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關鍵字(中)	電泳晶片、安培法偵測、碳纖維電極、神經傳導物質、表面修飾、高分子電解質、羥丙基纖維素、pH 修飾、抑制擴散。
關鍵字(英)	Electrophoresis microchip; Amperometric detection; Carbon fiber electrode; Neurotransmitters; Surface modification; Polyelectrol
摘要(中)	高效能電泳晶片之研究：速度及效率系統之改善 摘要 微電泳晶片的製作、應用及微流道修飾一直以來都是本實驗室研究的重點。微型化學分析系統(m-TAS)不但具有價廉、靈敏、快速及溶劑低耗量等優點，在結合高選擇性與高靈敏電化學後還具備有晶片實驗室(Lab-on-a-chip)的條件。 有鑑於微電泳晶片檢測系統的優越性，如將其應用在講求時效性的疾病診斷方面，將有很大的幫助。本論文將針對 DNA 組成份中的鹼基片段進行探討，結合 2 公分短流道晶片及間接安培法進行偵測與分離，並探討電活性試劑的選擇，以達到系統最佳化的選擇。 在改善晶片的解析度與功能性方面，第一部份：成功將碳纖維(7 μm)材質移轉於微電泳晶片上分離神經傳導物質，也提高晶片使用壽命與偵測樣品多元化。第二部份：藉由流道表面的改植而邁向快速分離與抑制樣品擴散的目標。據文獻指出，在溶液中添加微量高分子可大幅改變流變性其拖曳現象能降低擾流達 80 %，間接改善樣品於電泳中的擴散。所以此部份主要是研究添加微量高分子對電泳分離的效應，探討微電泳晶片流道經過修飾後，對分析樣品滯留時間、訊號?寬、解析度等影響，接著由逆相層析管柱加尾罩(endcap)的概念進而添加小分子試劑於高分子中來改善管柱的平衡，希冀藉此來提昇晶片使用效能，目前發現以羥丙基纖維素結合丙三醇來改質管柱有不錯的效果。第三部分藉由探討不同 pH 溶液修飾微流道管壁，來觀察其表面帶電荷及電滲透流(EOF)所受影響，進而改善樣品分析效果，以達快速分離的目標。
摘要(英)	Abstract The merits inherent with micro capillary electrophoresis of sensitivity, speed and versatility have echoed through the years. Its potential to annex the necessary functional parts for the utopian aim of Lab-on-a-chip is of particular interest to all the workers. Ironically, the tongues that spread the gospels also demand it to be fully-fledged for routine use. Its coupling with amperometric detection is sensitive, which is beneficial to applications in bioanalysis. However, its innate selectivity impedes the detection of the base fragments from DNA, for example, which calls for indirect amperometric detection. In addition, this investigation employs a 2-cm chip to shorten the analysis to a couple of minutes, as opposed to 20 to 30 minutes described in the literature. The study falls into three parts：the use of 7-micron carbon fiber as the electrode to extend its service life and increase sensitivity；surface modification

	with a trace amount of polyelectrolyte to adjust the flow rheology and to suppress solute diffusion in the channel；modification of surface pH to accelerate the migration and to escalate its resolution.
論文目次	目錄 中文摘 要……..... Ⅰ 英文 摘要……..Ⅱ 目 錄……...……...Ⅲ 圖目錄……...…..... Ⅵ 表目錄……..……..…….... Ⅹ 第一章 緒論…….……..…….…1 1-1 研究背景與目的……..….....…1 1-2 毛細管電泳技術的探討…….3 1-2-1 毛細管電泳發展的歷史.……3 1-2-2 毛細 管電泳之基本組成.……6 1-2-3 毛細管電 泳分離原理….……7 1-2-4 毛細管電泳電 泳的分離模式……...…11 1-2-5 毛細管電泳常用之 偵測方式……...…14 1-3 DNA 介 紹…….....18 1-3-1 DNA 組 成……...…18 1-3-2 DNA 檢測方 法……...…19 1-4 晶片微流道修飾的 探討…….....21 第二章 實驗部 份……...….23 2-1 微電泳晶 片之微機電製程……...23 2-1-1 製程設 備……...…23 2-1-2 材料與試 劑……...…24 2-1-3 微電泳晶片製 作流程……...…25 2-1-3-1 流道基板製 作……...….25 2-1-3-2 感應電極基板製 作……...….29 2-1-4 高溫熔融接 合……...…30 2-1-5 微電泳晶片組 裝……...…31 2-1-6 外接式電極晶 片……...…32 2-1-6-1 一般金屬電極晶 片……32 2-1-6-2 碳纖維電極晶 片……34 2-2 微電泳晶片實 驗……...36 2-2-1 儀器設 備……...…36 2-2-2 試 劑……...…38 2-2-3 實驗操 作……...…41 2-2-3-1 微電泳晶 片之清洗步驟與維護……...….41 2-2-3-2 微電泳晶片進樣 與分離……...….42 2-2-3-3 微電泳晶片效能檢 測……...….43 第三章 結果與討 論……...….48 3-1 碳纖維電極 之電泳晶片……...48 3-1-1 碳纖維電極 效能檢測……...…48 3-1-2 神經傳導物質於 碳纖維電極晶片檢測……...…49 3-2 微電泳晶片檢測與分離

參考文獻

第五章 參考文獻 [1] Madou, M. J. Fundamentals of Microfabrication: The Science of Miniaturization (2nd edition), CRC Press. [2] Yamazoe, N.；Hisamoto, J.；Miura, N.； Kuwata, S. “Potentiometric solid-state oxygen sensor using lanthanum fluoride operative at room temperature.” Sensors and Actuators, 12 (1987) 415-423. [3] Graber, N.；Luedi, H.；Widmer, H. M. “The use of chemical sensors in industry.” Sensors and Actuators, B: Chemical B1 (1990) 239-243. [4] Manz, A.；Graber, N.；Widmer, H. M. “Miniaturized total chemical analysis systems：a novel concept for chemical sensing.” Sensors and Actuators, B: Chemical B1 (1990) 244-248. [5] He, B.；Tait, N.；Regnier, F. “Fabrication of nanocolumns for liquid chromatography.” Analytical Chemistry 70 (1998) 3790-3797. [6] Harrison, D. J.；Manz, A.；Fan, Z.; Luedi, H.; Widmer, H. M. “Capillary electrophoresis and sample injection systems integrated on a planar glass chip.” Analytical Chemistry 64 (1992) 1926-1932. [7] Manz, A.；Harrison, D. J.；Verpoorte, E. M. J.；Fettinger, J. C.；Paulus, A.；Luedi, H.；Widmer, H. M. “Planar chips technology for miniaturization and integration of separation techniques into monitoring systems. Capillary electrophoresis on a chip.” Journal of Chromatography 593 (1992) 253-258. [8] Harrison, D. J.；Fluri, K.；Seiler, K.；Fan, Z.；Effenhauser, C. S.；Manz, A. “Micromachining a miniaturized capillary electrophoresis-based chemical analysis system on a chip.” Science (Washington, DC, United States) 261 (1993) 895-897. [9] Chrisey, L. A.；Lee G. U.；O'Ferrall C. E. “Covalent attachment of synthetic DNA to self-assembled monolayer films.” Nucleic acids research 24 (1996) 3031-3039. [10] Chrisey L. A.；O'Ferrall C. E.；Spargo B. J.；Dulcey C. S.；Calvert J. M. “Fabrication of patterned DNA surfaces.” Nucleic acids research 24 (1996) 3040-3047. [11] Cheng, J.；Shoffner, M. A.；Hvichia, G. E.；Kricka, L. J.；Wilding, P. “Chip PCR. II. Investigation of different PCR amplification systems in microfabricated silicon-glass chips.” Nucleic Acids Research 24 (1996), 380-385. [12] Lee, F. Lab-on-a-chip：The Revolution in

Portable Instrumentation, (2nd Edition), John Wiley & Sons. [13] 施宗廷 , 私立輔仁大學化學研究所 , 碩士論文 , 2004 . [14] 李慧玲 , 私立輔仁大學化學研究所 , 博士論文 , 2004 . [15] 曾以亞 , 私立輔仁大學化學研究所 , 碩士論文 , 2005 . [16] 鄭弘馳 , 私立輔仁大學化學研究所 , 碩士論文 , 2002 . [17] Eijkel, J. C. T.；van den B. A.；Manz, A. “Cyclic electrophoretic and chromatographic separation methods.” Electrophoresis 25 (2004) 243-252. [18] Keynton, R. S.；Roussel, T. J.；Crain, M. M.；Jackson, D. J.；Franco, D. B.；Naber, J. F.；Walsh, K. M.；Baldwin, R. P. “Design and development of microfabricated capillary electrophoresis devices with electrochemical detection.” Analytica Chimica Acta 507 (2004) 95-105. [19] Jacobson, S. C.；Koutny, L. B.；Hergenroeder, R.；Moore, A. W. J.；Ramsey, J. M. “Microchip Capillary Electrophoresis with an Integrated Postcolumn Reactor.” Analytical Chemistry 66 (1994) 3472-3476. [20] Fan, Z. H.；Harrison, D. J. “Micromachining of capillary electrophoresis injectors and separators on glass chips and evaluation of flow at capillary intersections.” Analytical Chemistry 66 (1994) 177-184. [21] He, B.；Tan, L.；Regnier, F. “Microfabricated filters for microfluidic analytical systems.” Analytical chemistry 71 (1999) 1464-1468. [22] Yan, J.；Yang, X.；Wang, E. “Fabrication of a poly(dimethylsiloxane)-based electrochemiluminescence detection cell for capillary electrophoresis.” Analytical Chemistry 77 (2005) 5385-5388. [23] Munce, N. R.；Li, J.；Herman, P. R.；Lilge, L. “Microfabricated System for Parallel Single-Cell Capillary Electrophoresis.” Analytical Chemistry 76 (2004) 4983-4989. [24] Tiselius, A. “A new apparatus for electrophoretic；analysis of colloidal mixtures.” Transactions of the Faraday Society 33 (1937) 524-531. [25] Hjerten, S. “Free-zone electrophoresis.” Arkiv foer Kemi 13 (1958) 151-152. [26] Virtanen, R. “Zone electrophoresis in a narrow-bore tube employing potentiometric detection. Theoretical and experimental study.” Acta Polytechnica Scandinavica, Chemistry Including Metallurgy Series 123 (1974) 67 pp. [27] Mikkers, F. E. P.；Everaerts, F. M.；Verheggen, T. P. E. M. “High-performance zone electrophoresis.” Journal of Chromatography 169 (1979) 11-20. [28] Jorgenson, J. W.；Lukacs, K. D. “Zone electrophoresis in open-tubular glass capillaries.” Analytical Chemistry 53 (1981) 1298-1302. [29] Terabe, S.；Otsuka, K.；Ichikawa, K.；Tsuchiya, A.；Ando, T. “Electrokinetic separations with micellar solutions and open-tubular capillaries.” Analytical Chemistry 56 (1984) 111-113. [30] Hjerten, S.；Liao, J.；Yao, K. “Theoretical and experimental study of high- performance electrophoretic mobilization of isoelectrically focused protein zones.” Journal of Chromatography 387 (1987) 127-138. [31] Cohen, A. S.；Karger, B. L. “High-performance sodium dodecyl sulfate polyacrylamide gel capillary electrophoresis of peptides and proteins.” Journal of Chromatography 397 (1987) 409-417. [32] Wilm, M.；Mann, M. “Analytical properties of the nano electrospray ion source.” Analytical Chemistry 68 (1996) 1-8. [33] Kennedy, R. T.；Jorgenson, J. W. “Preparation and evaluation of packed capillary liquid chromatography columns with inner diameters from 20 to 50 micrometers.” Analytical Chemistry 61 (1989) 1128-1135. [34] Yan, C.；Dadoo, R.；Zare, R. N.；Rakestraw, D. J.；Anex, D. S. “Gradient Elution in Capillary Electrochromatography.” Analytical Chemistry 68 (1996) 2726-2730. [35]

Woolley, A. T.；Lao, K.；Glazer, A. N.；Mathies, R. A. “Capillary Electrophoresis Chips with Integrated Electrochemical Detection.” Analytical Chemistry 70 (1998) 684-688. [36] Khandurina, J.；Jacobson, S. C.；Waters, L. C.；Foote, R. S.；Ramsey, J. M. “Microfabricated porous membrane structure for sample concentration and electrophoretic analysis.” Analytical chemistry 71 (1999) 1815-1819. [37] 林雲漢 , 私立輔仁大學化學研究所 , 碩士論文 , 2003. [38] Heiger, D. N. High Performance Capillary Electrophoresis – An Introduction,(2nd edition), Hewlett-Packard GmbH, Germany. [39] Ewing, A. G.；Wallingford, R. A.；Olefirowicz, T. M. “Capillary electrophoresis” Analytical chemistry 61 (1989) 292A-303A. [40] Bardelmeijer, H. A.；Waterval, J. C. M.；Lingeman, H.；Van't Hof, R.；Bult, A.；Underberg, W. J. M. “Pre-, on-, and post-column derivatization in capillary electrophoresis.” Electrophoresis 18 (1997) 2214-2227. [41] Waterval, J. C. M.；Lingeman, H.；Bult, A.；Underberg, W. J. M. “Derivatization trends in capillary electrophoresis.” Electrophoresis 21 (2000) 4029-4045. [42] Effenhauser, C. S.；Bruin, G. J. M.；Paulus, A. “Integrated chip-based capillary electrophoresis.” Electrophoresis 18 (1997) 2203-2213. [43] Xue, Q.；Foret, F.；Dunayevskiy, Y. M.；Zavracky, P. M.；McGruer, N. E.；Karger, B. L. “Multichannel Microchip Electrospray Mass Spectrometry.” Analytical Chemistry 69 (1997) 426-430. [44] Ramsey, R. S.；Ramsey, J. M. “Generating Electrospray from Microchip Devices Using Electroosmotic Pumping.” Analytical Chemistry 69 (1997), 1174-1178. [45] Xue, Q.；Dunayevskiy, Y. M.；Foret, F.；Karger, B. L. “Integrated multichannel microchip electrospray ionization mass spectrometry: analysis of peptides from on-chip tryptic digestion of melittin.” Rapid Communications in Mass Spectrometry 11 (1997) 1253-1256. [46] Zhang, B.；Liu, H.；Karger, B. L.；Foret, F. “Microfabricated Devices for Capillary Electrophoresis-Electrospray Mass Spectrometry.” Analytical Chemistry 71 (1999) 3258-3264. [47] Bings, N. H.；Wang, C.；Skinner, C. D.；Colyer, C. L.；Thibault, P.；Harrison, D. J. “Microfluidic devices connected to fused-silica capillaries with minimal dead volume.” Analytical Chemistry 71 (1999) 3292-3296. [48] Lazar, I. M.；Ramsey, R. S.；Jacobson, S. C.；Foote, R. S.；Ramsey, J. M. “Novel microfabricated device for electrokinetically induced pressure flow and electrospray ionization mass spectrometry.” Journal of Chromatography, A 892 (2000) 195-201. [49] Mangru, S. D.；Harrison, D. J. “Chemiluminescence detection in integrated post-separation reactors for microchip-based capillary electrophoresis and affinity electrophoresis.” Electrophoresis 19 (1998) 2301-2307. [50] Hashimoto, M.；Tsukagoshi, K.；Nakajima, R.；Kondo, K.；Arai, A. “Chemiluminescence detection in microchip capillary electrophoresis.” Chemistry Letters 8 (1999) 781-782. [51] Olefirowicz, T. M.；Ewing, A. G. “Capillary electrophoresis with indirect amperometric detection.” Journal of Chromatography 499 (1990), 713-719. [52] Http://www.web-books.com/MoBio/Free/Ch3B.htm [53] Palecek, E. “Oscillographic polarography of highly polymerized deoxyribo- nucleic acid.” Nature (London, United Kingdom) 188 (1960) 656-657. [54] Yan, F.；Erdem, A.；Meric, B.；Kerman, K.；Ozsoz, M.；Sadik, O. “Electrochemical DNA biosensor for the detection of specific gene related to Microcystis species.” Electrochemistry

Communications 3 (2001) 224-228. [55] Napier, M. E.；Thorp, H. H. “Modification of Electrodes with Dicarboxylate Self-Assembled Monolayers for Attachment and Detection of Nucleic Acids.” Langmuir 13 (1997) 6342-6344. [56] Johnston, D. H.；Glasgow, K. C.；Thorp, H. H. “Electrochemical Measurement of the Solvent Accessibility of Nucleobases Using Electron Transfer between DNA and Metal Complexes.” Journal of the American Chemical Society 117 (1995) 8933-8938. [57] Sistare, M. F.；Holmberg, R. C.；Thorp, H. H. “Electrochemical Studies of Polynucleotide Binding and Oxidation by Metal Complexes: Effects of Scan Rate, Concentration, and Sequence.” Journal of Physical Chemistry B 103 (1999) 10718-10728. [58] Heller, A. “Spiers Memorial Lecture. On the hypothesis of cathodic protection of genes.” Faraday discussions 116 (2000) 1-13. [59] Brooks, S.C. and Richter, M.M. The Chemical Educator. Vol. 7, No. 5 . [60] 莊達人, VLSI 製造技術, 高立圖書有限公司, 1995. [61] Skoog, D.A.；Holler, F.J.；Nieman, T.A. Principles of Instrumental Analysis, (fifth edition), Thomson Learning. [62] Huang, W.H.；Pang, D.W.；Tong, H.；Wang, Z.Li.；Cheng, J.K. “A method for the fabrication of low-noise carbon fiber nanoelectrodes.” Analytical Chemistry 73 (2001) 1048-1052. [63] Chen, R.S.；Huang, W.H.；Tong, H.；Wang, Z.Li.；Cheng, J.K. “Carbon fiber nanoelectrodes modified by single-walled carbon nanotubes.” Analytical Chemistry 75 (2003) 6341-6345. [64] Kara, P.；Kerman, K.；Ozkan, D.；Meric, B.；Erdem, A.；Ozkan, Z.；Ozsoz, M. “Electrochemical genosensor for the detection of interaction between methylene blue and DNA.” Electrochemistry Communications 4 (2002), 705-709. [65] Situmorang, M.；Gooding, J. J.；Hibbert, D. B.；Barnett, D. “The development of a pyruvate biosensor using electrodeposited polytyramine.” Electroanalysis 14 (2002) 17-21. [66] Payan, E.；Presle, N.；Lapicque, F.；Jouzeau J. Y.；Bordji, K.；Oerther, S.；Miralles, G.；Mainard, D.；Netter, P. “Separation and quantification by ion-association capillary zone electrophoresis of unsaturated disaccharide units of chondroitin sulfates and oligosaccharides derived from hyaluronan.” Analytical chemistry 70 (1998) 4780-4786. [67] Ahmed, A.；Ibrahim, H.；Pastore, F.；Lloyd, D. K. “Relationship between Retention and Effective Selector Concentration in Affinity Capillary Electrophoresis and High-Performance Liquid Chromatography.” Analytical Chemistry 68 (1996) 3270-3273 [68] Http://www.galcit.caltech.edu/Seminars/Fluids/PastFluids/2002-2003/White_abs.html. [69] Sanders, J. C.；Breadmore, M. C.；Kwok, Y. C.；Horsman, K. M.；Landers, J. P. “Hydroxypropyl cellulose as an adsorptive coating sieving matrix for DNA separations: Artificial neural network optimization for microchip analysis.” Analytical Chemistry 75 (2003) 986-994. [70] Smith, J. T.；Rassi, E.Z. “Capillary zone electrophoresis of biological substances with fused silica capillaries having zero or constant electroosmotic flow.” Electrophoresis 14 (1993) 396-406. [71] Mitnik, L.；Salome, L.；Viovy, J. L.；Heller, C. “Systematic study of field and concentration effects in capillary electrophoresis of DNA in polymer solutions.” Journal of Chromatography, A 710 (1995) 309-321. [72] Willard, H.；Merritt,；Dean, J.；Sttle, F. Instrumental Methods of Analysis,(7th edition), Wadsworth Publishing Company.

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