-demand ink-jet with primary emphasis on the gould jet concept, J. Appl. Photo. Eng. 5 (3), 174 (1979).
- [24] T. Kitahara, Ink-jet head with multi-layer piezoelectric actuator, in Proc. IS&T's 11th Int'l. Congress on Adv. in Non-Impact Printing Tech., IS&T, Springfield, VA, 1995, pp. 346 – 349.
- [25] K. Kohei, et al. (Epson), Ink jet recording head, European Patent Appl. EP 0723867 (1996).
- [26] U. Minoru, et al., Actuator for an ink jet print head, European Patent EP 0723867 1996.
- [27] K. H. Fischbeck, et al (Spectra), Shear mode transducer for drop-on-demand liquid ejector, U.S. Patent 4,584,590 (1986).
- [28] W. S. Bartky, et al (Xaar), Droplet deposition apparatus, U.S. Patent 4,879,568 (1989).
- [29] A. J. Michaelis, et al (Xaar), Droplet deposition apparatus, U.S. Patent 4,887,100 (1989).
- [30] J. Pies, et al, Sidewall Actuator for a High Density Ink Jet Printhead, U.S. Patent 5227813, 1993.
- [31] J. Pies, et al, "High Density Ink Jet Printhead," U.S. Patent 5,235,352, August 10, 1993.
- [32] D. Wallace et al, "Droplet volume modulation techniques for ink jet printheads, " U.S. Patent 5,461,403, October 24, 1995.
- [33] D. J Hayes, D.B. Wallace, M.T. Boldman and R.E. Marusak, "Picoliter solder droplet dispensing," ISHM J. of Microcircuits & Electronic Packaging, Vol.16, No.3, 173-180, 1993.
- [34] D.B. Wallace and D.J. Hayes, " Solder Jet Technology Update, " The International Journal of Microcircuits and Electronic Packaging, Vol 21, No.1, 1998.
- [35] D.J. Hayes, D. B. Wallace and W.R. Cox, " MicroJet Printing of Solder and Polymers for Multi-Chip Modules and Chip-Scale Packages, " IMPAS, 1999.
- [36] W.R. Cox, D.J. Hayes, T. Chen, D.W. Ussery, D.L. MacFarlane and E. Wilson, "Fabrication of micro-optics by microjet printing," SPIE Proceedings, Vol.2383, pp.110-115, 1995.
- [37] W.R. Cox, T. Chen, D. Ussery, D.J. Hayes, J.A. Tatum and D.L. MacFarlane, "Microjetted lenslet tipped fibers," Optics Communication, Vol.123, pp.492-496, 1996.
- [38] W.R. Cox, T. Chen, D.W. Ussery, D.J. Hayes, R.F. Hoenigman, D.L. MacFarlane and E. Rabinovich, "Micro-jet printing of anamorphic micro-lens arrays," SPIE Pro., 2687, 89-98, 1996.
- [39] 陳俍鈞、林智堅、陳富港、鄭兆凱, " 噴墨列印技術於工業應用之系統發展, " 工業技術研究院光電工業研究所 [40] G. Percin, " Micromachined piezoelectrically actuated flexextensional transducers for high resolution printing and imaging, " Ph.D. dissertation, Stanford Univ., Stanford, CA, 2002.
- [41] U. Demirci, G. G.Yaralioglu, E. Haggstrom, G. Percin, S. Ergun, and B. T. Khuri-Yakub, " Acoustically actuated flexextensional Si N and single crystal silicon 2-D micromachined ejector arrays, " IEEE Trans. Semiconduct. Manufact., vol. 17, no. 4, pp. 517 – 524, Nov. 2004.
- [42] Chris P. Steinert, Ingo Goutier, Oliver Gutmann, Hermann Sandmaier ,Martina Daub, Bas de Heij and Roland Zengerle, " A highly parallel picoliter dispenser with an integrated, novel capillary channel structure, " Sensors and Actuators A 116 pp.171 – 177, 2004.
- [43] Utkan Demirci, Goksenin Yaralioglu, Edward Haggstrom, and B. T. Khuri-Yakub, " Femtoliter to Picoliter Droplet Generation for Organic Polymer Deposition Using Single Reservoir Ejector Arrays, " IEEE Transactions On Semiconductor Manufacturing, Vol. 18, No. 4, pp.709-715, 2005.
- [44] U. Demirci, " Picoliter droplets for spinless photoresist deposition, " Rev.Sci. Instrum., vol. 76, no. 6, 2005.
- [45] U. Demirci and A. Ozcan, " Picoliter acoustic droplet ejection by femtosecond laser micromachined multiple-orifice membrane-based 2D ejector arrays, " IEE Electron. Lett., vol. 41, no. 22, 2005.
- [46] 方昱仁, " 單體單噴孔壓電致動式噴液裝置之設計與製造, " 國立台灣大學機械工程研究所碩士論文,2002 [47] 鄭江河, " 壓電式噴墨列印頭之振動板的設計, " 大葉學報,第十卷,第一期, 2001.
- [48] 鄭江河,胡榮章,葉東昇與林烜鵬, " 壓電式噴墨頭及其製作方法, " 中華民國,專利194947, 2004.
- [49] 王仲偉, " 黑色反應性噴墨印花染料之合成與應用以及噴印PLED墨水之研究, " 國立台北科技大學 , 碩士論文 , 2004 [50] 林智堅,

賴建彰、鄭兆凱、邱琬雯，“噴墨列印技術用於製造液晶顯示器之彩色濾光片，”工業材料雜誌, Vol.199, pp.165-170, 2003 [51] 陳錦泰、楊慈雅、邱顯灃、賴建彰、袁宏彥、陳以哲、陳耿銘、黃友澤、張惠珍，“寬尺寸噴墨列印技術開發，”光學工程, Vol.75, pp.5-10, 2001 [52] 呂志平、周柏甫、胡紀平，“應用熱氣泡式噴墨法開發PLED全彩顯示器之製程技術，”工業材料雜誌, Vol.194, pp.140-146, 2003 [53] 王韋鈞，“可捲式軍用電子地圖製作關鍵技術 - 液滴噴射準確定位之實驗研究，”國防大學中正理工學院,碩士論文,2005 [54] 周復初、任天熹、黃國鑫、張皓翔、林建宏，“彩色濾光片噴塗研究，”中國機械工程學會第二十二屆全國學術研討會論文集 國立中央大學 臺灣、中壢 2005 [55] 張琮勛，“壓電驅動多孔微噴頭之設計製作與測試，”大葉大學機械系,碩士論文,2005 [56] 楊時文，“壓電噴墨頭-微陣列致動器之設計與製作，”碩士論文,大葉大學機械工程研究所,2003 [57] 顧孝鈞，“壓電微致動器之製作與量測，”碩士論文,大葉大學機械工程研究所,2004 [58] 周宗柏，“應用於微流體系統之壓電致動器特性探討，”碩士論文,大葉大學機械工程研究所,2005