國科會專題專題研究成果報告

計劃名稱：毛細管電泳對環境污染物及藥物分離之研究 II
計劃編號：NSC-89-2113-M-002-037
執行期限：88 **年** 8 **月** 1 **日至** 89 **年** 7 **月** 31 **日**
計劃主持人：林敬二　　執行單位：國立台灣大學化學系
研究生：林國勝、邱泰嘉、劉宇智、楊宗穎、戴斌峰、陳鴻文、楊筑棨、黃惠淳

第一部份　毛細管電泳對環境污染物 triazines 分離之研究

1 A、計劃緣由與目的

Triazines **為廣泛使用之除草劑，因具毒性與持久姓，對環境造成之污染實在不可忽視，其中以** chlorotriazines **最為嚴重。因此對** triazines **之分離及分析是個相當重要的研究課程。**

此計畫是以毛細管區帶電泳法(CZE)**及微胞電動法**(MEKC)**對** triazines **最佳化的分離及其電泳遷移律行為加以探討，並對陽離子界面活性劑之臨界微胞濃度值**(CMC)**測定方法加以探討。**

1 B、結果與討論

去年之研究工作主要以 MEKC **法探討** triazines **之分離與其電泳遷移行為，此部份之研究結果已發表於** *J. Chromatogr. A*, 835 (1999) 349-357.**本年度之研究工作著重於以** CZE **法探腦討** chlorotriazines **之分離及分離機制，並對陽離子界面活性劑**(TTAB **及** DTAB)**之臨界微胞濃度加以測定。此部份之研究結果已分別發表於** *J. Chromatogr. A*, 878 (2000) 137-145 **及** *J. High Resol. Chromatogr.* 22 (1999) 265-270**。**

1 C、計劃成果自評

此研究計劃之研究已完全達成。

1 D、參考文獻

見研究結果所發表之期刊。

第二部份　毛細管電泳對 β-阻斷劑藥物分離之研究

2 A、計劃緣由與目的

β-阻斷劑適用於治療心血管疾病、常用藥物。在臨床上及心律不整及 angina pectoris **之治療相當有效。因此發展快速而有效的檢驗方法也是一個重要的研究課題。**

此計畫是以毛細管區帶電泳法(CZE)**及微胞電動法**(MEKC)**對 β-阻斷劑最佳化的分離及其電泳遷移律行為加以探討。在** MEKC **法上，選用陽離子界面活性劑。**

2 B、結果與討論

此部份之研究結果已發表於 *J. Chromatogr. A*, 753 (1996) 133-138, 776 (1997) 362-364 **及** 775 (1997) 349-357**。尚有部分資料仍待整理發表。**

2 C、計劃成果自評

此研究計劃之研究內容雖已達成，但在探討陽離子界面活性劑種類之效應上，仍有部分資料尚未整理發表。

2 D、參考文獻

見研究結果所發表之期刊。

附錄一

Capillary zone electrophoretic separation of neutral species of chloro-*s*-triazines in the presence of cationic surfactant monomers

Ching-Erh Lin* , Ta-Zen Wang, Hui-Chun Huang, Chung-Chuan Hsueh, Yu-Chih Liu
Journal of Chromatography A, 878 (2000) 137-145
Department of Chemistry, National Taiwan University,
Taipei, Taiwan

Abstract

Chloro-*s*-triazines are difficult to separate by capillary zone electrophoresis (CZE), due to their low p*K* values. However, a these analytes can be effectively separated by CZE in the presence of cationic surfactant monomers, such as tetrade-cylammonium bromide (TTAB) and dodecyltrimethylammonium bromide (DTAB). The separation mechanism based on a 1:1 binding of analytes to cationic surfactant monomers is proposed. The binding constants of chloro-*s*-triazines to cationic surfactant monomers are estimated. The results show that the strength of the interactions of these analytes with TTAB monomers is considerably strong, whereas that of the corresponding analyte with DTAB monomers is about 12- to 14-fold weaker. A linear correlation of binding constants with log *P*ow (the logarithm of the partition coefficient of analytes between 1-octanol and aqueous phases) indicates that the migration order of these chloro-*s*-triazines depends primarily on their hydrophobicity. Moreover, the skewed peaks of chloro-*s*-triazines observed may reveal the occurrence of adsolubilization of these analytes in the adsorbed cationic surfactant layer on the capillary surface.

附錄二

Determination of the Critical Micelle Concentration of Cationic Surfactants by Capillary Electrophoresis

Ching-Erh Lin*, Ta-Zen Wang, Tai-Chia Chiu, Chung-Chuan Hsueh
Journal of High Resolution Chromatography, 22 (1999) 265-270
Department of Chemistry, National Taiwan University,
Taipei, Taiwan

Abstract

The determination of the critical micelle concentration (CMC) of cationic surfactants by capillary electrophoresis was demonstrated. In this study, tetradecyltrimethylammonium bromide (TTAB) and dodecyltrimethylammonium bromide (DoTAB) were selected as cationic surfactants and propazine was chosen as test solute. In the evolution of the effective electrophoretic mobility of propazine as a function of surfactant concentration, a dramatic change in slope at a particular concentration is a good indication of the CMC of this surfactant. The CMC values determined experimentally were further confirmed by a curve-fitting approach. Simulation of the electrophoretic mobility curves as a function of surfactant concentration in both micellar electrokinetic chromatography and capillary zone electrophoresis using cationic surfactants as an electrolyte modifier was performed for propazine, and the intersection of these two mobility curves allowed us to precisely predict the CMC of the surfactant. The CMC values determined for TTAB and DoTAB are 1.6± 0.1 and 11.0± 0.1 mM, respectively, in the case of an electrolytic solution consisting of 70 mM phosphate buffer at pH 6.0. Moreover, the applicability of the electroosmotic mobility as a parameter for the determination of the CMC was examined.

附件：出席國際會議之出國報告及發表之論文

出席國際學術會議報告書　　89 年 7 月 14 日

報告人姓名	**林敬二**	**服務機關名稱及職務**	**國立台灣大學 化學系教授**
會議期間及地點	89 年 6 月 25-30 日 **美國，西雅圖市**	**國科會研究計劃**	NSC 89-2113-M-002-037
會議名稱	(**中文**) **第** 24 **屆高效能液相分離國際研討會議** (**英文**) 24th International Symposium on High Performance Liquid Phase Separation		
發表論文題目	(1) (**中文**) **以毛細管電泳法研究**β-**環糊精對** SDS **的** CMC **值的影響** (**英文**) Influence of β-Cyclodextrin on the CMC of SDS by capillary electrophoresis (2) (**中文**) **以** MEKC **法研究氯砒啶之分離** (**英文**) Separation of Chloropyridines by MEKC		

報告內容

一、參加會議經過：

第 24 **屆高效液相分離國際研討會於美國西雅圖市舉行。會期為** 6 **月** 25-30 **日,** 2000 **年，由美國** Iowa **州立大學的** Eduard S. Yeung **教授籌辦。此次研討會主要由** ThermoQuest, Waters, PE, PE Biosystems, Agilent Technologies, Beckman Coulter, BIA Separations **等儀器廠商，美國化學會分析小組加州分離科學學會，美國各地層析及分離學會，及** Elsevier Science **出版商共同協辦。**

此次研討會共有口頭論文及壁報論文共六百餘篇的發表。參加人數約有六、七百人，場面相當熱絡。大會於 6 **月** 25 **日晚上舉行酒會招待。**26 **日上午九點正式揭幕，並由美國** Sequenom **公司的** C. R. Cantor **博士，瑞典** Lund Univ. **的** K. Mosbach **教授及挪威** Rikshospitalet **醫院的** E. Jellum **博士為主講人展開為期五天的學術活動。今年的研討主題包括下列** 16 **項：**

1. New directions in CE/MEKC
2. Method development & validation
3. Pharmaceutical and combinatorial analysis
4. New directions in HPLC
5. Advances in electrochromatography
6. Miniaturized & Chip Techniques
7. Novel applications
8. Fundamental concepts & retention mechanisms
9. New developments & advances in separation technology
10. Hyphenated techniques
11. Analytical biotechnology
12. Chiral recognition and separation
13. Sample manipulation & purification
14. Characterization of column materials
15. Preparative Technology
16. Detection & Instrumentation

除了大會專題演講外，學術研討分三組三個場地同時進行。本屆壁報論文之數目約如往年一樣熱絡，大會也在會前舉辦講習會 (workshop)**。而多家儀器廠商，如** ThermoQuest, Agilent Technologies, PE Biosystems, Akzo Nobel/EKa Chemicals, Waters, Merck, Bruker Analytik, Beckman, BIA Separations **等，也分批於下午五點到六點間舉行工業界的書報討論** (industrial seminar)**，參加人數甚多，由此可見與會人員對新技術及儀器的發展甚為關切。**

研討會所邀請的國際知名學者甚多且所發表之論文實在太多，而時間有限，且口頭報告之論文又分三組同時進行，筆者也只能就與個人的研究興趣或研究領域較為相關的

論文去觀摩或聆聽，顯得遺憾。在整個會程中特別值得筆者留意的議程(Session)包括 Sessions 1, 5, 7, 8 及 12。

在此研討會中，筆者提出兩篇論文發表 – 論文題目為：

(1) Influence of β-Cyclodextrin on the CMC of SDS by capillary electrophoresis

(2) Separation of Chloropyridines by MEKC

此外，台中榮總的陳甫州博士及中國醫藥研究所的陳介甫及蔡東湖教授亦參予盛會。

二、與會心得：

此次參加液相分離國際研討會，除了能多了解此研究領域進展的現況，吸收新知識，交換研究心得之外，並能認識一些國際知名學者及交談，實在獲益不少。此次研討會所發表的論文實在很多，值得觀摩學習的論文不少，台灣學者應該多多參加。

三、考察參觀活動：除參觀儀器展外，大會未有安排。

四、攜回資料：論文摘要(CD)乙片。

五、建議：

參加國際學術研討會，不僅參加者能增廣見聞與學識，也可讓國際人士瞭解台灣學者的研究成果，應多加鼓勵參加。

附錄一、

Influence of -Cyclodextrin on the Critical Micelle Concentration of Sodium Dodecyl Sulfate：A Capillary Electrophoresis Study

Ching-Erh Lin*, Hui-Chun Huang, and Hung-Wen Chen
Department of Chemistry, National Taiwan University
Taipei, Taiwan

Abstract

The influence of β-cyclodextrin (β-CD) on the critical micelle concentration (cmc) of sodium dodecyl sulfate (SDS) was investigated by capillary electrophoresis using anionic chlorophenols as probe molecules at pH 7.0. The variations of the electrophoretic mobility of probe molecules as a function of surfactant concentration in both premicellar and micellar regions in the absence and presence of β-CD was analyzed. The results indicate that, as a consequence of a strong inclusion complexation between β-CD and SDS, the encapsulation of β-CD with probe molecules is greatly diminished, or even vanished, in the presence of SDS. The complexes formed between β-CD and SDS monomers exist predominantly in the form of a 1:1 stoichiometry, while the complexes with a 2:1 stoichiometry reported previously in the literature as a minor component may exist by less than 10 %. The elevation of the cmc value of SDS depends not only on the concentration of β-CD in the buffer electrolyte but also on methanol content in the sample solution. The binding constants of probe molecules to β-CD, to surfactant molecules, and to the complexes formed between β-CD and SDS are reported.

附錄二、

Optimization of Separation and Migration Behavior of Chloropyridines in Micellar Electrokinetic Chromatography

Ching-Erh Lin[(1)]*,Chia-Chong Chen[(1)], Hung-Wen Chen[(1)], Hui-Chun Huang[(1)], Chen-Hsing Lin[(2)], and Yu-Chih Liu[(1)]

(1) Department of Chemistry, National Taiwan University Taipei, Taiwan

(2) Department of Applied Chemistry, Foo-Ying Institute of Technology, Ta-Liao, Kao-hsung Country, Taiwan

Abstract

The separation and migration behavior of pyridine and eight chloropyridines, including three monochloropyridines, four dichloropyridines, and 2,3,5-trichloropyridine were investigated by micellar electrokinetic chromatography using either sodium dodecyl sulfate (SDS) as an anionic surfactant or SDS-Brij 35 mixed micelles. Various parameters such as buffer pH, SDS concentration, Brij 35 concentration and methanol content that affect the separation were optimized. Complete separation of these chloropyridines was optimally achieved with a phosphate buffer containing SDS (30 mM) and methanol (10 %, v/v) at pH 7.0. The resolution and selectivity of analytes could be considerably affected by the addition of methanol and/or Brij 35 to the background electrolyte. The migration order of these chloropyridines depends primarily on their hydrophobicity. However, electrostatic interactions may also play a significant role in the determination of the migration order of the positional isomers of chloropyridines.