出國報告（出國類別：開會）

參加國際環境污染鑑識會議

－2010 環太平洋化學國際研討會

服務機關：行政院環境保護署環境檢驗所

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派赴國家：美國 夏威夷州

出國期間：**99** 年 **12** 月 **14** 日至 **21** 日

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摘　要

爲積極參與國際學術活動，持續蒐集國際間環境污染鑑識之最新訊息及發展技術，本所派員參加本（99）年於美國夏威夷州檀香山市所舉行之 2010 環太平洋化學國際研討會（2010 International Chemical Congress of Pacific Basin Societies），除了發表論文一篇分享本所工作成果外，亦期望由此研討會汲取各先進國家於環境鑑識的技術及經驗，使本所之鑑識技術發展能與國際接軌，並於未來 對環境污染物鑑識及追蹤做更精確的評估。

Pacifichem 2010 是一個非常大型的研討會，其討論的內容包含所有化學相關的領域，除了分析化學、無機化學、高分子化學、有機化學、物理化學外，還包含農業化學、生物化學、環境化學、材料（含奈米技術）化學、替代能源技術、健康安全等等。環境鑑識爲環境化學下的一個討論會，其相關論文發表共 15 篇，包含 13 篇口頭報告及 2 篇壁報發表，其中 9 篇爲有機物污染鑑識（包含：油品、海上溢油、碳氫化合物、含氯有機溶劑、PAHs、脂肪醇等等） 4 篇爲無機污染物鑑識（包含：空氣微粒中重金屬、水中無機鹽及水中重金屬） ,其他爲鑑識經驗、方法、生物復育等研究。

本次研討會在環境鑑識這一領域所發表的論文，其所用的儀器設備包含 GC-MS、HPLC、IRMS、GC×GC-TOFMS、ICP-MS、LA-ICP-MS、XAS、SEM/EDS 等。目前檢驗所除了 LA-ICP-MS、XAS、SEM/EDS 外，幾乎都有裝置一台以上。其他之貴重儀器還包含 XRF、XRD、HRGC/HRMS、LC/MS-MS 等，故本所之儀器設備於環境鑑識領域已算健全且達到甚至高過國際水準。若能再建立數值模式之技術配合 GIS 系統，於環境鑑識領域會更趨完善。

目　　次

壹、 目的

全名 2010 International Chemical Congress of Pacific Basin Societies 的 2010 環太平洋化學國際研討會（Pacifichem 2010）是一個很盛大的國際研討會，此會議是由美國化學會，加拿大化學會，日本化學會，紐西蘭化學會，澳洲化學會，韓國化學會和中國化學會所聯合舉辦的。自 1984 年起每五年於夏威夷舉辦一次，今（2010）年是第六屆，今年的主題是化學、技術及全球環境。其願景是促進太平洋地區化學家的合作，提高世界人民的生活品質，並關注化學業界最新的發展動態。

由於環境污染案件層出不窮，爲了釐清責任歸屬，使得環境法醫鑑識技術近年來漸受到全世界關注。環檢所爲了積極發展環境法醫鑑識技術， 派員參加本研討會，期在會議中經由各專家學者所發表的最新論文，瞭解現今各國於環境污染鑑識之技術發展及經驗分享，以作爲國內相關議題之參考。本次參加 2010 環太平洋化學國際研討會主要具體目的爲：

一、發表壁報展示論文一篇，分享本所於環境鑑識之研究成果。

二、積極參與國際活動，持續蒐集最新環境污染鑑識技術。

三、與環境法醫相關學者及研究機構交流聯繫，作爲未來經驗與技術交流之基礎。

四、瞭解先進國家檢測技術及分析方法之發展。

貳、 會議過程

2010 環太平洋化學國際研討會於 99 年 12 月 15 至 20 日，假美國夏威夷州檀香市夏威夷會議展覽中心（Hawaii Convention Center）、希爾頓夏威夷度假村（Hilton Hawaiian Village）、喜來登威基基酒店（Sheraton Waikiki）及皇家夏威夷飯店（Royal Hawaiian Hotel）等四個地方舉行（圖 1）。

Hawaii Convention Center; Hilton Hawaiian Village;
Sheraton Waikiki; and the Royal Hawaiian Hotel

圖 1 大會會場

全名 2010 International Chemical Congress of Pacific Basin Socienties 的環太平洋化學國際研討會是一個很盛大的國際研討會，此會議是由美國化學會，加拿大化學會，日本化學會，紐西蘭化學會，澳洲化學會，韓國化學會和中國化學會聯合舉辦，並由加拿大化學會主辦。自 1984 年起每五年舉辦一次，舉辦的地點爲夏威夷歐胡島的檀香山市，因其座落在太平洋的中心，且約 2/3 的世界人口分布圍繞著歐胡島。Pacifichem 2010 是第六屆，其主題是化學、技術及全球環境。這次會議的目的是促進太平洋地區化學科學家間的合作，提高世界各地人民的生活品質，並關注化學業界最新的發展動態。自 1984 年第一次舉行以來，本研討會呈極大的發展。本次研討會總共收到 69 個國家超過 13500 篇的論文，有 235 個討論會共 1092 場次的口頭及壁報發表。註冊參加會議的人至少 20000 人，是難得一見的化學盛會。

口頭論文的發表在喜來登威基基酒店、皇家夏威夷飯店、希爾頓夏威夷度假村及夏威夷會議展覽中心等四個地方分組進行，時間是上午 07:30-11:30，下午 12:30-16:30 及晚間 19:00-21:00。所有的壁報發表都在夏威夷會議展覽中心一樓進行，時間是上午 10:00-12:00 及晚間 19:00-21:00。儀器化學品及應用軟硬體展覽於 12 月 16-18 日於希爾頓度假村的珊瑚廳及其門廊舉行，最主要的攤位來自出版社及軟體公司。不同會場之間的交通大會安排免費的接駁巴士，與會者可依自己的需求及興趣規劃行程。

本次研討會之論文專題包含 3 大類 13 個主題，各領域及其主題如下：

I. The core Area of Chemistry

1. Analytical
2. Inorganic
3. Macromolecular
4. Organic
5. Physical, Theoretical & Computational

II. Multi- and Cross-Disciplinary Area of Chemistry

6. Agrochemistry
7. Biological Chemistry
8. Environmental Chemistry
9. Materials & Nanotechnology

III. Challenges and Opportunities

10. Alternate Energy Technology
11. Chemistry Outreach to the Community
12. Health & Technology
13. Security

各主題都包含很多個副主題，共有 235 個討論會。

其中與本所業務較相關的主題爲 Analytical 及 Environmental Chemistry。

Analytical 之主題共含有下列 19 個討論會：

1. On-site & In vivo Instrumentation & Applications
2. Innovation in Chemical Sensing & Separation Systems toward Advanced Chemical Analysis
3. Recent Advances in Bioanalysis：Ultrasmall Volumes, Global Metabolite

Profiling & Single Cells

4. Optical Waveguide Techniques for the Analyses of Materials & Interfaces
5. New Frontiers of Plasma Spectrochemistry
6. New Frontiers in Separation Science
7. Analytical Applications & New Technique Developments of Soft X-ray Spectroscopy
8. Ionic Liquids for Analytical Chemistry & Analytical Chemistry for Ionic Liquids
9. Fluorescent Sensors by Design
10. Comprehensive Multidimensional Separations
11. Electroanalytical Sciences
12. Microfluidec & Nanofluidic Devices for Chemical & Biochemical Experimentation
13. Analytical & Environmental Chemistry in Human Health
14. Advances in Flow-Based Analytical Techniques
15. Rapid, Multicomponent Environmental Analysis
16. （Bio-）Chemical/Electrochemical Sensors & Sensing Materials
17. Novel Applications of Magnetic Fields in Analytical Chemistry
18. Non- & Minimally Invasive Diagnostics of Biological Systems using Vibrational Spectroscopy
19. Enabling Mass Spectrometric Techniques for Proteomics

而 Environmental Chemistry 主題含有下列 13 個討論會：

1. Interfacial & Disinfection Chemistry：Fate, Transport & Adsorption of Pathogens, Nanoparticles, Biocolloids & Trace Organics if Aquatic Systems
2. Environmental Forensics
3. Chemistry of Ultraviolet Treatment for Water
4. Sources, Transport, Fate & Behavior of Global Contaminants
5. Free Radical Chemistry in the Environment
6. Environment-Friendly Syntheses Using Ionic Liquids
7. Recycling Of Polymeric Waste Materials ：Challenges & Perspectives
8. Green Electrochemistry

9. Chemistry of Post-Combustion Carbon Dioxide Capture
10. Environmental Chemistry of Aerosols
11. Sonochemistry & Sonoprocessing
12. Innovative Green Chemistry with Microwave
13. Challenges of Heterogeneous Catalysts for Environmentally Benign Materials Conversions

大會於 12 月 14 日下午開始受理報到；而 12 月 15 日至 20 日是口頭及壁報論文發表時間，議程如附件一；於 12 月 20 日中午結束所有議程。

圖 2 夏威夷會議展覽中心大會報到櫃台

圖 3 壁報展示會場

參、心 得

一、 Pacifichem 2010 是一個非常大型的研討會，其討論的內容包含所有化學相關的領域，除了分析化學、無機化學、高分子化學、有機化學、物理化學外，還包含農業化學、生物化學、環境化學、材料（含奈米技術）化學、替代能源技術、健康安全等等。由於此一研討會包含了超過 13,000 份研究論文以口頭或海報形式陳述，所以議程非常的緊湊和豐富，同一時間有相當多場次的演講，與會者除了可以選擇與自己研究領域相關的議程外，亦可參加其他有興趣的場次，吸收不同領域的知識及研究成果。這次參加會議主要目的爲蒐集國際間環境污染鑑識之最新訊息 和發展技術並發表環境鑑識 相關論文一篇，但在會議中除了環境鑑識外亦可聆聽其他主題之研究成果，如與環境檢驗所之業務相關之環境污染物分析的最新技術及儀器應用等相關主題。

二、 於研討會中，環境鑑識是在 Environmental Chemistry 中之一個討論會，本研討會有關環境鑑識之論文發表共 15 篇，包含 13 篇口頭報告及 2 篇壁報發表，將其摘錄如下：

I.口頭發表

1. Fast oil fingerprinting analysis using commercial solid phase extraction（SPE）and gas chromatography-mass spectrometry（GC-MS）

C. Yang[1]; Z. Yang[1]; Z. Wang[1]; B. Hollebone[1]; C. Brown[1]; M. Landriault[1]
1. Emergencies Science and Technology Section , Environment Canada, Ottawa, ON, Canada.

溢油之鑑識大多以分析一系列汽油碳氫化合物之化學指紋爲基礎。用活性矽膠所填充的層析管柱廣泛地應用在將石油烴分餾成脂肪族和芳香族，這些物質隨後再經由 GC-FID 及 GC-MS 分析。然而，製備和活化矽膠需要有經驗的操作者，且層析管柱之淨化是很耗時及乏味的。爲了響應溢油事件之快速鑑識且達到大量例行性樣品分析之目的，發展快速及可靠的分離及表徵油品之分析方法是必要的。本研究評估不同之商業化固相萃取(SPE)管柱對石 油樣品分餾之效果。特徵碳氫化合物包 括正烷烴（n-alkanes），烷基化多環芳烴（alkylated PAHs），生物指標萜烷和類固烷（biomarker terpanes and steranes） 類金剛和雙環類倍半萜烷（diamondoids and bicyclic sesquiterpanes）。結果發現 SiO_2/C_3-CN（1.5g, 6ml）之管柱展現最佳的選擇性，油品裝載在此種 SPE 管柱上分別再經由 4 ml 的 hexane 及

4 mL 的 hexane-DCM（1:3,v:v）淋洗後，可以很成功的分離出脂肪族和芳香族。SiO_2/C_3-CN（1.5g, 6ml ）之管柱於油品的量低於 40 mg 時，展現出很好之線性。以 SPE-GC/MS 分別對 5 mg 之參考油品做五重複分析得到很好的重複性，對於正烷烴、多環芳烴及生物指標之相對標準偏差分別爲 5.2%、6.1%及 3.2%。對於六種氘擬似標準品的回收率都在 95%以上。此方法被應用在很多原油及油品的指紋。目標化合物的濃度及診斷率都與傳統矽膠管柱 GC/MS 方法相當。

2. Source identification of hydrocarbons following spill events

D. A. Birkholz[1]
1. Centre of Excellence, ALS Laboratory Group, Edmonton, AB, Canada.

在加拿大艾伯塔省（Alberta, Canada）之碳氫化合物洩漏已經發生了幾十年了。2007 年一整年就有超過 1500 個洩漏事件被通報到加拿大能源保護局（Energy Resources Conservation Board）。對於第一階段及第二階段審查，支持產權交易找到碳氫化合物污染並不意外。執行這些審查的委員通常會問的問題爲：這是什麼?來自哪裡?時間多久了?回答這些問題引發了很多碳氫化合物鑑識之興趣。作者參與了很多處理汽油、噴氣燃料、燃油 C 和 2＃燃料油污染土壤和地下水的議題。發現用特定芳香族化合物和多環芳烴類化合物之比例來區分碳氫化合物來源是一種強大的工具，此結果與之前所找到的文獻資料結果一致。

3. Numerical simulation of the trajectory and fate of spilled oil at sea

D. Xiong[1]
1. Environmental Sci&Eng., Dalian Maritime University, Dalian, China.

只要原油於海上生產且經由船隻或輸油管於海上運輸，就會有產生重大環境危害之溢油風險。香港超級油輪「河北精神號」（Hebei Spirit）2007 年造成南韓海域歷來最嚴重的漏油事件，以及近年來之溢油事件已經顯示石油污染對當地經濟和環境造成高風險及危害。爲了將漏油事件之損害降至最低，必須迅速作出反應和適當的戰略。準確地預測溢油行爲對成功恢復操作和保護海洋資源是至關重要的。因此，數值模式及模擬海上溢油事件於海上溢油之緊急應變和決策扮演很重要之角色。採用物理模擬溢油的三維水動力潮流、軌跡、宿命爲基礎，一個整合的數值模擬技術被開發用來做溢油的行爲之即時預測。軌跡主要受風速及表面潮汐之影響。對於宿

命之模式，水平熱對流之風化作用、擴散、蒸發、乳化和海岸線的互動都包括在內。作者以發生在中國廣東省珠江河口之溢油事件作爲事後預報(hindcast)並與所得到之數據比較作爲案例研析。模擬結果顯示於有限的環境輸入數據時，溢油模型可以提出溢油行爲軌跡合理的估計，爲了未來能精確即時地預測溢油過程，海洋環境的資料庫應該再改善。

4. Soil- and air borne polycyclic aromatic hydrocarbons in the United States/Mexico border region

W. Lee[1, 2]; R. J. De La Torre[2]; L. M. Santiago[1]
1. Chemistry, University of Texas at El Paso, El Paso, TX, United States.
2. Environmental Science and Engineering Ph.D. Program, University of Texas at El Paso, El Paso, TX, United States.

多苯環碳氫化合物（PAHs）爲含兩個苯環以上之有機化合物，可能是人爲產生然後經由大氣短程或長程傳輸到其他地方。本計畫主要是研究在 El Paso/Juarez 邊境地區 PAHs 可能之排放源。本研究總共收集 106 個點的土壤樣品及 19 個點的空氣樣品。土壤樣品被分爲六類包含工業的、農業的、城市的、娛樂的、學校的及偏遠的點；而空氣樣品之採樣點則爲代表高交通及低交通流量之地區。空氣樣品同時在夏天及冬天採集。使用磁轉子吸附萃取（stir bar sorptive extraction）結合熱脫附及 GC-MS 分析樣品。於土壤樣品中之 PAHs 範圍爲 0.1 - 2225.5 μg/kg；於空氣樣品中之 PAHs 範圍爲 6.8 – 1410.5 ng/m ^{3}。使用地理資訊系統（geographic information system）可以得到 PAHs 之分佈地圖。其結果顯示 PAHs 之濃度值可能與交通有關。再者，PAHs 的診斷比率分析（diagnostic ratio analysis）確定污染的主要來源可能是源自汽車廢氣。這個結果排除了石油煉製爲地區性 PAHs 污染主要來源的可能性。但是他們也提出在 El Paso 土壤和空氣樣品中發現的 PAHs 與人類活動息息相關，如交通及工業製程。本研究爲此類型第一個全面性的研究，可以提供研究人員及大眾有關美國及墨西哥邊境 PAHs 的濃度及分布狀況。

5. Atmospheric pollution of polycyclic aromatic hydrocarbons and nitropolycyclic aromatic hydrocarbons in East Asia

K. Hayakawa[1]; N. Tang[1]; A. Izaki[1]; T. Kameda[1]; A. Toriba[1]
1. Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kanazawa, Japan.

多環芳香烴化合物（polycyclic aromatic hydrocarbons, PAHs）及硝基多環芳香烴化合物(Nitro-polycyclic aromatic hydrocarbons, NPAHs) 是普遍存

在的環境污染物質且其多具致癌或致突變性，其中幾個羥基衍生物也會干擾內分泌活動。作者使用 HPLC 搭配螢光 (fluorescence)及化學發光 (chemiluminescence)偵測器發展一個高感度的 PAHs 及 NPAHs 檢測方法，並用此方法找到 PAHs 及 NPAHs 的來源。此研究組織一個國際偵測網，包含日本、中國、南韓和俄羅斯以監測大氣中的 PAHs 及 NPAHs。結果顯示，城市空氣中 PAHs 及 NPAHs 的濃度在中國顯著高於其他國家，其主要來源爲在日本及南韓的汽車排放。 眾所皆知，汽車數量近年來顯著增加，故中國政府必須宣布新的環境政策。再者，除了日本及南韓外，中國汽車排氣控制也必須加強。爲了持續的發展，評估上述對策之效果是非常重要的。報告中敘述了 PAHs 及 NPAHs 大氣污染程度之改變及十年來其於東亞之主要來源。

6. Why chlorinated solvent investigation requires compound specific isotope analysis

Y. Wang[1]
1. ZymaX Forensics, Escondido, CA, United States.

含氯有機溶劑（chlorinated solvent）爲地下水中最常被檢測出之污染物質，因其自 1940 年早期即廣泛地被使用。這些化合物因溢出、洩漏及不當棄置而導致土壤及水遭受不同程度之污染。在很多的案例中，含氯有機溶劑污染團之來源不明而環境訴訟變成必須要的。除了傳統鑑識技術外，含氯有機溶劑 調查需要一個獨特之技術， 特定化合物同位素分析（compound-specific isotope analysis，CSIA）。作爲一個迅速崛起的分析方法，由 CSIA 所獲得之含氯有機物分子同位素特徵（^{13}C, ^{37}Cl 及 ^{2}H）可以回答以下往往不可能單由濃度測試就能釐清之問題。1.若四氯乙烯(PCE)或三氯乙烯(TCE)在一個污染團中，是來自一個或是多個污染源（混合污染團，co-mingled plume ）？2.若 PCE 或 TCE 在不同污染團中，是來自相同或不同來源？3.若 TCE 在 PCE 的污染團中，是來自 PCE 的降解，或是另一個 TCE 來源? 4. 若是爲混合污染團則其費用如何分配? 5. 確定降解機制、程度及速率 6.尋找更具成本效益之整治技術等等。針對訴訟焦點之超過 15 家乾洗店場址，對碳、氫及氯之 CSIA 已經被建立來檢測土壤及地下水中含氯有機溶劑同位素比值。在東岸的一個場址，PCE、TCE 及順式-1,2-

二氯乙烯(cis-DCE)之同位素比值在地下水樣品中被檢測出。碳和氯的同位素比值指出該場址至少有三個污染源，以兩個 PCE 的污染團及一個 TCE 污染團爲代表。TCE 之氫同位素比值進一步指出，上述之 TCE 污染團並沒有移動至鄰近井中。在電阻加熱 TCE 場址過程中，同位素之研究已經證明將同位素納入整治計畫中可以指導整治之決定及幫助達到場址之關閉。

7. Refining technology and its correlation of source identification

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發展煉油技術已經大大的改善石油相關商品之生產。了解煉油技術之發展將有助於環境化學家建立精煉產品組成之基本觀念。煉油製程之改變大幅影響精煉產品之組成，隨著煉油技術的提高，混合模式將做相對應修改以滿足產品規格。煉油能力，混合模式，產品組成的變化和法規限制互相關連。了解這些相關性才能將一些污染源鑑定之鑑識困難點發表出來。

8. Use of laser ablation ICP-MS for characterizing airborne particulate of glass fiber filters

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雷射剝蝕結合感應耦合電漿質譜儀(Laser Ablation Inductively Coupled Plasma Mass Spectrometry， LA-ICP-MS) 被使用來表徵高量採樣器玻璃纖維空氣濾紙上之空氣微粒，以評估人體的暴露並鑑定住宅區空氣中錳之來源。於約 40 km2 的面積中布了五個採樣點，濾紙收集的時間是 24 小時，每六天收集一次，研究進行了一整年。LA-ICP-MS 對錳的反應與對鉛、鋅和鉻的反應相關，且於順風及逆風收集點錳反應會隨著每天平均風向而改變，意味著空氣中錳微粒一個主要的點污染源存在於這些採樣點之間。選定 55 個濾紙，將 LA-ICP-MS 之結果與用酸消化和 ICP-OES 得到之結果比較，其結果顯示 LA-ICP-MS 可以用來評估個別玻璃纖維濾紙上之重金屬濃度。由 LA-ICP-MS 之反應估計錳的濃度，在所研究之區域其空氣錳粒子超出美國毒性物質及疾病登記署（U.S. Agency for Toxic Substances and Disease Registry）對錳之新最低危害值（Minimum Risk Level）：超過 9 成的時間錳濃度達 0.06 $\mu g/m^3$。

9. Study on heavy metals via ambient air particulates pathway：An example from a

historical mining and mineral processing site

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對於一個複雜的系統，如周邊有採礦和礦物加工設施的社區，其環境法醫調查在鑑識和定位污染源時，也必須使用到關鍵技術及很多方法。這項研究對於附近有歷史的鉛採礦和礦物加工設施之地區，樹立了空氣粉塵鉛路徑的榜樣。樣品由潛在污染源被收集，系統性計算元素的總濃度以得到整個社區的空間分佈。X 光吸收光譜儀（X-ray absorption spectroscopy，XAS）爲一個關鍵技術，使用在這個地區空氣微粒樣品之檢測。使用掃描式電子顯微鏡附加能量分散光譜儀（Scanning Electron Microscope/Energy Dispersive Spectrometer, SEM/EDS）所得微粒之型態和元素資訊，可以清楚地區分污染源和環境受體樣品。表徵不同組樣品，如採礦，選礦，自然礦化來源，經比較後被群集。最後，經由空氣微粒途徑可能鑑定之鉛污染源進行了討論。

10. Forensic identification of the anthropogenic contribution of fatty alcohols to the environment

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此研究爲一個環境中脂肪醇來源及宿命大型研究的一部分，在美國一個流域集水區及在英國有海水排放之集水區被用來做測試。脂肪醇可被大部分的生命體自然地生產出，也可能從油的很多來源被合成。這些化合物被使用在很多制式化的商品中，像清潔劑即是一例。通常會隨著污水被排放然後於污水處理廠(WWTP)處理。石油爲基礎的（petroleum-based）脂肪醇在功能上等同於油脂化工爲基礎的（oleochemical-based）自然）脂肪醇，不容易以傳統方式區別。但是與油脂化工爲基礎的化合物比較，石油爲基礎的化合物可以被偵測不同的碳（$\delta^{13}C$）和氫（$\delta^{2}H$）的穩定同位素比。在英國的集水區收集了土壤、海洋沉積物及當地污水收集系統的樣品；相同地，從美國的集水區收集 80 個樣品，包含土壤、河川沉積物、道路的揚

塵（可能會逕流入水中）及污水處理廠所用到的物質。以 GC-MS 分析確認濃度及概況，每一個樣品也都用穩定同位素比例質譜儀（Stable Isotope Ratio Mass Spectrometry ）測定。銷往集水區消費產品也一併採集分析。陸地上的土壤和植物可以經由較低的 $\delta^{13}C$ 值明顯的與其他樣品區隔開，其值約爲-35‰。同樣的，海洋衍生的化合物 $\delta^{13}C$ 約爲-20‰。由污水處理廠所得到的樣品，其值介於中間且隨著樣品由系統的何處取得而變化。 $\delta^{2}H$ 的值分布的範圍較廣，從-350‰到 0‰。這個方法清楚地表明這些化合物不同的來源及其經過污水處理廠後之宿命。總括來說， 環境中脂肪醇並非由 WWTP 放流水所衍生而來，且放流水中脂肪醇亦不同於進流水中脂肪醇，其最可能的來源是現場細菌合成(in situ bacterial synthesis)。

11. Relationship of soluble major ions in creek water to redox process of iron from sandstone

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在澳洲的 Waratah Rivulet 水系統發現大量的鐵沉澱且伴隨著主要陰離子(包含碳酸氫鹽)的增加。Waratah Rivulet 爲一個坐落於表面 70 公尺以下之切溝系統，位於一個 120 公尺厚的 Hawkesbury 砂岩層，此砂岩層位在另一個距表面 450 公尺之沉積層及煤層之上。砂岩的表面裂縫沿著更深層長壁開採的煤礦而發生，造成水從表面層流滲透到約 30 米的深度。研究了水化學及穩定同位素如水中之 ^{18}O、^{2}H、溶解性無機碳的 ^{13}C、硫酸鹽的 ^{34}S 及放射性同位素 ^{87}Sr，且提出大氣降水爲此系統之主要水源。比較 Waratah Rivulet 上下游之表面水，結果顯示硫酸鹽、鍶（Sr）、錳、鐵、pH、EC、濁度及 Eh 皆有變化，上游之碳酸氫鹽後來會被稀釋，但是不會變成其他主要物種。在 Waratah Rivulet 的水中，硫酸濃度的改變與碳酸氫鹽濃度的改變並沒有顯示出相關性。總溶解固體與碳酸氫鹽濃度相關，而高濃度碳酸氫鹽出現與上游的 Waratah Rivulet 水相關，且來自不同的硫酸鹽來源。水及岩石化學的結果顯示沒有重金屬或煤相關元素之環境顯著濃度。地下水和滲流含豐富的與碳酸氫鹽相關之溶解性二價鐵，這可能是存在於含碳酸鹽砂岩中的富鐵礦物（iron-rich minerals）溶解所造成的。

12. Application of environmental and historical forensic techniques for liability

apportionment among potentially responsible parties under CERCLA

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於真實世界中環境鑑識技術有其限制，包含預算的限制（budgetary constraints）、複雜的環境變化（complex environmental variables ）及分析的限制（analytical limitations ）。嘗試著去辨識化學指紋及操作歷史相似之兩個潛在責任團體的環境責任時，這些限制會更複雜。然而，當分析的鑑識技術結合其他之鑑識方法時，這種技術之結合很多時候被證明是非常有價值的。本研究探討如何結合環境及歷史的鑑識技術使用於前身爲航空太空業場所，而此場所受含氯溶劑及汽油碳氫化合物污染之衝擊，如何建立責任團體間之清理責任。在加州一個工業廠區，因同時多成分的發現、缺乏純的產品及缺乏洩漏時間，使得傳統鑑識之時間鑑定技術的應用非常沒有效率。很多模擬技術也不能單獨地指出在第二個廠家進駐期間之洩漏。因此，辨識在這個場址使用了相同的化學物品之責任團體間之清理責任，需要使用包含環境分析和歷史研究方法之多管方式（multi-prong forensic approach）。結合鑑識及歷史分析的結果，使用多管的證據而得到一個推論，第二個廠家爲排放之代表，因此需要負責支付 CERCLA 美國環境法底下剩餘之費用。當分析技術無法提供所尋找的資訊時，就必須依靠環境和歷史結合的鑑識技術去建立一個技術可靠的案例以對抗潛在責任團體。

13. Comprehensive fingerprinting of chemical mixtures for environmental and biological forensics

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常規實驗室中化學品的測定數目，對於牽涉到化學指紋之環境法醫調查是有限的，使用 GCxGC 可以分離數以千計之化學物質。而且 GCxGC 系統解析能力大幅增加也讓數據能以 3D 圖像呈現，而對環境法醫調查有幫助。GCxGC 方法是由兩個分離特性不同之管柱組成，通常爲極性（polar）及非極性（non-polar）管柱。此方法可以產生一 3D 結構的層析圖譜可以構成化學指紋用來表徵來源基質。GCxGC 系統可以和不同的偵測系統結合，而最強大的系統爲與飛行時間質譜儀（TOFMS）結合，其可以收集所有在

選定的常規的質量選擇偵測器的感度以上的掃描圖譜。此系統由在兩根管柱間之調節裝置（modulation device ）濃縮補集而增加約 10 倍的感度。經由收集全部之掃描圖譜，數千種化學品可以經由光譜資料庫比對而被確認。在概念驗證研究中調查此系統做原油和汽油模組評估（ pattern assessment）之成效。

II.壁報發表

1. Genotypic and phenotypic analysis of novel Mesorhizobium bacteria relevant to plant-microbial interaction and bioremediation

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對環境清理而言，微生物整治是一項新興的生物技術。整治的效率通常取決於微生物和植物之間的相互作用，許多中慢生根瘤菌物種會與豆科植物結瘤。許多菌株從石油化學物污染的土壤分離，其中有四種細菌中慢生根瘤菌株。這些菌株受到 multilotus 基因測序（multilotus gene sequencing, MLGS）和表型基因晶片分析（phenotypic microarray analysis ）。四管家基因（housekeeping genes）和 16S rRNA 基因被用來執行 MLGS 分析和比較中慢生根瘤菌屬相關菌株。結果顯示，與已知的中慢生根瘤菌屬比較，所有分離株構成一個單一的分支有 97.7％ 16S rRNA 基因相似度，小於 98％管家基因相似度。經由型態、生化、酵素及生理的特性與 DNA- DNA 雜交（DNA-DNA hybridization ），四種細菌中慢生根瘤菌株被確定爲中慢生根瘤菌的新屬種。表型分析結果顯示，四株中慢生根瘤菌能利用大範圍的碳水化合物和氮源。大部分石油化學污染場址都是氮缺乏的。研究固氮細菌，如中慢生根瘤菌與植物及其相互作用，在克服這些氮缺乏的場址上有其重要意義。

2. Forensics about the causal relationships of indium concentration between industrial effluents and well waters in residential area by using ICP-MS （本所發表之壁報）

三、 在這次的研討會中本所以壁報方式發表了一篇題目爲「Forensics about the causal relationships of indium concentration between industrial effluents and well

waters in residential area by using ICP-MS」的論文，其摘要如附件二。壁報發表被安排在 12 月 18 日晚上 19:00-21:00 發表於 Environmental Chemistry 主題下的 Environmental Forensics （#23）討論會。本論文敘述如何發現以銦作爲化學指紋鑑識污染源之經過。以感應耦合電漿質譜儀(ICP-MS)爲檢測儀器，對污染源排放水體及疑似受污染之地下水井進行一系列因果關係之鑑識。研究過程除了分析飲用水水質標準之重金屬元素外，亦分析了其他高科技產業製程可能會用到之稀有元素。藉由比對疑似受污染井水與其他未受污染水體中之金屬元素成分，找出可當化學指紋之銦元素，再由排放源放流水及其承受水體上下游溪水及底泥中銦含量之因果關係進行污染源鑑識，找出地下水井中銦之疑似汙染源。爲了驗證鑑識結果之可靠性，本研究採集相關之受污染地區底泥及未受污染地區底泥進行比對，以確認銦元素並非天然來源，最後經由地下水井中銦元素隨污染源銦濃度遞減而減少之趨勢，斷定本次鑑識結果無誤。

壁報論文展覽期間很多國外專家學者對於本所發表的壁報內容很有興趣，因爲銦通常是當成 ICP-MS 的內標準品，而我們突破既有的思考邏輯，把它拿來當成鑑識之化學指紋，於環境鑑識這一塊領域算是一種創新的突破。另外，很多人都對這個鑑識案之後續發展很有興趣，他們都很好奇在發現高科技業可能潛在的污染後，政府有無相關的作爲來因應等等。

四、 將本研討會於環境鑑識領域所使用之技術整理如下：（一）有機物污染物鑑識所使用之儀器包含氣相層析質譜儀（GC-MS）、高效能液相層析儀（HPLC）、二維氣相層析飛行式時間質譜儀（GC×GC-TOFMS）及氣相層析儀/同位素比值質譜儀（GC-IR/MS）等。（二）無機物污染物鑑識所使用之儀器包含感應耦合電漿質譜儀（ICP-MS）、雷射剝蝕結合感應耦合電漿質譜儀（LA-ICP-MS）、X 光吸收光譜儀（XAS）及掃描式電子顯微鏡附加能量分散光譜儀（SEM/EDS）等。（三）鑑識技術及工具包含指紋(fingerprint)鑑識、特定化合物同位素分析 CSIA、數值模式模擬、統計模式及地理資訊系統（GIS）等。目前環境檢驗所除了 LA-ICP-MS、XAS、SEM/EDS 外，鑑識所用的儀器幾乎都裝置有一台以上。其他之貴重儀器還包含 X 射線螢光分析儀（XRF）、X 光繞射儀（XRD）、氣相層析儀/高解析質譜儀（HRGC/HRMS）、

高效液相層析串聯式質譜儀（LC/MS-MS）等。此外，本所亦擁有生物檢測技術。故本所之儀器設備於環境鑑識領域不僅健全，甚至高過國際水準，未來若能再建立數值模式之技術配合 GIS 系統，在環境污染鑑識領域之發展會更趨完善。

五、儀器化學品及應用軟硬體展覽

本研討會之展覽會最主要的攤位來自出版社及軟體公司。儀器及化學品的廠商較少，因爲大部分都是化學計算或是結構之專業軟體與環境鑑識及環境檢驗較無直接相關，故於展覽會場並無駐足太多攤位，篩選了三個對本所業務較相關的廠商產品。分述如下：

1. CAS(化學索摘服務社)爲 ACS(美國化學學會)旗下的分支機構，其使命爲提供世界上最全面性、權威性與高可靠性的科學資料庫，以幫助化學領域及相關科學之研究學者或具研發能力之企業單位，俾能快速精準地檢索文獻資料、完整架構研究領域，聚焦研究主題進而提升研究能量與加速產品研發能力。本資料庫系統包含五大領域 80 學門，計有生物化學 (生醫製藥、藥理毒理、農化微生物…)；有機化學 (脂肪類固醇、合成、雜環…)；高分子 (塑膠、染劑塗料、介面、紡織皮革…)；應用化學 (燃料、冶金、電化學、化妝品、污染防治…)；物理/無機/分析 (反應動力、核子技術、輻射、光電…)等多種科學領域。SciFinder 是化學文摘社自己開發的檢索軟體，定位於服務商業客戶，同時它也有服務科學研究的 SciFinder Scholar 版。 除了使用檢索工具外，還可以通過 Science IP 直接向化學文摘社提出檢索請求，Science IP 的專業團隊會根據客戶需要提供訂製的檢索報告。

   CAS 是唯一整合期刊文獻與專利文獻的資料庫系統，涵蓋超過 10,000 種世界主要科學期刊與來自全球 59 個主要專利局(包含 2 個專利組織)的專利文獻資料、技術報告、書籍、論文資料、會議紀錄...等等。對於做研究的化學家來說，是一套強而有力的資料庫，不但檢索的功能強大、檢索內容完整且可以非常有效率的檢索。若是經費上許可，可以考慮購買他們的產品，對所內研究的文獻收集會更加方便快速，且可以隨時了解世界頂尖研究機構的創新研究。

2. 日本 JAI 公司(Japan Analytical Industry Co., Ltd) 展示了一台回收製備型液

相層析儀 (Recycling Preparative HPLC) LC-NEXT Series 。對於高效能液相層析儀而言，管柱的長度是改善分離效率的重要因素之一，然而管柱長度卻因壓力問題而受到限制，爲解決此問題，回收技術（recycling technique）可以被應用。第一次通過管柱後，回收技術使得含有待測樣品之相同流洗液再一次回到相同的管柱，重複層析週期直到達到預期之分離效果。因以相同之流洗液(含待測物)重複層析的過程，故無須再消耗多餘的溶劑，且儀器本身之大小只有 W464xH492xD504(mm) ，算是綠色化學分析之產品。其可進樣的體積爲幾 mg 到 g 的範圍，可用來做有機化合物、天然物質及生物活性物質之分離純化，未來所裡如有購買 HPLC 之需求，可以將其納入考慮。

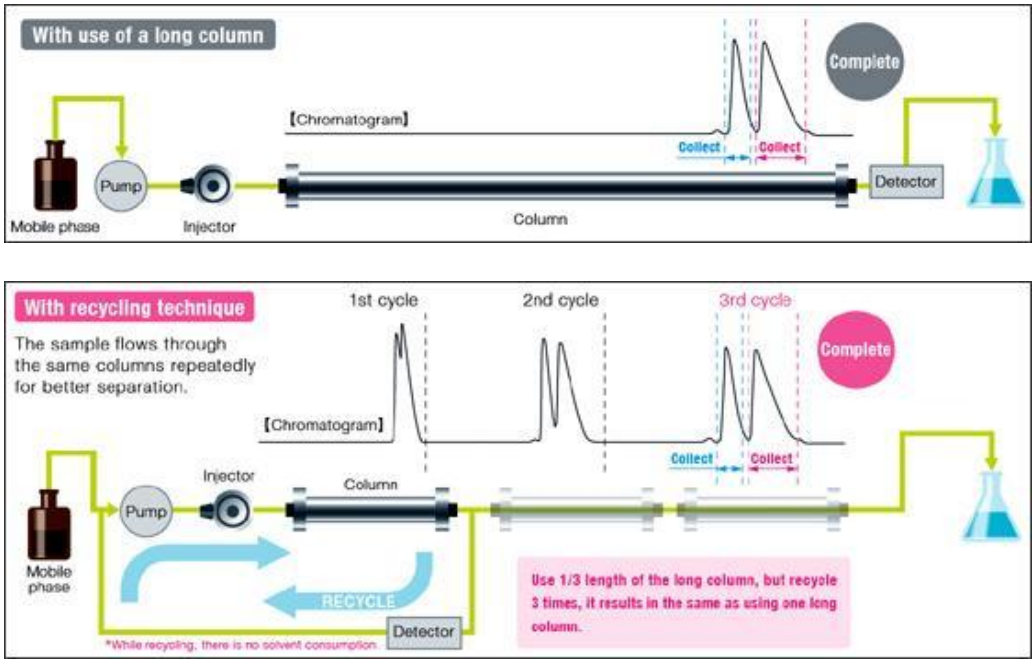

圖 4 單一管柱及回收製備型液相層析儀操作原理示意圖

3. 美國 Thomson 公司針對上機前需要過濾之樣品，設計出單一步驟之過濾樣品瓶(SINGLE StEP Filter Vials)可以取代傳統過濾所需使用之針筒、針頭濾膜、樣品瓶跟瓶蓋，其使用方式如圖 5 所示，先將樣品置放於外層瓶中，將底部含有濾膜之內層瓶輕壓入外層瓶中，使外層瓶中之樣品經過濾膜進入內層瓶中。其濾膜有 0.2 及 0.45 μm 兩種規格，材質可依樣品性質而選

擇 PTFE、PVDF、Nylon 或 PES，且此樣品瓶可直接放置於大部分標準的自動取樣器上，不但超作簡單、減少針筒及針頭濾膜之廢棄，而且對 UPLC、HPLC、GC、LCMS 及 GCMS 系統沒有風險，算是一種很環保的產品。

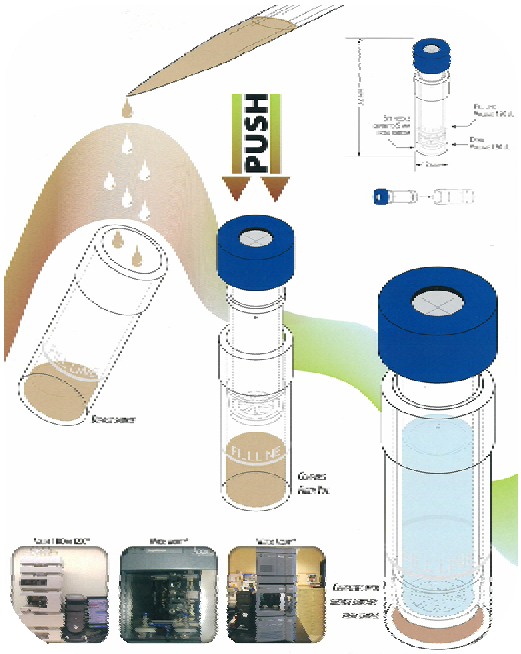

圖 5 SINGLE StEP Filter Vials 操作示意圖

此外，玻璃器皿廠商 Kimble Chase、Containment Isolator 及 Standard Glovebox Workstations 廠商 MBRAUN、儀器廠商 Bruker、超臨界流體及高壓化學廠商 Supercritical Fluid Technologies、JASCO、出版社 WILEY、ACS 及很多國家的化學學會也都有擺設攤位。泰國化學會也設了一個攤位，專門爲了 2011 年將在泰國曼谷舉行的亞洲化學會議作宣傳。

肆、建議

（一） 本次研討會在環境鑑識這一領域所發表的論文，其所用的儀器設備包含 GC-MS、HPLC、IRMS、GC×GC-TOFMS、ICP-MS、LA-ICP-MS、XAS、SEM/EDS 等。目前檢驗所除了 LA-ICP-MS、XAS、SEM/EDS 外，幾乎都裝置有一台以上。此外，本所還有 XRF、XRD、LC/MS-MS HRGC/HRMS 等貴重儀器等及生物檢測技術。故本所之儀器設備於環境鑑識領域不僅健全，甚至高過國際水準。建議未來若有經費及能力，可再建立數值模式之技術及 GIS 系統，相信在環境污染鑑識這一領域之發展會更趨完善。

（二） 綜觀此研討會有關環境鑑識之論文大多屬於有機污染物鑑識，只有少數是屬於無機污染物鑑識，本所目前鑑識案件之研究主要是聚焦於台灣鋼鐵業廢棄之爐碴及飛灰，以 XRF 及 XRD 爲主，其他技術爲輔，進行鑑識之案例研析，於鑑識領域算是較少見的案例。未來若有機會建議可以將研究成果發表於相關的國際研討會中，分享台灣於環境鑑識的經驗及成果。

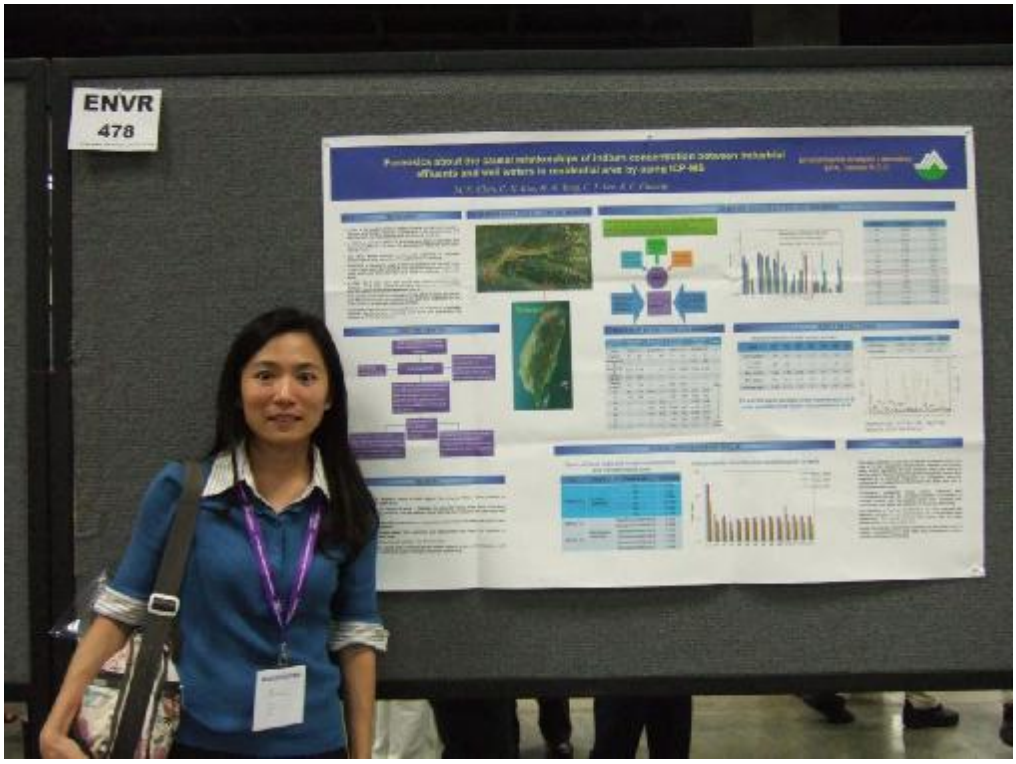

圖 6 作者與其展示之壁報

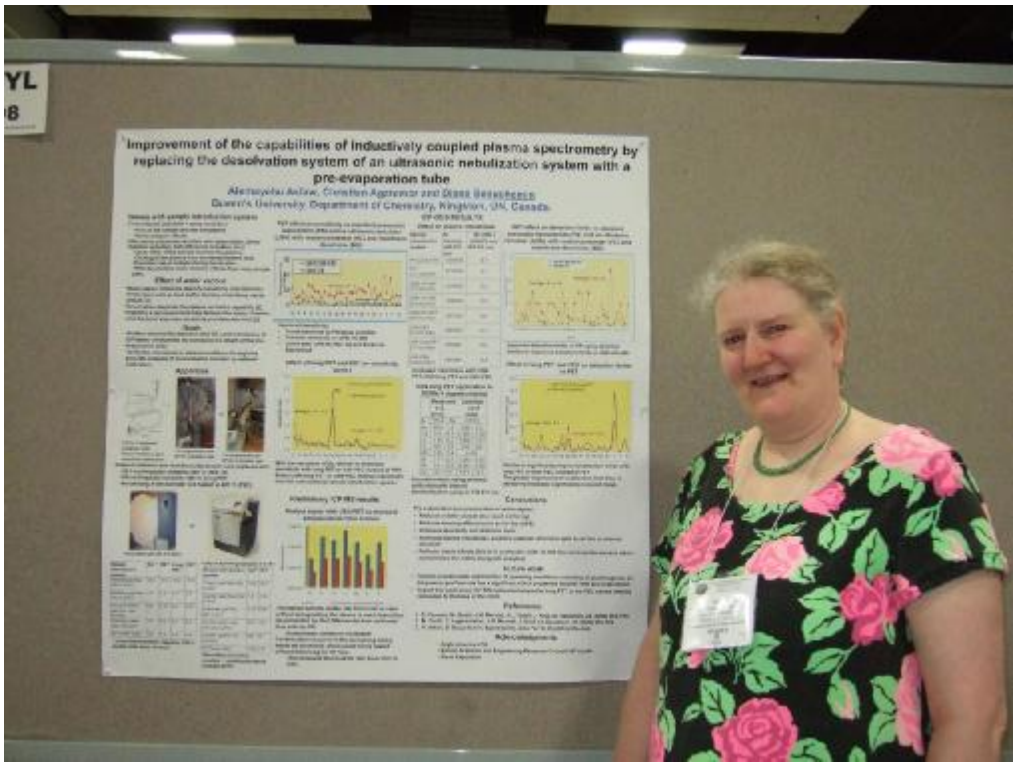

圖 7 加拿大 Diane Beauchemin 與她展示之壁報

TECHNICAL PROGRAM SUMMARY

Congress Themes and Topic Areas

I. The Core Areas of Chemistry

1. ANYL - Analytical
2. INOR - Inorganic
3. MACR - Macromolecular
4. ORGN - Organic
5. PHYS - Physical, Theoretical & Computational

II. Multi- and Cross-Disciplinary Areas of Chemistry

6. AGRO - Agrochemistry
7. BIOL - Biological Chemistry
8. ENVR - Environmental Chemistry
9. MATL - Materials & Nanotechnology

III. Challenges and Opportunities for Chemistry

10. ALTE - Alternate Energy Technology
11. COMM - Chemistry Outreach to the Community
12. HEAL - Health & Technology
13. SECR - Security

01. Analytical	A	N	Y	L		
Convention Center	W	T	F	S	S	M
On-site & In vivo Instrumentation & Applications (36)					D	
Innovation in Chemical Sensing & Separation Systems toward Advanced Chemical Analysis (39)		D				
Recent Advances in Bioanalysis: Ultrasmall Volumes, Global Metabolite Profiling & Single Cells (56)			P	D	D	
Optical Waveguide Techniques for the Analyses of Materials & Interfaces (74)					D	
New Frontiers of Plasma Spectrochemistry (84)			D	D		
New Frontiers in Separation Science (113)	D					
Analytical Applications & New Technical Developments of Soft X-Ray Spectroscopy (145)				DE		
Ionic Liquids for Analytical Chemistry & Analytical Chemistry for Ionic Liquids (166)					DE	A
Fluorescent Sensors by Design (181)					D	
Comprehensive Multidimensional Separations (191)		P	A			
Electroanalytical Sciences (193)		P	A			
Microfluidic & Nanofluidic Devices for Chemical & Biochemical Experimentation (198)	P	D	A			
Analytical & Environmental Chemistry in Human Health (206)	D	A				
Advances in Flow-Based Analytical Techniques (207)					D	A
Rapid, Multicomponent Environmental Analysis (253)	D	A				
(Bio-)Chemical/Electrochemical Sensors & Sensing Materials (255)			P	D		
Novel Applications of Magnetic Fields in Analytical Chemistry (260)			P	D		
Non- & Minimally Invasive Diagnostics of Biological Systems using Vibrational Spectroscopy (276)	D	A				
Enabling Mass Spectrometric Techniques for Proteomics (277)		D	D			

A = AM AE = AM/EVE P = PM D = AM/PM
E = EVE DE = AM/PM/EVE PE = PM/EVE

02. Inorganic	I	N	O	R		
Hilton Hawaiian Village	W	T	F	S	S	M
Molecular Photonics (9)	D	D	A			
Controlling the Structure & Properties of Solids (20)		E	DE	A		
Olefin Oligomerization & Polymerization Catalyzed by Early Transition Metals (22)			D	D		
Functional Molecule-Based Magnets (25)			P	D	D	
Metal Ion Complex Interactions with Nucleic Acids (30)	D	A				
Organoboron, Organosilicon & Organophosphorus as Optoelectronic & Energy-Related Materials (35)			DE	D	A	
Actinides & the Environment: A Multidisciplinary Look at What We Know & What We Need To Know (38)	D	AE				
Organo-f-Element Compounds: From Novel Chemical Transformations to Applications in Catalysis & Materials Science (46)			D	D		
Schiff Base Macrocycles & Materials (60)		P	D			
Frontiers in Organometallic Chemistry (68)	D	D				
Construction of Photofunctional Supramolecular Metal Complexes (94)				P	A	
Chemistry of Sulfur-Bridged Multimetallic Complexes (96)		P	D	P		
Syntheses & Applications of Metal-Organic Frameworks (97)	D	D				
Early Main Group Chemistry (100)	D	A				
Dioxygen Activation Chemistry & Catalytic Oxidation Reactions (108)				D	D	A
Structural & Functional Aspects of Coordination Polymers (133)					D	A
Discrete Coordination Systems with Switchable Structures & Properties (143)	D	D				
Advances in Metal-Mediated Bond Activation: From Unusual Bonding Motifs to Applications in Catalysis (146)		P	D	A		
Preparation & Reactions of Early Transition Metal & Lanthanide Compounds (150)	D	D				
Functional Molecules of the Heavier Main Group & Transition-Metal Elements (156)	D	A				
Self-Assembly & Coordination Chemistry (164)					D	A
Molecular Design in Bioinorganic Chemistry (173)			DE	D		

02. Inorganic (continued)	I	N	O	R		
Hilton Hawaiian Village	W	T	F	S	S	M
Electron Transfer & Electrochemistry of Transition-Metal-Containing Inorganic & Organometallic Materials (187)	D		P			
Coordination Chemistry toward Artificial Photosynthesis & Energy Conversion Processes (194)					D	A
Redox Redux: The Renaissance of Non-Innocent Ligand Complexes (217)		D	D			
Advances in Nuclear Chemistry of Transactinide Elements (218)				D	A	
Chemistry & Materials Science at High Pressures (239)				D	D	
Carbon-Fluorine Bond Activation: Crossroads for Inorganic, Organic & Environmental Chemistry (248)	D	D				
Fundamental & Applied Inorganic Fluorine Chemistry & Their Impacts on Energy Conservation & the Environment (249)		P	D			
New Frontiers in Polyoxometalate Chemistry (251)				D	D	
Nanoscale Characterization of Functional Materials by Nuclear Probes (275)				DE	A	

03. Macromolecular	M	A	C	R		
Convention Center	W	T	F	S	S	M
Polymeric Materials from Renewable Resources (5)	D	D				
NMR Spectroscopy of Polymers: Innovative NMR Strategies for Complex Macromolecular Systems (12)				DE	D	A
Chemistry & Functional Properties of Soft Interfaces (42)	D	DE				
Advanced Polymeric Membranes for Environmental, Biomedical & Bioengineering Application (51)		P	D	A		
Functional Block Copolymer Assemblies (57)			D	DE	A	
Polymer Materials Performance, Degradation & Optimization (64)	D	DE				
Hybrid Conjugated Polymer Materials (82)	D	A				
Biodegradable & Biomass Plastics (95)			D	D		
New Age of Advanced Materials: Supramolecular Architectures & Smart Materials (98)	D	D				

03. Macromolecular (continued) — MACR

Convention Center	W	T	F	S	S	M
Molecular-Based Ordered Materials Formed Through Self-Organization (102)				P	DE	A
Biomimetic Engineering of Hierarchically Structured Polymer Materials (126)				P	D	
Polymer Nano-Hybrids at Bio-Interfaces (127)			D	A		
Synthesis, Structure & Physical Properties of Advanced Polymer Gels (136)			D	D		
Azobenzene Polymers for Photo-Reversible Structures & Surfaces (144)	D					
Nano Structure & Function of Organic-Inorganic Hybrid Polymers (152)				P	D	A
Controlled/Living Radical Polymerization in Dispersed Systems (160)				D		
Separation & Characterization of Synthetic and/or Biological Macromolecules: Principles, Practices & Applications (179)					D	A
Polyolefins Chemistry & Beyond: From Bench to Commercial Scale (211)	D	D				
Radical Polymerization Kinetics & Mechanisms (219)					D	
Amphiphilic Polymers: Fundamentals & Applications (231)			D	A		
Controlled/Living Radical Polymerization: Mechanisms, Catalysts, Reaction Engineering, Materials & Applications (236)			D			
Frontiers of Precisely Controlled Polymer Synthesis: Fine Control of Polymerization Reaction & Impact on Advanced Material Designs (257)				PE	D	A

04. Organic — ORGN

Hilton Hawaiian Village	W	T	F	S	S	M
Reactive Intermediates & Unusual Molecules: A Celebration of Bob Moss's 70 years (1)			DE	A		
Cooperative Catalysis (14)			D	D		
Anion Coordination Chemistry (15)				P	D	A
C–H Functionalization, Memorial Symposium for Professor Keith Fagnou (18)				P	D	A

04. Organic (continued) — ORGN

Hilton Hawaiian Village	W	T	F	S	S	M
Interface between Organic Synthesis & Chromatography (19)	P	D				
Designed Pi-Electronic Systems: Synthesis, Properties, Theory & Function (29)	D	DE				
Diversity Oriented Synthesis (32)					DE	
Chemistry of Novel Nanocarbons: Fullerenes, Carbon Nanotubes & Related Materials (45)	D	DE				
New Directions of Supramolecular Chemistry toward Nanomaterial Science, Biomedical Science & Supramolecular Catalysts (47)	D	D				
Asymmetric Organocatalysis (62)			D	D		
Novel Synthetic Methodology & Its Application to Natural Product Synthesis (63)	D	DE	AE			
Marine Natural Products: Isolation, Biology, Ecology & Synthesis (80)			D	D		
Science & Strategy of Process Chemistry: From Molecules to Pharmaceutical Drugs (85)	D	DE				
Mechanistic Organic Photochemistry (89)			DE	D		
New Advances in Metal-Catalyzed Alkylation & Fluoroalkylation (115)			D	A		
Frontiers in Biocatalysis Applications to Organic Synthesis (124)				P	D	A
Supramolecular Photochemistry (125)	D	D				
New Dimensions of Green Sustainable Chemistry: Novel Reactions & Catalysts (132)	D	D				
Total Synthesis of Natural Products & Related Compounds (134)				P	D	A
Achieving Efficiency in Organic Reactions via Greener Processes & Practices (139)			D	A		
Design & Synthesis of Biologically Active Compounds for Elucidating Mode-of-Action (148)				P	D	
Organic Solid-State Chemistry: Structure, Synthesis & Reactivity (155)	D	A	A			
Molecular Probes & Fluorophores for Cellular Imaging (157)					D	A
Boronic Acids: Synthetic & Biological Applications (199)					DE	A
Molecular Complex Systems: Reversible Aggregation/Disaggregation of Organic Molecules (216)					D	

04. Organic (continued)	ORGN					
Hilton Hawaiian Village	W	T	F	S	S	M
Practical Applications of Basic Research on Molecular Recognition (222)			P	D		
Carbanions: Modern Perspectives in Structure, Reactivity & Synthesis (229)	D	D				
Recent Advances in Natural Products as Anticancer Agents (279)			DE	A		
Supramolecular Catalysis (280)		P	A			
Metal Catalysis for Asymmetric Synthesis (282)	D	DE				
Transition-Metal Catalysis: Mechanism & Practice (283)			P	D	A	

05. Physical, Theoretical & Computational	PHYS					
Sheraton Waikiki	W	T	F	S	S	M
Computational Quantum Chemistry: Theory & Interactions with Experiment (10)			PE	DE	DE	
Gas Phase Studies of Metal Ligand Interactions: Relevance in Organic Chemistry & Biochemistry (17)			D			
Recent Advances in Studies of Molecular Processes at Liquid Interfaces (21)	A	DE	DE	AE		
Ultrafast Intense Laser Chemistry (24)	D	DE				
Kuiper Belt Objects: Laboratory Studies, Models, Theory & Observations (31)				DE	AE	
Advances in Quantum Monte Carlo (37)	D	DE	E			
Interfacial Electrochemistry: New Systems, Experimental Methods & Theoretical Approaches (40)	D	DE				
Theory of Excited States Structures & Dynamics: Application to Organic Materials & Biosystems (66)	D	DE				
Frontiers of Surface-Enhanced Raman Scattering: Single-Nanoparticles & Single Cells (72)				DE	DE	
Dynamics & Mechanisms of Photochemical Reactions of Biological Proteins (75)				P	D	
Challenges & Solutions to Accurate Calculations on Large Molecular Systems (81)				D	DE	A
Spectroscopic Probes of Intramolecular & Intermolecular Interactions in Molecules & Molecular Clusters (87)	D	DE				

05. Physical, Theoretical & Computational (continued)	PHYS					
Sheraton Waikiki	W	T	F	S	S	M
Systems Chemistry: Toward the Holistic Understanding of Complex Molecular Systems (103)			PE			
Anharmonic Vibrations of Molecules & Clusters: Experiment & Theory (116)			D	A		
New Experimental & Computational Probes of Water in Biological Systems (130)			P	D	A	
Molecular Theory for Real Systems & Chemical Reactions (138)	D	DE	D			
Re-encounter of Computational Chemistry & Chemometrics (140)				P	A	
Quantum Coherence & its Control in Condensed Phases (161)	D	DE	A			
Cold Molecules & Quantum Computation/Information Processes (163)	P	DE				
Nanostructure-Enhanced Photochemical Reactions (171)	D	D				
DNA Photonics (204)			D	D		
Frontiers of State-to-State Dynamics (212)				DE	DE	A
Molecular Dynamics in Complex Environments: Theory & Experiments (220)			D	D		
Solid-State NMR Methods & Applications in Inorganic Materials (228)				D	D	
Interfacial Phenomena for Bubbles, Droplets, Films & Soft Matter (252)				D	D	
Advanced Linear & Nonlinear Vibrational Spectroscopy (254)		D	D			
Orbital-Free Density Functional Theory & Its Applications to Large-Scale Materials Simulations (258)				PE	DE	A
Plasmonics & Nanophotonics for Chemical Sensing, Imaging & Spectroscopy (259)	D	D				
Frontiers of Colloid & Interface Chemistry (265)			D	D		
Frontiers of Biomolecular Dynamics (267)					D	A

A = AM AE = AM/EVE P = PM D = AM/PM
E = EVE DE = AM/PM/EVE PE = PM/EVE

06. Agrochemistry — A G R O

Royal Hawaiian	W	T	F	S	S	M
Cellulose-Based Nanomaterials: Fundamentals & Applications (50)	D	A				
Flavonoids, Synthesis toward Functions (88)		P	A			
Metabolomics for Fundamental & Applied Plant Sciences (111)	D					
Application of Liquid & Gas Chromatography Mass Spectrometry to Agrochemical Challenges (118)		D				
Value-Added Food Products from Fruits & Vegetables (162)			P	D	A	
Ionic Liquids: Novel Processing Platforms of Cellulose & Biomass (210)	D	D	A			
Fungi & Mushrooms: Ecology, Chemistry & Agricultural Relevance (214)			P	A		
Rodenticide-Based Opportunities for Protection of Agriculture, Ecosystems & Public Health (227)			D			
International Food Safety Issues & Opportunities (230)				D		
Genomics Approach to the Analysis of Fungal Secondary Metabolites & Diversity (243)					A	

07. Biological Chemistry — B I O L

Convention Center	W	T	F	S	S	M
Chemical Biology of Botulinum Neurotoxin (5)	D					
Frontiers in Peptide Chemistry: Synthesis & Applications (41)				D	D	
Biomolecular Structure & Dynamics? Recent Advances in NMR (43)				D	D	A
Molecular Control of Stem Cell Fate (55)	P					
Advances in Solid-State NMR of Biological Molecules (58)	D	D	A			
Pectin: Affect on Structural & Functional Properties by Enzyme or Chemical Modification (76)		D				
Polypharmacology for Drug Discovery (90)			P	D		
Studying the Chemistry Inside Living Cells with Infrared Spectromicroscopy (93)			A			
Biomarkers: PET/SPECT Imaging (105)	D	D				
Biosynthesis of Natural Products (106)	D	DE	A			

07. Biological Chemistry (continued) — B I O L

Convention Center	W	T	F	S	S	M
Chemical Approaches to Astrobiology (117)			D			
Gas-Sensor Proteins/Enzymes: Molecular Mechanisms of Gas Sensing & Intramolecular Signal Transduction (119)		D				
Bioorganic Reaction Mechanisms (129)			D	D		
Protein, Peptide & Peptidomimetics Design (149)			DE	DE		
Carbohydrate Recognition in Health & Disease (200)	D	D				
New Frontiers of Functional Nucleic Acids: Chemistry, Biology & Applications (208)				DE	D	
Protein Alteration by Mutagenesis & Chemical Modification: Applications in Biochemistry, Drug Discovery, Diagnostics & Nutrition (213)	D	D				
Recent Advances in Research on Leukotrienes & Prostaglandins in Inflammatory & Respiratory Diseases (235)			D			
Frontiers in Ubiquitin Research: Structures, Mechanisms, Biology & Drug Development (244)				P	D	A
Frontiers of Metalloproteins in Biology (255)	D	D				
Molecular Recognition of Nucleic Acids: Biological Applications (278)			D	A		

08. Environmental Chemistry — E N V R

Convention Center	W	T	F	S	S	M
Interfacial & Disinfection Chemistry: Fate, Transport & Adsorption of Pathogens, Nanoparticles, Biocolloids & Trace Organics in Aquatic Systems (2)	P	DE	A			
Environmental Forensics (23)				D		
Chemistry of Ultraviolet Treatment for Water (26)	D					
Sources, Transport, Fate & Behavior of Global Contaminants (48)					D	A
Free Radical Chemistry in the Environment (73)		DE	A			
Environment-Friendly Syntheses Using Ionic Liquids (83)			P	D		
Recycling of Polymeric Waste Materials: Challenges & Perspectives (86)				DE		

08. Environmental Chemistry (continued) — ENVR

Convention Center	W	T	F	S	S	M
Green Electrochemistry (128)		PE	D			
Chemistry of Post-Combustion Carbon Dioxide Capture (131)		DE	AE			
Environmental Chemistry of Aerosols (237)				PE	D	A
Sonochemistry & Sonoprocessing (247)	D	D				
Innovative Green Chemistry with Microwave Energy (250)	D					
Challenges of Heterogeneous Catalysts for Environmentally Benign Materials Conversions (262)			P	D	A	

09. Materials & Nanotechnology — MATR

Convention Center	W	T	F	S	S	M
Nanoparticles & Nanoparticle-Based Materials: Synthesis, Characterization & Applications (13)	D	DE	DE			
Measurement Sciences for Life Cycle Performance of Nanomaterials & Nanocomposites (65)			D			
Titanium Dioxide: Synthesis & Applications for Energy, Environment & Devices (77)					D	A
Ionic Liquids in a Sustainable World (92)	D	D				
Synchrotron Radiation: Emerging Techniques & Applications (104)					D	A
Nitroxide Radicals: Synthesis & Advanced Bio- & Nanomaterials Applications (120)			P	D	A	
Green Biomacromolecular Materials & Biocomposites (121)	D					
Nanofluidics & Chemical Manipulations in Restricted Environments (123)				D	A	
Carbon Nanotubes & Nano-Carbon Materials: Preparation, Characterization & Applications (135)		E	E	DE	DE	A
Emerging Perovskite & Spinel Compounds for Materials Science & Applications (141)		D				
Fundamentals & Applications of Nanomaterials for Electronics & Photonics (142)	D	DE	AE			
New Materials & Concepts for Next-Generation Membranes (165)	D	A				
Supramolecular Nanoassemblies & Extended Frameworks (168)			P	D	A	

09. Materials & Nanotechnology (continued) — MATR

Convention Center	W	T	F	S	S	M
Design of Zeolite Catalysts for Clean Synthesis of Chemicals (178)		P	D			
Computational Chemistry in Materials & Nanotechnology (182)	D	D				
Standard Reference Materials & Methods for Nanotechnology (184)					D	A
Liquid Crystals in Materials Chemistry (202)		PE	D	A		
Polymer/Organic Solar Cells (224)			DE	A		
Organic Electronic Materials: From Small Molecules to Conducting Polymers (225)				P	D	A
Biological & Bio-Inspired Materials Synthesis & Assembly (226)	D	D	A			
High-Performance Solution-Processed Materials for Electronic/Optoelectronic Device Applications (233)	D	D				
Self- & Directed Assembly of Small Molecules, Macromolecules & Colloids (242)					D	A
Inorganic Nanowires: Syntheses & Growth Mechanisms (264)			D	A		
Redox Processes on Nanoparticles, Nanomaterials & Nanostructured Systems in the Environment (272)					D	A

A - AM AE - AM/EVE P - PM D - AM/PM
E - EVE DE - AM/PM/EVE PE - PM/EVE

10. Alternate Energy Technology — A L T E

Convention Center	W	T	F	S	S	M
Advances in Chemistry & Materials for Hydrogen Storage (69)	D	DE	A			
Nanoporous Materials for Renewable Energy & Chemicals (122)			DE	D		
Clean Fuels from Coal, Natural Gas & Biomass (172)				DE	DE	A
Thermochemical & Metal-Catalyzed Transformations of Biomass to Petrochemical Feedstocks, Polymer Precursors & Fuels. (176)	D	AE				
Chemistry, Structure & Properties of Fuel-Cell Membranes (180)					D	A
Nanocatalysis for Fuels & Chemicals (205)					P	A
Bioconversion of Lignocellulose to Fuel Ethanol, Chemicals & Materials (221)			D	A		
Light-Driven Generation of Hydrogen from Water (238)	D	D	P			
Petroleomics: A Roadmap for Better Extraction & Processing of Petroleum (266)				P	A	

11. Chemistry Outreach to the Community — C O M M

Hilton Hawaiian Village	W	T	F	S	S	M
Green Chemistry & Micro/Small-Scale Chemistry in the Curriculum (28)	D	A				
The Two Sides of Research & Development (99)	A					
Best Practices for Teaching Chemistry at Every Level (154)		D				
Women at the Forefront of the Time: Challenges toward Next Decades (185)			D	A		
Chemical Security & Safety in the University & the Laboratory (203)					A	
Pharmaceutical & Chemical Patent Protection & Enforcement Around the Pacific Basin (245)			E	D		
Visualization in Chemical Education (246)					D	
Cultural Influences on Professional Ethics (273)		P	A			

12. Health & Technology — H E A L

Convention Center	W	T	F	S	S	M
Advances in the Chemistry of Targeted Radionuclide Therapy (3)			D			
Biological Interactions of Engineered Nanoparticles: Novel Functions & Nanosafety Issues (11)				DE	D	
Photodynamic Therapy & Photodetection (71)				E	D	A
Understanding the Chemistry of Phytochemical Antioxidants & their Role in Human Health & Wellness (110)	D	D				
Chemistry, Safety, Quality & Regulatory Aspects of Functional Food Ingredients, Nutraceuticals & Natural Health Products (114)			D	A		
Nucleic Acid-Based Therapeutics (153)	D	D				
Tuberculosis Drug Development in the Pacific Rim (175)			A		-	
G-Quadruplexes & i-Motifs: Structures, Biological Roles & Therapeutic & Technological Applications (192)	D	D				
New Aspects of Chemical Glycobiology toward Development of New Diagnostics & Therapeutics (223)			P	D		
Advances in Nanomedicine 2010 (271)	D	D	A			
Assembling New Biomedical Materials for Tissue Regeneration (284)			P	A		

13. Security — S E C R

Convention Center	W	T	F	S	S	M
LIBS Detection of CBRNE Threats (44)			P	A		
Targeting Chemical & Biological Warfare Agents (137)	D					
Smart Materials & Devices for CBRNE Detection (167)	D					
Sampling & Analysis of Weapons of Mass Destruction Threats for Antiterrorism Purposes (201)			D			
Spectroscopic, Radioanalytical & Nuclear Methods for Security Applications (240)		D				
Laser-Based Detection of CBE Threats (281)				P	D	

A = AM AE = AM/EVE P = PM D = AM/PM
E = EVE DE = AM/PM/EVE PE = PM/EVE

PACIFICHEM 2010 POSTER SESSIONS

Thursday Evening
Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(1) Analytical	Innovation in Chemical Sensing and Separation Systems toward Advanced Chemical Analysis (#39)
(1) Analytical	New Frontiers in Separation Science (#113)
(1) Analytical	Analytical and Environmental Chemistry in Human Health (#206)
(1) Analytical	Rapid, Multi-Component Environmental Analysis (#253)
(1) Analytical	Non- and Minimally-Invasive Diagnostics of Biological Systems using Vibrational Spectroscopy (#276)
(1) Analytical	Enabling Mass Spectrometric Techniques for Proteomics (#277)
(1) Analytical	Analytical General Posters [1S]
(2) Inorganic	Metal Ion Complex Interactions with Nucleic Acids (#30)
(2) Inorganic	Schiff Base Macrocycles and Materials (#60)
(2) Inorganic	Frontiers in Organometallic Chemistry (#68)
(2) Inorganic	Early Main Group Chemistry (#100)
(2) Inorganic	Discrete Coordination Systems with Switchable Structures and Properties (#143)
(2) Inorganic	Functional Molecules of the Heavier Main Group and Transition Metal Elements (#156)
(2) Inorganic	Electron Transfer and Electrochemistry of Transition Metal Containing Inorganic and Organometallic Materials (#187)
(2) Inorganic	Carbon-fluorine Bond Activation: a Crossroads for Inorganic, Organic, and Environmental Chemistry (#248)
(3) Macromolecular	Polymeric Materials from Renewable Resources (#6)
(3) Macromolecular	Hybrid Conjugated Polymer Materials (#82)
(3) Macromolecular	Azobenzene Polymers for Photo-Reversible Structures and Surfaces (#144)

Thursday Evening
Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(3) Macromolecular	Polyolefins Chemistry and Beyond - From Bench to Commercial Scale (#211)
(4) Organic	Organic Solid-State Chemistry: Structure, Synthesis & Reactivity (#155)
(4) Organic	Carbanions: Modern Perspectives in Structure, Reactivity, and Synthesis (#229)
(5) Physical, Theoretical & Computational	The Nanostructure-Enhanced Photochemical Reactions (#171)
(5) Physical, Theoretical & Computational	Plasmonics and Nanophotonics for Chemical Sensing, Imaging and Spectroscopy (#259)
(6) Agrochemistry	Cellulose-based Nanomaterials - Fundamental and Application (#50)
(6) Agrochemistry	Metabolomics for Fundamental and Applied Plant Sciences (#111)
(6) Agrochemistry	Application of Liquid and Gas Chromatography Mass Spectrometry to Agrochemical Challenges (#118)
(7) Biological Chemistry	Molecular Control of Stem Cell Fate (#55)
(7) Biological Chemistry	Gas-Sensor Proteins/Enzymes: Molecular Mechanisms of Gas Sensing and Intra-Molecular Signal Transduction (#119)
(7) Biological Chemistry	Carbohydrate Recognition in Health and Disease (#200)
(8) Environmental Chemistry	Chemistry of Ultraviolet Treatment for Water (#26)
(8) Environmental Chemistry	Sonochemistry & Sonoprocessing (#247)
(8) Environmental Chemistry	Innovative Green Chemistry with Microwave Energy (#250)
(9) Materials & Nanotechnology	Green Biomacromolecular Materials and Biocomposites (#121)
(9) Materials & Nanotechnology	Emerging Perovskite and Spinel Compounds for Materials Science and Applications (#141)

Thursday Evening

Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(9) Materials & Nanotechnology	New Materials and Concepts for Next Generation Membranes (#165)
(9) Materials & Nanotechnology	Computational Chemistry in Materials and Nanotechnology (#182)
(9) Materials & Nanotechnology	High-Performance Solution-Processed Materials for Electronic/ Optoelectronic Device Applications (#233)
(10) Alternate Energy Technology	Light Driven Generation of Hydrogen from Water (#238)
(11) Chemistry Outreach to the Community	Green Chemistry and Micro/Small Scale Chemistry in the Curriculum (#28)
(11) Chemistry Outreach to the Community	Best Practices for Teaching Chemistry at Every Level (#154)
(12) Health & Technology	Understanding the Chemistry of Phytochemical Antioxidants and their Role in Human Health and Wellness (#110)
(12) Health & Technology	Nucleic Acid Based Therapeutics (#153)
(12) Health & Technology	G-Quadruplexes and i-Motifs: Structures, Biological Roles, and Therapeutic and Technological Applications (#192)
(12) Health & Technology	Advances in Nanomedicine 2010 (#271)
(13) Security	Targeting Chemical and Biological Warfare Agents (#137)
(13) Security	Spectroscopic, Radioanalytical and Nuclear Methods for Security Applications (#240)

Friday Morning

Kamehameha Halls II and III (Convention Center)
10:00-12:00

Area	Symposium
(2) Inorganic	Actinides and the Environment: A Multidisciplinary Look at What We Know and What We Need to Know (#38)
(2) Inorganic	Syntheses and Applications of Metal-Organic Frameworks (#97)
(2) Inorganic	Preparation and Reactions of Early Transition Metal and Lathanide Compounds (#150)
(3) Macromolecular	Polymer Materials Performance, Degradation and Optimization (#64)
(3) Macromolecular	The New Age of Advanced Materials: Supramolecular Architectures and Smart Materials (#98)
(4) Organic	Interface between Organic Synthesis and Chromatography (#19)
(4) Organic	Designed pi-Electronic Systems: Synthesis, Properties, Theory and Function (#29)
(4) Organic	Chemistry of Novel Nanocarbons - Fullerenes, Carbon Nanotubes and Related Materials (#45)
(4) Organic	New Directions of Supramolecular Chemistry toward Nanomaterial Science, Biomedical Science, and Supramolecular Catalysts (#47)
(4) Organic	The Science and Strategy of Process Chemistry: From Molecules to Pharmaceutical Drugs (#85)
(4) Organic	Supramolecular Photochemistry (#125)
(4) Organic	New Dimensions of Green Sustainable Chemistry: Novel Reactions and Catalysts (#132)
(4) Organic	Metal Catalysis for Asymmetric Synthesis (#282)
(5) Physical, Theoretical & Computational	Computational Quantum Chemistry: Theory and Interactions with Experiment (#10)
(5) Physical, Theoretical & Computational	Ultrafast Intense Laser Chemistry (#24)
(5) Physical, Theoretical & Computational	Interfacial Electrochemistry: New Systems, Experimental Methods and Theoretical Approaches (#40)
(5) Physical, Theoretical & Computational	Theory of Excited States Structures and Dynamics: Application to Organic Materials and Biosystems (#66)

Friday Morning

Kamehameha Halls II and III (Convention Center)
10:00-12:00

Area	Symposium
(5) Physical, Theoretical & Computational	Frontiers of Surface-Enhanced Raman Scattering: Single-Nanoparticles and Single Cells (#72)
(5) Physical, Theoretical & Computational	Spectroscopic Probes of Intramolecular and Intermolecular Interactions in Molecules and Molecular Clusters (#87)
(5) Physical, Theoretical & Computational	Cold Molecules and Quantum Computation/Information Processes (#163)
(7) Biological Chemistry	Protein Alteration by Mutagenesis and Chemical Modification: Applications in Biochemistry, Drug Discovery, Diagnostics, and Nutrition (#213)
(7) Biological Chemistry	Frontiers of Metalloproteins in Biology (#256)
(9) Materials & Nanotechnology	Ionic Liquids in a Sustainable World (#92)
(9) Materials & Nanotechnology	Carbon Nanotubes and Nano-Carbon Materials: Preparation, Characterization, and Applications (#135)

Friday Evening

Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(1) Analytical	New Frontiers of Plasma Spectrochemistry (#84)
(1) Analytical	Electroanalytical Sciences (#193)
(1) Analytical	Microfluidic and Nanofluidic Devices for Chemical and Biochemical Experimentation (#198)
(1) Analytical	(Bio-)Chemical/Electrochemical Sensors and Sensing Materials (#255)
(2) Inorganic	Molecular Photonics (#9)
(2) Inorganic	Organo-f-Element Compounds: From Novel Chemical Transformations to Applications in Catalysis and Materials Science (#46)
(2) Inorganic	Advances in Metal-Mediated Bond Activation: From Unusual Bonding Motifs to Applications in Catalysis (#146)
(2) Inorganic	Redox Redux: The Renaissance of Non-Innocent Ligand Complexes (#217)
(2) Inorganic	Fundamental and Applied Inorganic Fluorine Chemistry and Their Impacts on Energy Conservation and the Environment (#249)
(3) Macromolecular	Advanced Polymeric Membranes for Environmental, Biomedical and Bioengineering Application (#51)
(3) Macromolecular	Functional Block Copolymer Assemblies (#57)
(3) Macromolecular	Polymer Nano-Hybrids at Bio-Interfaces (#127)
(3) Macromolecular	Synthesis, Structure, and Physical Properties of Advanced Polymer Gels (#136)
(4) Organic	Cooperative Catalysis (#14)
(4) Organic	Practical Applications of Basic Research on Molecular Recognition (#222)
(5) Physical, Theoretical & Computational	Kuiper Belt Objects - Laboratory Studies, Models, Theory, and Observations (#31)
(5) Physical, Theoretical & Computational	Molecular Theory for Real Systems and Chemical Reactions (#138)
(5) Physical, Theoretical & Computational	Quantum Coherence and its Control in Condensed Phases (#161)
(5) Physical, Theoretical & Computational	Frontiers of State-to-State Dynamics (#212)

Friday Evening

Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(5) Physical, Theoretical & Computational	Molecular Dynamics in Complex Environments: Theory and Experiments (#220)
(5) Physical, Theoretical & Computational	Advanced Linear and Non-Linear Vibrational Spectroscopy (#254)
(5) Physical, Theoretical & Computational	Frontiers of Colloid and Interface Chemistry (#265)
(6) Agrochemistry	Flavonoids, Synthesis toward Functions (#88)
(6) Agrochemistry	Ionic Liquids: Novel Processing Platforms of Cellulose and Biomass (#210)
(6) Agrochemistry	Fungi and Mushrooms: Ecology, Chemistry and Agricultural Relevance (#214)
(6) Agrochemistry	Rodenticide-Based Opportunities for Protection of Agriculture, Ecosystems and Public Health (#227)
(7) Biological Chemistry	Advances in Solid-State NMR of Biological Molecules (#58)
(7) Biological Chemistry	Polypharmacology for Drug Discovery (#90)
(7) Biological Chemistry	Biosynthesis of Natural Products (#106)
(7) Biological Chemistry	Chemical Approaches to Astrobiology (#117)
(7) Biological Chemistry	Bioorganic Reaction Mechanisms (#129)
(7) Biological Chemistry	Recent Advances in Research on Leukotrienes and Prostaglandins in Inflammatory and Respiratory Diseases (#235)
(7) Biological Chemistry	Molecular Recognition of Nucleic Acids: Biological Applications (#278)
(8) Environmental Chemistry	Interfacial and Disinfection Chemistry: Fate, Transport, and Adsorption of Pathogens, Nanoparticles, Biocolloids, and Trace Organics in Aquatic Systems (#2)
(8) Environmental Chemistry	Free Radical Chemistry in the Environment (#73)
(8) Environmental Chemistry	Green Electrochemistry (#128)
(9) Materials & Nanotechnology	Nitroxide Radicals: Synthesis and Advanced Bio- and Nano-materials' Applications (#120)

Friday Evening

Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(9) Materials & Nanotechnology	Supramolecular Nanoassemblies and Extended Frameworks (#168)
(9) Materials & Nanotechnology	Design of Zeolite Catalyts for Clean Synthesis of Chemicals (#178)
(9) Materials & Nanotechnology	Liquid Crystals in Materials Chemistry (#202)
(9) Materials & Nanotechnology	Biological and Bio-Inspired Materials Synthesis and Assembly (#226)
(10) Alternate Energy Technology	Advances in Chemistry and Materials for Hydrogen Storage (#69)
(10) Alternate Energy Technology	Clean Fuels from Coal, Natural Gas and Biomass (#172)
(10) Alternate Energy Technology	Thermochemical and Metal-Catalyzed Transformations of Biomass to Petrochemical Feedstocks, Polymer Precursors and Fuels. (#176)
(10) Alternate Energy Technology	Bioconversion of Lignocellulose to Fuel Ethanol, Chemicals and Materials (#221)
(12) Health & Technology	Tuberculosis drug development in the Pacific Rim (#175)
(12) Health & Technology	New Aspects of Chemical Glycobiology toward Development of new Diagnostics and Therapeutics (#223)
(13) Security	Sampling and Analysis of Weapons of Mass Destruction (WMD) Threats for Antiterrorism Purposes (#201)

Saturday Morning

Kamehameha Halls II and III (Convention Center)
10:00-12:00

Area	Symposium
(2) Inorganic	Self-Assembly and Coordination Chemistry (#164)
(3) Macromolecular	Chemistry and Functional Properties of Soft Interfaces (#42)
(3) Macromolecular	Controlled/Living Radical Polymerization: Mechanisms, Catalysts, Reaction Engineering, Materials and Applications (#236)
(3) Macromolecular	Frontiers of Precisely Controlled Polymer Synthesis: Fine Control of Polymerization Reaction and Impact on Advanced Material Designs (#257)
(4) Organic	Diversity Oriented Synthesis (#32)
(4) Organic	Novel Synthetic Methodology and Its Application to Natural Product Synthesis (#63)
(5) Physical, Theoretical & Computational	Gas Phase Studies of Metal Ligand Interactions: Relevance in Organic Chemistry and Biochemistry (#17)
(5) Physical, Theoretical & Computational	Advances in Quantum Monte Carlo (#37)
(5) Physical, Theoretical & Computational	Systems Chemistry - Towards the Holistic Understanding of Complex Molecular Systems (#103)
(5) Physical, Theoretical & Computational	Physical, Theoretical & Computational General Posters [1S]
(6) Agrochemistry	Agrochemistry General Posters [1S]
(7) Biological Chemistry	Biological Chemistry General Posters [1S]
(8) Environmental Chemistry	Chemistry of Post Combustion Carbon Dioxide Capture (#131)
(8) Environmental Chemistry	Environmental Chemistry General Posters [1S]
(9) Materials & Nanotechnology	Nanoparticles and Nanoparticle-based Materials: Synthesis, Characterization, and Applications (#13)
(9) Materials & Nanotechnology	Fundamentals and Applications of Nanomaterials for Electronics and Photonics (#142)
(9) Materials & Nanotechnology	Materials & Nanotechnology General Posters [1S]
(12) Health & Technology	Advances in the Chemistry of Targeted Radionuclide Therapy (#3)

Saturday Evening

Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(1) Analytical	On-site and In-vivo Instrumentation and Applications (#36)
(1) Analytical	Recent Advances in Bioanalysis: Ultra-Small Volumes, Global Metabolite Profiling and Single Cells (#56)
(1) Analytical	New Frontiers of Plasma Spectrochemistry (#84) [PS_2]
(1) Analytical	Ionic Liquids for Analytical Chemistry and Analytical Chemistry for Ionic Liquids (#166)
(1) Analytical	Novel Applications of Magnetic Fields in Analytical Chemistry (#260)
(2) Inorganic	Controlling the Structure and Properties of Solids (#20)
(2) Inorganic	Olefin Oligomerization and Polymerization Catalyzed by Early Transition Metals (#22)
(2) Inorganic	Organoboron, Organosilicon and Organophosphorus as Optoelectronic and Energy-related Materials (#35)
(2) Inorganic	The Construction of Photofunctional Supramolecular Metal Complexes (#94)
(2) Inorganic	Chemistry of Sulfur-Bridged Multimetallic Complexes (#96)
(2) Inorganic	Advances in Nuclear Chemistry of Transactinide Elements (#218)
(2) Inorganic	Chemistry and Materials Science at High Pressures (#239)
(2) Inorganic	New Frontiers in Polyoxometalate Chemistry (#251)
(3) Macromolecular	Molecular-Based Ordered Materials Formed Through Self-Organization (#102)
(3) Macromolecular	Controlled/Living Radical Polymerization in Dispersed Systems (#160)
(3) Macromolecular	Amphiphilic Polymers: Fundamentals and Applications (#231)
(4) Organic	Reactive Intermediates and Unusual Molecules - A Celebration of Bob Moss's 70 years (#1)
(4) Organic	New Advances in Metal-Catalyzed Alkylation and Fluoroalkylation (#115)
(4) Organic	Frontiers in Biocatalysis Applications to Organic Synthesis (#124)
(4) Organic	Achieving Efficiency in Organic Reactions via Greener Processes and Practices (#139)

Saturday Evening

Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(4) Organic	Boronic Acids: Synthetic and Biological Applications (#199)
(4) Organic	Recent Advances in Natural Products as Anticancer Agents (#279)
(4) Organic	Transition Metal Catalysis: Mechanism and Practice (#283)
(5) Physical, Theoretical & Computational	Dynamics and Mechanisms of Photochemical Reactions of Biological Proteins (#75)
(5) Physical, Theoretical & Computational	Challenges and Solutions to Accurate Calculations on Large Molecular Systems. (#81)
(5) Physical, Theoretical & Computational	Anharmonic Vibrations of Molecules and Clusters: Experiment and Theory (#116)
(5) Physical, Theoretical & Computational	DNA Photonics (#204)
(5) Physical, Theoretical & Computational	Solid-State NMR Methods and Applications in Inorganic Materials (#228)
(5) Physical, Theoretical & Computational	Interfacial Phenomena for Bubbles, Droplets, Films and Soft Matter (#252)
(6) Agrochemistry	Value-Added Food Products from Fruits and Vegetables (#162)
(6) Agrochemistry	International Food Safety Issues & Opportunities (#230)
(7) Biological Chemistry	Frontiers in Peptide Chemistry: Synthesis and Applications (#41)
(8) Environmental Chemistry	Environmental Forensics (#23)
(8) Environmental Chemistry	Environment Friendly Syntheses Using Ionic Liquids (#83)
(8) Environmental Chemistry	Challenges of Heterogeneous Catalysts for Environmental-Benign Materials Conversions (#262)
(9) Materials & Nanotechnology	Polymer/Organic Solar Cells (#224)
(9) Materials & Nanotechnology	Inorganic Nanowires: Syntheses and Growth Mechanisms (#264)
(10) Alternate Energy Technology	Nanoporous Materials for Renewable Energy and Chemicals (#122)
(10) Alternate Energy Technology	Petroleomics: A Roadmap for Better Extraction and Processing of Petroleum (#266)
(11) Chemistry Outreach to the Community	Women at the Forefront of the Time: Challenges toward Next Decades (#185)

Saturday Evening

Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(11) Chemistry Outreach to the Community	Chemical Security and Safety in the University and the Laboratory (#203)
(12) Health & Technology	Chemistry, Safety, Quality and Regulatory Aspects of Functional Food Ingredients, Nutraceuticals and Natural Health Products (#114)
(12) Health & Technology	Assembling New Biomedical Materials for Tissue Regeneration (#284)
(13) Security	LIBS Detection of CBRNE Threats (#44)
(13) Security	Laser-Based Detection of CBE Threats (#281)

Sunday Morning

Kamehameha Halls II and III (Convention Center)
10:00-12:00

Area	Symposium
(1) Analytical	Analytical Applications and New Technical Developments of Soft X-Ray Spectroscopy (#145)
(2) Inorganic	Molecular Design in Bioinorganic Chemistry (#173)
(2) Inorganic	Inorganic General Posters [1S]
(3) Macromolecular	Biodegradable and Biomass Plastics (#95)
(3) Macromolecular	Macromolecular General Posters [1S]
(4) Organic	Asymmetric Organocatalysis (#62)
(4) Organic	Marine Natural Products: Isolation, Biology, Ecology, and Synthesis (#80)
(4) Organic	Mechanistic Organic Photochemistry (#89)
(4) Organic	Organic General Posters [1S]
(5) Physical, Theoretical & Computational	Recent Advances in Studies of Molecular Processes at Liquid Interfaces (#21)
(7) Biological Chemistry	Protein, Peptide, and Peptidomimetics Design (#149)
(8) Environmental Chemistry	Recycling of Polymeric Waste Materials: Challenges and Perspectives (#86)
(10) Alternate Energy Technology	Alternate Energy Technology General Posters [1S]
(11) Chemistry Outreach to the Community	Pharmaceutical and Chemical Patent Protection and Enforcement Around the Pacific Basin (#245)
(12) Health & Technology	Health & Technology General Posters [1S]

Sunday Evening
Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(1) Analytical	Optical Waveguide Techniques for the Analyses of Materials and Interfaces (#74)
(1) Analytical	Fluorescent Sensors by Design (#181)
(1) Analytical	Advances in Flow-based Analytical Techniques (#207)
(2) Inorganic	Functional Molecule-Based Magnets (#25)
(2) Inorganic	Dioxygen Activation Chemistry and Catalytic Oxidation Reactions (#108)
(2) Inorganic	Structural and Functional Aspects of Coordination Polymers (#133)
(2) Inorganic	Coordination Chemistry toward Artificial Photosynthesis and Energy Conversion Processes (#194)
(3) Macromolecular	NMR Spectroscopy of Polymers: Innovative NMR Strategies for Complex Macromolecular Systems (#12)
(3) Macromolecular	Biomimetic Engineering of Hierarchically Structured Polymer Materials (#126)
(3) Macromolecular	Nano Structure and Function of Organic-Inorganic Hybrid Polymers (#152)
(3) Macromolecular	Separation and Characterization of Synthetic and/or Biological Macromolecules: the Principles, Practices and Applications (#179)
(3) Macromolecular	Radical Polymerization Kinetics and Mechanisms (#219)
(4) Organic	Anion Coordination Chemistry (#15)
(4) Organic	C-H Functionalization, Memorial Symposium for Professor Keith Fagnou (#18)
(4) Organic	Total Synthesis of Natural Products and Related Compounds (#134)
(4) Organic	Design and Synthesis of Biologically Active Compounds for Elucidating Mode-of-Action (#148)
(4) Organic	Molecular Probes and Fluorophores for Cellular Imaging (#157)
(5) Physical, Theoretical & Computational	New Experimental and Computational Probes of Water in Biological Systems (#130)
(5) Physical, Theoretical & Computational	Re-Encounter of Computational Chemistry and Chemometrics (#140)

Sunday Evening
Kamehameha Halls II and III (Convention Center)
19:00-21:00

Area	Symposium
(5) Physical, Theoretical & Computational	Frontiers of Biomolecular Dynamics (#267)
(7) Biological Chemistry	Biomolecular Structure and Dynamics - Recent Advances in NMR (#43)
(7) Biological Chemistry	New Frontiers of Functional Nucleic Acids: Chemistry, Biology and Applications (#208)
(7) Biological Chemistry	Frontiers in Ubiquitin Research: Structures, Mechanisms, Biology and Drug Development (#244)
(8) Environmental Chemistry	Sources, Transport, Fate, and Behaviour of Global Contaminants (#48)
(8) Environmental Chemistry	Environmental Chemistry of Aerosols (#237)
(9) Materials & Nanotechnology	Titanium Dioxide: Synthesis and Applications for Energy, Environment, and Devices (#77)
(9) Materials & Nanotechnology	Synchrotron Radiation: Emerging Techniques and Applications (#104)
(9) Materials & Nanotechnology	Nanofluidics and Chemical Manipulations in Restricted Environments (#123)
(9) Materials & Nanotechnology	Organic Electronic Materials: From Small Molecules to Conducting Polymers (#225)
(9) Materials & Nanotechnology	Self and Directed Assembly of Small Molecules, Macromolecules and Colloids (#242)
(9) Materials & Nanotechnology	Redox Processes on Nanoparticles, Nanomaterials, and Nanostructured Systems in the Environment (#272)
(10) Alternate Energy Technology	The Chemistry, Structure, and Properties of Fuel Cell Membranes (#180)
(10) Alternate Energy Technology	Nanocatalysis for Fuels and Chemicals (#205)
(11) Chemistry Outreach to the Community	Visualization in Chemical Education (#246)
(12) Health & Technology	Biological Interactions of Engineered Nanoparticles: Novel Functions and Nanosafety Issues (#11)
(12) Health & Technology	Photodynamic Therapy and Photodetection (#71)

附件二 發表之論文英文摘要

Forensics about the causal relationships of indium concentration between industrial effluents and well waters in residential area by using ICP-MS

M. N. Chen, C. H. Kuo, H. N. Yang, C. S. Lee, S. C. Chuang

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Abstract

This study used the environmental forensic techniques to investigate whether the downstream receiving water body was polluted by the effluents of TFT-LCD plants. We demonstrated how to discover indium as a chemical fingerprint. The trace element concentrations were determined by inductively coupled plasma mass spectrometer (ICP-MS). A series of causal relationships forensics between industrial effluents and suspected contaminated well water were tested. In addition to heavy metals regulated in water quality standards, other rare elements used in high-tech industrial process were also analyzed. Indium was regarded as a chemical fingerprint by comparing elements components in suspected contaminated well water with that in non-contaminated water. Furthermore, suspected indium source inference was accomplished through the correlation between the effluent of polluted sources and the samples taken from upstream and downstream river water and sediment in receiving water body. For reliability of forensic identification, we also analyzed the sediment samples in non-contaminated and contaminated area respectively. The results showed that indium was not from natural source in contaminated area. Finally, the forensic results were confirmed by the similar trend of indium concentrations in well water and contaminant source through continuous monitoring.

Keywords：Environmental forensics, Indium, ICP-MS, Chemical fingerprinting.