出國報告（出國類別：其他）

「**2010**年國際氣膠研討會」出國報告 **(2010 International Aerosol Conference，IAC 2010)**

服務機關： 行政院勞工委員會勞工安全衛生研究所

姓名職稱： 陳春萬研究員

派赴國家： 芬蘭赫爾辛基 (Helsinki)

出國期間： 99年8月27日至9月3日

報告日期： 99年11月

摘要

出國報告名稱：參加2010年國際氣膠研討會 (2010 International Aerosol Conference，IAC 2010)
服務機關：行政院勞工委員會勞工安全衛生研究所
姓名職稱：陳春萬研究員
出國類別：其他(參加國際學術會議)
派赴國家：芬蘭赫爾辛基
出國期間：99年8月27日至9月3日
報告日期：99年11月
關 鍵 詞：氣膠、奈米微粒、國際研討會

內容：

本次行程主要為參加於芬蘭赫爾辛基 (Helsinki)舉行之2010年國際氣膠研討會(International Aerosol Conference 2010)，發表有關奈米氣膠捕集、作業環境生物氣膠與奈米氣膠量測等三篇論文，並參加有關微粒量測儀器、健康危害、呼吸道沉積、控制與防護等研討活動與學者交流，收集本所未來研究設計之經驗，也參觀赫爾辛基大學氣膠實驗室學習相關研究經驗。

本次行程所發表之論文，有關奈米氣膠量測受到較大之關注，而有關奈米氣膠通風系統捕集及作業環境生物氣膠量測，因為氣膠研究學者認為已熟悉相關研究成果，因此詢問者較少，對照各國學者所發表之論文，可知國際上最新研究趨勢的改變，最近氣膠熱門研究議題為氣候變遷、生質能源、奈米微粒應用等研究，而有關職業衛生氣膠研究議題為奈米微粒暴露評估、危害流行病學、與呼吸道沉積等研究。而參觀赫爾辛基大學氣膠實驗室，強烈感受到先進實驗室在研究議題上堅持及新穎的實驗設計，儀器整合、改裝與應用，都是值得研究實驗室學習。

透過國際研討會之交流，除介紹台灣研究資料外，最重要能夠了解最新研究趨勢與發展，提供未來研究規劃，另外也可學習國際上先進的研究經驗，提供未來努力之方向。

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壹、目的

台灣在職業衛生上之研究，已經逐漸獲得成效，雖然透過論文發表，已讓世界各國職業衛生從業人員參考，但只侷限於部分學者，並無法有效呈現台灣之研究能量，若是能透過有系統的介紹，將可讓更多世界各國職業衛生人員，清楚台灣在職業衛生上的研究成果。而對於研究議題之設定，除了解決國內之現況外，也必須了解國際發展趨勢，才能規劃更完善之研究計畫，配合國際上相關研發能量，提出創新也具體可行之的研究概念。

本次行程主要爲參加於芬蘭赫爾辛基舉行之「2010年國際氣膠研討會」(International Aerosol Conference 2010)，發表有關奈米氣膠捕集、作業環境生物氣膠與奈米氣膠量測等三篇論文與學者交流，並參與各項研討活動及參觀赫爾辛基大學氣膠實驗室，學習相關研究經驗，特別是職業衛生之應用，希望了解奈米技術等氣膠研究國際趨勢，必要時將引進國外研發但適合本土運用之新技術，提供本所未來研究設計之參考；以提昇我國安全衛生永續發展實力，也促成我國職業安全衛生服務產業之發展。

國際氣膠研究學會爲NGO組織，台灣氣膠研究學會爲其會員，透過參加國際氣膠學會之研討會，可強化國內氣膠研究國際合作研究及技術交流，而本所透過國際研討會之交流，除介紹台灣研究氣膠在職業衛生研究成果外，最重要能夠了解最新研究趨勢與發展，提供未來研究規劃，另外也可學習國際上先進的研究經驗，提供未來努力之方向。

關鍵字：奈米微粒、研討會、氣膠、職業衛生

貳、過程

職業衛生危害預防研究，氣膠一直是研究重點，從早期礦工之塵肺症危害預防，石綿間皮瘤的危害預防，及粉塵所造成之塵肺症危害預防，都是職業衛生預防重點，研究上仍必須釐清如何透過評估技術掌握暴露概況；透過局部排氣等工業通風設計與管理措施之研究，釐清適當控制策略之性能；透過呼吸防護具性能之測定與管理措施等研究，才能落實勞工有效使用呼吸防護具，避免粉塵之危害。

而近年來隨著科技蓬勃發展，工作場所類型更趨多元化，使得職場環境樣態多變化也愈趨於複雜，因此職場中也潛藏許多的新類型之氣膠危害因子，例如生物氣膠與奈米微粒，由於其特性與過去習知之粉塵不同，因此需要更多之研究投入，才能避免發生新型職業疾病案例，例如「退伍軍人症」、病菌感染與傳播之發生等生物氣膠之危害。而對於奈米微粒，已有研究指出其物性、化性、活性發生巨大的改變，對於人體造成之安全與健康危害也隨之改變，雖然目前仍缺乏奈米微粒之毒理、安全性、暴露之完整評估，但根據奈米微粒有較大的表面積，奈米微粒可能穿透人體之屏蔽系統(如細胞膜、有傷口皮膚等)，因此對於奈米物質之暴露問題、作業安全、沉積吸收、及毒性可能都不相同，已有文獻陸續指出奈米物質毒性遠大於該物質在一般狀況下之毒性，因此對於奈米物質之暴露危害評估與控制防護，應該隨著奈米科技之發展，注意防範造成人員健康衝擊，對於奈米微粒對人體健康的潛在影響，更是需特別注意。而這些文獻多為細胞毒理研究，大多證實微粒越小可能造成危害越嚴重，不過作業環境現場的資料仍然不充分，對於可能造成危害的恕限值將會因微粒粒徑及種類不同而不同，都仍待釐清，而對於作業場所實際暴露評估技術，文獻上也都認為有待改善。對於奈米微粒之暴露途徑與控制措施性能，隨著奈米科技發展，應該是責無旁貸地應該早日掌握，透過奈米微粒性質，才能規劃適當措施，避免奈米微粒之暴露與危害。

一、　國際氣膠研討會

「2010年國際氣膠研討會」為國際氣膠研究學會(IARA，International Aerosol

Research Assembly)所主辦之研討會，國際氣膠研究學會為NGO組織，台灣氣膠研究學會為其會員，每四年舉辦一次研討會，透過研討會交流國際上氣膠之研究經驗，並促成國際合作，第一屆研討會於1984年於美國明尼蘇達舉辦，1986年於德國西柏林舉辦，而後每四年由各會員國分別主辦，台灣也於2002年於台北主辦過此項國際研討會。

「2010年國際氣膠研討會」由國際氣膠研究學會及芬蘭氣膠研究學會主辦，並且邀請芬蘭赫爾辛基大學、芬蘭氣象研究所及芬蘭VTT技術研究中心共同主辦，研討會時間為2010年8月29日至9月3日，舉辦地點為芬蘭赫爾辛基大學。研討會共有5篇專題演講，同一時間有8個會場口頭發表研究論文，共有11個時段口頭發表研究論文，共發表論文536篇，並且有三個時段發表海報研究論文，共發表734篇研究論文。

透過專題演講之題目，可了解現階段氣膠研究最受到重視之研究方向，此次研討會受邀發表之專題演講題目如下，可知有關奈米微粒之性質與應用為一主要方向，而微粒對氣候異常之影響(包括生質能源之應用影響)也是主要方向。

- Aerosols from biomass combustion plants – formation, characterisation and emissions
- Molecular Modeling of Atmospheric Clusters
- Charging, Electrical Classification and vapor Condensation on sub - 3 nm Aerosols
- Integrating an Understanding of Aerosol Source-Receptor Relationships and Climate Perturbation: From Challenge to Opportunity
- Aerosol Assembly of Nanoparticles and Its Applications

對於88個口頭發表研究論文的時段議題來看，可了解氣膠研究受到各界關注的情形，將88個議題排列並分類如附件一，我概分為氣膠基本原理(生成、物理化學等性質等)、大氣環境氣膠研究議題、氣膠儀器、氣膠健康效應、特殊氣膠、生物氣膠、氣膠對氣象之影響、生質能源燃燒有關氣膠問題、奈米微粒等。前面幾4項是氣膠研究上傳統重點研究應用方向，後面5個方向一特殊氣膠、生物氣膠、氣膠對氣象之影響、生質能源燃燒有關氣膠問題、及奈米微粒等，屬於最近受到重視之議題，特別是後面三項，也與專題演講題目呼應。

最近此研討會透過專題演講之題目，可了解現階段氣膠研究最受到重視之研究方向，此次研討會受邀發表之專題演講題目如下，可知有關奈米微粒之性質與應用為一主要方向，而微粒對氣候異常之影響(包括生質能源之應用影響)也是主要方向。

二、 研討會有關氣膠在職業衛生之應用

氣膠研究由於範圍很大，職業衛生只是其中一部分，過去研究議題主要為氣膠健康效應與量測儀器中部分內容，不過近年來，在生物氣膠與奈米微粒研究方向上，較多與職業衛生相關之研究議題。

將氣膠健康效應、生物氣膠、及奈米微粒之研究題目整理於附件二，健康效應研究議題上，研究論文會專注於新興危害物質及探究基本測試方法，因此此研討會所發表論文在於生質能源及生物氣膠所產生之氣膠危害，也探討如何透過細胞株毒性測試了解不同微粒粒徑所造成之影響，對於不同微粒粒徑所造成之影響，例如可呼吸性粉塵、可吸入性粉塵、總粉塵等對人體之影響與職業衛生研究較為相關。

對於氣膠研究奈米微粒之研究議題，主要在於如何應用氣膠技術於奈米科技上，因此對於奈米技術之應用、產生機制、與基本性質有較多人探討，而有關職業衛生之議題，包括奈米微粒之危害性評估方法、暴露評估技術、控制防護技術等，也都有研究議題正在進行，這些也是勞研所努力之研究方向。

關於生物氣膠之研究，很多關於室內空氣品質之研究，另外一項重要的研究議題為生物氣膠快速偵測儀器之開發，也有關於職場之生物氣膠暴露評估與控制之研究，相關職業衛生研究，主要在於暴露評估與控制之研究。

除了這些主要議題外，有關職業衛生氣膠研究海包括呼吸道沉積與粉塵過濾研究，這一部份屬於基本之應用，不是熱門研究議題，但屬於職業衛生重要課題，在這一方面，勞研所投入較多研究資源。

三、　發表論文

本次行程主要爲發表有關奈米氣膠捕集、作業環境生物氣膠與奈米氣膠量測等論文，由於投稿數非常的多，而且主辦單位希望透過海報論文方式增加討論之時間(海報論文張貼整天時間，而特別安排90分鍾，要求作者與海報旁解說)，因此此次發表論文主要爲海報論文，將大會手冊資料中有關發表論文之資料整理於附件三，主要發表論文爲P2J41—局部排氣捕集奈米微粒之效率(Capture Efficiency of Local Exhaust Hoods for Nanoparticles)，張貼與交流討論情形如圖1-3，另外也與台灣氣膠研究教授合作發表論文，張貼與交流討論情形如圖4，包括，

- 口頭論文2E時段--Instrumentation development I，Chun-Nan, Liu; Sheng-Chieh, Chen; Chun-Wan, Chen; Chuen-Jinn, Tsai: A Novel Multi-Channel PM10-PM2.5 Sampler (MCPPS) (第759篇PDF)
- 海報論文(P2L5) Chang, Yuan-Yi; Lee, Yao-Chuan; Lien, Chen-Ting; Chen, Chun-Wan; Lin, Wen-Yinn: Generation Characteristics of ZnO by Evaporation/Condensation(第1076篇PDF)
- 海報論文(P2J8) P2J8 Chuen-Jinn, Tsai; Cheng-Yu, Huang; Chun-Wan, Chen; Sheng-Chieh, Chen; Chi-En, Ho: “Measurement of nanoparticle exposure at different workplaces”(第1059篇PDF)
- 海報論文(P1F43) Wen-Hai, Lin; Yen-Chuang, Huang; Po-Chen, Hung; Chun-Wan, Chen; Cheng-Ping, Chang: Control methods for emission of bioaerosols in the dental clinics(第997篇PDF)
- 海報論文(P3X2) Lin, Chih-Wei; Huang, Sheng-Hsiu; Chen, Chun-Wan; Chen, Chih-Chieh: ESP generated nanoparticles (第686篇PDF)

本次行程所發表之論文，有關奈米氣膠通風系統捕集及作業環境生物氣膠量測應該是較完整之研究結果，不過由於參加研討會之學者，對於新的事務興趣較大，對於熟悉議題較不願意花時間討論，因此此二議題氣膠研究學者多已熟悉相關研究成果，因此詢問者較少。而有關奈米氣膠個人暴露量測，全世界都正關注中，因此就受到較多之關注，詢問者也較多。對照研討會熱門之議題(各國學者發表較多之論文)，可知國際上最新研究趨勢的改變，最近氣膠熱門研究議題爲氣候變遷、生質能源、奈米微粒應用等研究。未來研究規劃上，若能透過參與國際專業研討會，將可掌握國際最新研究趨勢，規劃適當且迎合趨勢之研究。

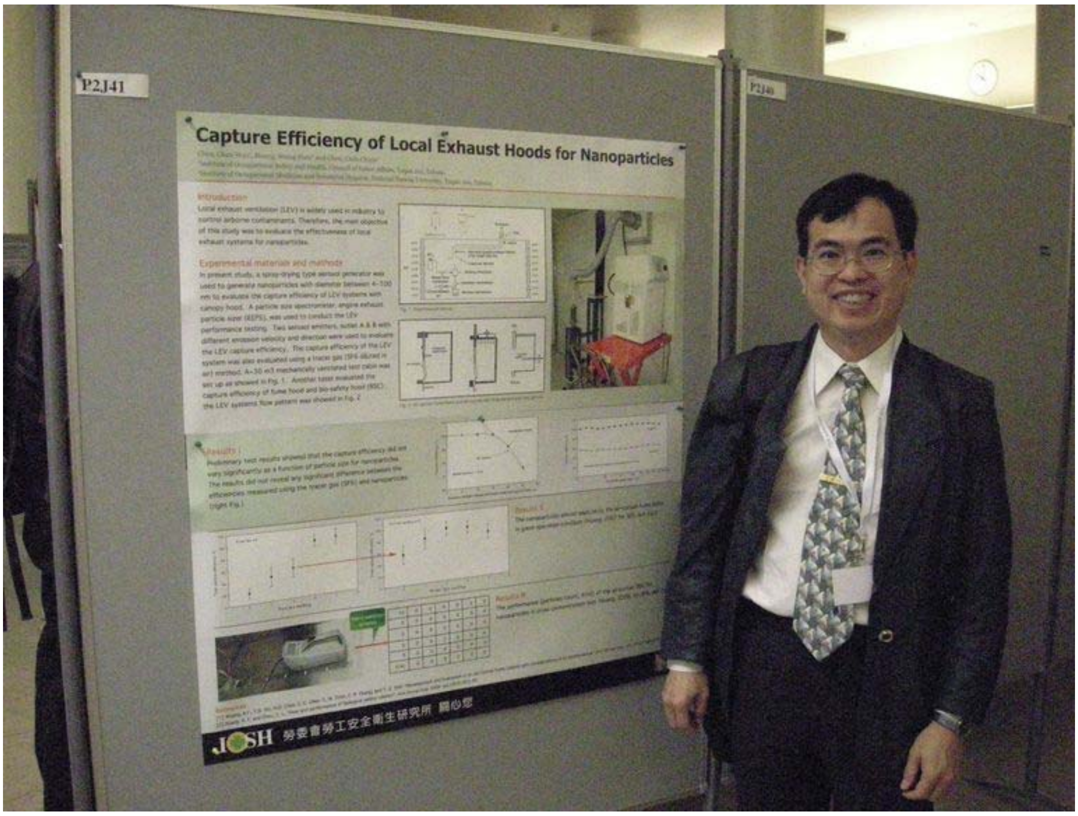

圖1 於發表論文前留影

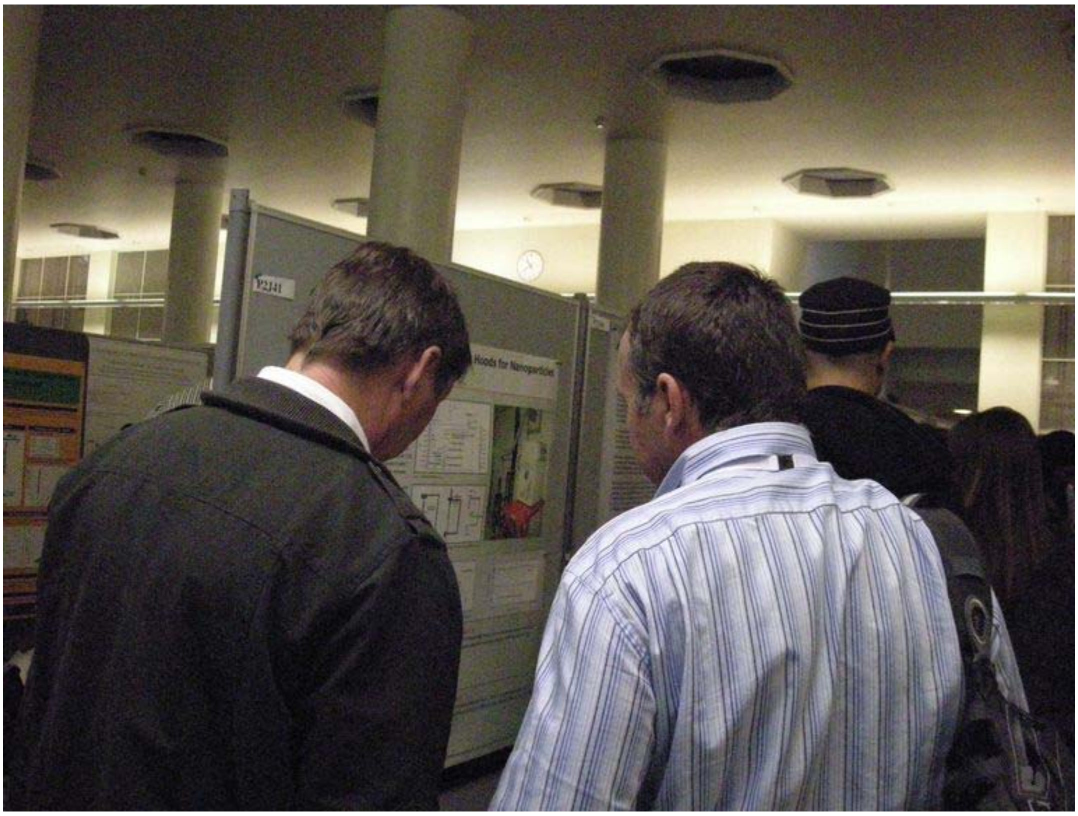

圖2 研討會學者參觀與討論海報論文情形(一)

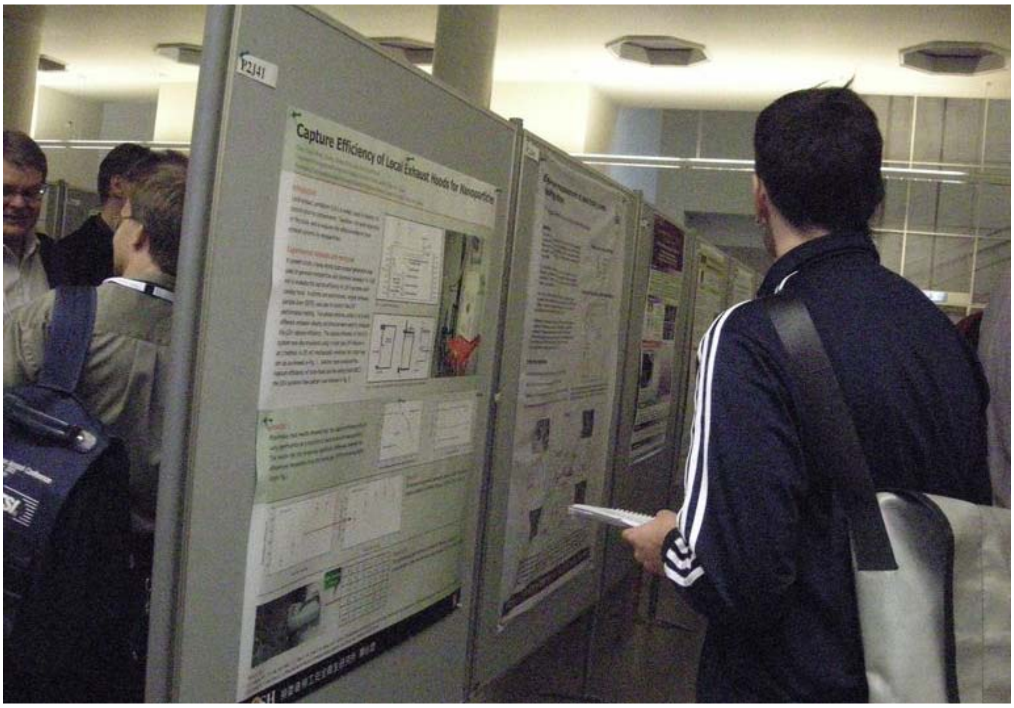

圖3 研討會學者參觀與討論海報論文情形(二)

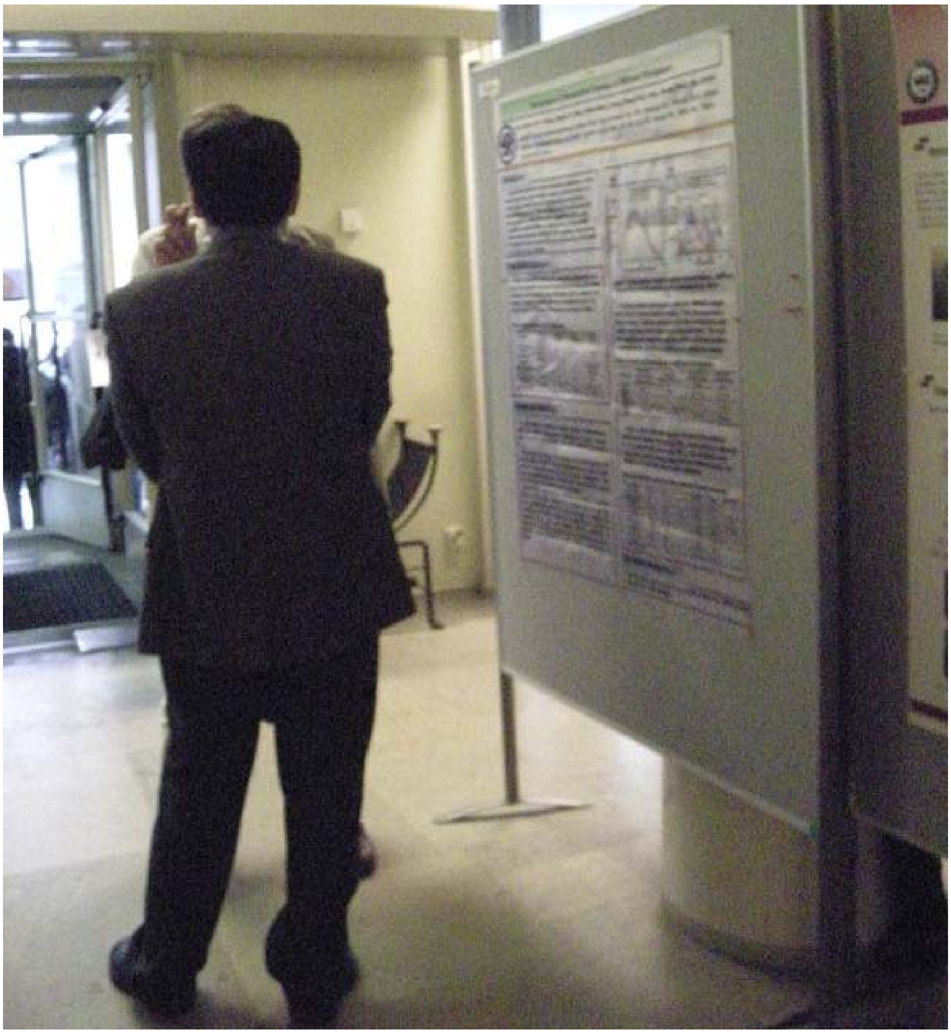

圖4 研討會學者參觀與討論海報論文情形(三)

四、 參觀研究實驗室

參與此次研討會可感受到主辦單位之用心及獲得相關單位之支持，雖然「2010年國際氣膠研討會」由國際氣膠研究學會領銜主辦，不過最主要爲芬蘭氣膠研究學會辦理，而芬蘭氣膠研究學會研究上非常傑出，也獲得赫爾辛基市及赫爾辛基大學全力支持，因此研討會能夠於赫爾辛基市政廳辦理歡迎會，能夠於赫爾辛基大學學校主要大廳辦理專題演講，最後也安排大學實驗室參觀，讓參觀者感受到最新的氣膠研究設備設計與研究規劃。

此次參加研討會有幸參觀赫爾辛基大學多間氣膠實驗室，赫爾辛基大學氣膠研究整合了物理系教授與化學系教授，而研究議題爲氣膠基本性質，特別是對於大氣環境與氣象變化之影響。應該是整合性研究與研究成果獲得肯定，赫爾辛基大學研究獲得歐盟及聯合國之支持，有許多國際合作計畫，而研究設計上，也結合物理化學相關領域專家，形成跨領域合作計畫，而研究設備上，能夠結合各類氣膠儀器，甚至能夠設計改裝氣膠儀器，而創造新的氣膠研究議題。

圖5 德國職業安全衛生研究所高階主管前來本所攤位拜會情形

參、心得

本次行程主要爲參加於芬蘭赫爾辛基舉行之「2010年國際氣膠研討會」，發表有關奈米氣膠捕集、作業環境生物氣膠與奈米氣膠量測等三篇論文與學者交流，並參觀赫爾辛基大學氣膠實驗室，學習相關研究經驗。此次行程強烈感受到氣膠研究趨勢之變化，在國際研討會上，各類型最新最熱門的研究議題會受到很大的重視，而各類研究都有很多研究學者，各類研究方法構想，都會在研討會發表，對於規劃研究方向有很大之參考價值。

規劃研究議題若只能參考學術期刊，將只能跟隨其他研究學者之研究方法，要發表論文就必須要有創新，而且要很大的突破，而在學術期刊所發表之論文，常常都是研究方法之介紹及特定環境之應用，可能只適用其研究環境，引用於台灣作業場所常常有適用性問題。因此台灣在特定議題研究上要能有所突破，應該要能夠有機會多參與國際學術研討會，掌握最新研究趨勢，而且應該專注於台灣所面臨之特定議題上，而且受到長期支持，如此才比較有機會領導特定研究議題，也才能在國際上獲得重視，在國際交流上獲得重視，例如獲得邀請專題演講等，能在國際研討會專題演講議題，常常是最新而且在國際上領先的研究團隊，受到國際研究學者之重視。

台灣在職業衛生氣膠相關研究議題上，很多都只能跟隨其他研究團隊作法，在本土化及台灣現況上進行研究，研究結果雖然可提供國內職業衛生應用參考，但是會與直接引用國際最新作法上之事業單位認知上有落差，研究也不容易有所突破而發表論文，甚至受到國際重視。例如在微粒採樣分析及微粒危害研究上，國際上研究都已很深入，在濾材捕集微粒之測試規範及微粒在呼吸道沉積之情形，也有很成熟之數據，雖然在本土化及台灣現況上仍需研究，但不容易發表論文，也不容易引起國際研究學者重視。幸好在奈米安全衛生研究議題上，台灣投入較多研究資源，而且結合各領域之專家，而且投入暴露評估與控制防護研究議題上，因此研究受到較多之重視，例如防塵口罩對於奈米微粒之捕集效果，獲得 Journal of Aerosol Science學術期刊被引用前50名之榮譽，有關奈米微粒個人暴露評估設備，獲得許多研討會學者重視等，都是我們研究上一些成果，也許是研究議題規劃上可參考之方向。

肆、建議事項

台灣在職業衛生部分研究議題已可與其他國家研究人員互相交流，而在研究議題之設定，除了解決國內之現況外，也必須了解國際發展趨勢，才能規劃更完善之研究計畫，而參加國際研討會可滿足這些需求。

本次行程主要爲參加於芬蘭赫爾辛基舉行之「2010年國際氣膠研討會」，發表有關奈米有關論文及收集學習國際上最新研究趨勢，供未來研究規劃參考，就參與整個研討會活動經驗，提出下列建議，可供未來參考。

1. 氣膠在職業衛生上應用研究趨勢，近年來在生物氣膠與奈米微粒方向有較多研究，例如危害基本測試方法、不同微粒粒徑所造成之影響、奈米微粒之危害性評估方法、暴露評估技術等，可供研究規劃參考。
2. 本所過去研究有關奈米微粒控制防護與暴露評估研究議題上，都已獲得不錯之成果，也獲得國際之重視，應該繼續延續此方面之研究議題。
3. 在濾材捕集微粒之測試規範及微粒在呼吸道沉積方面，雖然可能不容易發表論文，但可掌握本土化及台灣現況，研討會仍有濾材應用管理及呼吸道區域沉積論文發表，努力研究下仍有機會獲得不錯結果，因此仍值得繼續研究。
4. 國際研討會有最新的研究發展趨勢，研究人員規劃研究議題時應該參考這些資料，才能掌握趨勢，再結合本土資料，研究結果可提供本土職業衛生需求，也能與國際最新研究交流、發表論文與獲得國際重視，建議未來應有更多機會選派研究人員參加國際研討會，掌握研究趨勢。

附件一　研討會88個發表議題內容

氣膠基本原理

1. Aerosol modelling: Aerosol effects on climate
2. Aerosol modelling: Nucleation
3. Aerosol modelling: Processes and transport
4. Aerosol modelling: Sources and their impacts
5. Aerosol optical properties
6. New particle formation: Atmospheric Studies
7. New particle formation: Modelling
8. Optical properties /Remote sensing of aerosol properties
9. Particle charging and control
10. Physical and chemical particle properties and characterization
11. Physical and chemical properties – Thermodynamic properties of atmospheric aerosols
12. Physical and chemical properties- Physico-chemical characterisation
13. Physical and chemical properties: Regional and temporal patterns of aerosol distribution/ Climate effects of aerosols
14. Carbonaceous aerosol
15. Charged aerosol generation
16. Dosimetry and lung physiology
17. Fundamentals: Aerosol Deposition and Filtration
18. Fundamentals: Coagulation and Aggregation
19. Fundamentals: Nucleation & Aggregates
20. Fundamentals: Particle dynamics
21. High-temperature & Nuclear aerosol
22. Spectrometry

大氣環境氣膠研究議題

23. Atmospheric chemistry: AMS
24. Atmospheric chemistry: Analytical techniques
25. Atmospheric chemistry: Field measurements

26. Atmospheric chemistry: Field measurements /Indoor
27. Atmospheric chemistry: SOA I
28. Atmospheric chemistry: SOA II
29. Atmospheric chemistry: SOA model
30. Studies on SOA aging and terpene chemistry
31. Studies on SOA precursors and partitioning, and isoprene chemistry
32. EUCAARI: Aerosol Composition studies
33. EUCAARI: Aerosol properties and impacts
34. EUCAARI: Sources of aerosol particles
35. EUSAAR: Result from aerosol in-situ networks
36. EUSAAR: Techniques and methodologies for monitoring aerosol properties
37. Transport and transformation
38. Turbulent aerosol exchange fluxes between the atmosphere and surface
39. Urban aerosols – PM Characterization
40. Urban aerosols - Source Apportionment
41. Urban aerosols - Source Apportionment and Characterization
42. Urban aerosols - Traffic 2
43. Urban aerosols -Traffic
44. Volcanic ash special session
45. PMx: Physico-chemical analysis
46. PMx: variations in time and space

氣膠儀器

47. Instrument development III
48. Instrumentation
49. Instrumentation development I
50. Instrumentation development II
51. Instrumentation development IV
52. Instrumentation Testing
53. Integrated gas phase processes
54. Measurement Methods
55. Remote sensing of aerosol properties
56. Small scale and industrial studies

特殊氣膠

57. Marine Aerosols
58. Marine aerosols / Carbonaceous aerosols
59. Mineral dust
60. Radioactive aerosols

氣膠健康效應

61. PM and health
62. Particle Exposure and Health Effects
63. Linking ambient PM concentrations with epidemiologically derived response functions
64. Toxicolocial effects of particles

氣膠對氣象之影響

65. Aerosol, CCN, and Liquid Clouds I
66. Aerosol, CCN, and Liquid Clouds II
67. Aerosol, Clouds, and Precipitation
68. Aerosol, Ice Nuclei, and Cold Clouds
69. Aerosols in remote areas / UT aerosols, IN and clouds /Continental polluted
70. Hygroscopicity, CCN and clouds I
71. Hygroscopicity, CCN and clouds II
72. Atmospheric chemistry: CLOUD /Mechanisms

生質能源燃燒有關氣膠問題

73. Aerosols from solid biomass combustion and their health effects
74. Aerosols from wildland fires: sources, dispersion and impacts
75. Biomass and Biofuels
76. Biomass burning
77. Biomass burning / Bioaerosols
78. Diesel engines

奈米微粒

79. Application of Engineered Nanoparticles
80. Fundamentals and measurement of nanoparticles
81. Gas Phase Synthesis of Nanoparticles
82. Health Effects, Environmental Impact of NP, Worker Protection
83. Structuring of engineered nanoparticles
84. Resolving nano-CN in the atmosphere - experiments and theory
85. Nano/Pharma

生物氣膠

86. Bioaerosols
87. Bioaerosols special session I: Laboratory studies on characterization of bioaerosols
88. Bioaerosols special session II: Testing of new sampling and analysis methods in field studies

附件二　健康危害與奈米議題發表論文之題目

健康危害

1. A methodology for assessment of combined effects of particles and noise on humans during controlled chamber exposure
2. Exposure of newborns to high PM concentration affects “acquired susceptibility”, determining an increased prevalence of “susceptible individuals”
3. Toward comprehensive pollen aeroallergen exposure assessment
4. Methodology for assessing associations between exposure to generated airborne particles and health effects in residential
5. Characterization of particle emission from household products
6. Seasonal Comparison of Indoor Air Quality at Elementary School Classrooms in an Industrial City, Korea
7. Fine and ultrafine dust concentrations in vehicle interiors
8. Correlations between PM1 and other emission components in small-scale wood combustion
9. PM emissions from old and modern biomass combustion systems and their health effects Part 1: Determination and characterisation of PM emissions
10. PM emissions from old and modern biomass combustion systems and their health effects Part 2: Toxicological Characterization of PM emissions
11. Immunotoxic and genotoxic effects of particles emitted from smallscale wood combustion
12. The effect of a catalyzer on PCDD/Fs, chlorophenols and chlorobenzenes in wood combustion
13. Physicochemical characterization of fine particles from small scale wood combustion
14. Comparative analysis of chemistry transport simulations of a particulate matter episode over Germany
15. Aerosol Forecast and Evaluation in CMA Unified Atmospheric Chemistry Environmental Forecasting System (CUACE)
16. Long-Range Transport of Pollutants on the West Coast of North America: Whistler Mountain Observations Analyzed Using GEM-MACH

17. Urban plumes - Implications for climate and health Urban street canyons, Air pollution and population exposure: An Intake Fraction (iF) approach for Athens Area
18. Climate-induced changes on PM2.5 related premature mortality in 2050 over the US
19. Simulating the Annual-Average PM2.5 Mass Concentration & Composition Using CMAQ: A Decade in Review

奈米微粒

1. Effects of urban and rural aerosols on airway epithelial cells: role of the size and the physico-chemical composition of the aerosol.
2. Quantification of Quinones and Their Associated Health Effects From PM2.5 Collected at Tivoli Docks, Cork, Ireland
3. Barrier capacity of human placenta for nanosized materials
4. The impact of traffic pollution on antioxidant system of two populations exposed to different levels of pollutants: estimation of redox status of thiols
5. Differential gene expression of inflammatory and xenobiotic metabolizing genes after exposure to elementary classroom indoor/outdoor PM10
6. Uptake and effects of nanoparticles in lung epithelial cells
7. Novel device for the quantification of nanoagglomerate strength
8. On the validity of the Gormley and Kennedy’s solution of the masstransport equation in the sub 3 nanometers particles size range
9. Big MAG- A pilot plant for scaling up the synthesis of monodisperse nanoparticles
10. Sintering Mechanisms and Kinetics of Silica Nanoparticles
11. Mechanism of Single-walled Carbon Nanotube Formation by Aerosol Synthesis
12. Nano and sub-Nano Mixing of Materials in Nanoparticles Using Short Spark Discharges
13. Nanoparticle aerosols; modelling, formation, experimental methods, computational simulation and their impacts on global climate
14. Possible Nanoparticle Release from Liquid and Solid Materials into Environment
15. Potential for Exposure to Nanoparticles due to the Use of Nanotechnology-based Consumer Products

16. Generation and controlled deposition of airborne nanoparticles on lung cells for in vitro health studies
17. Exposure Measurement during the Production of Silicon Nanoparticles in a Pilot Scale Facility
18. Characterisation of engineered nanoparticles at different scale industrial factories
19. Application of catalysis for the specific detection of engineered nanoparticles in workplace air
20. Emission, dispersion and characterization of nano-aerosols during combustion chemical vapour deposition of SiOx in a workplace
21. Generation of nano particles using heterogeneous growth on homogeneous nuclei
22. Production and characterization of Cu, CuO coated and pure Co nanomagnets
23. Aerosol Techniques to Characterize Natural Light-Harvesting Antenna Systems for Enabling Design and Fabrication of Biohybrid Photovoltaic Devices
24. Flame Deposition of Functional Nanoparticle Surface on Paperboard Materials
25. Direct synthesis and coating of nanocomposites for Li-ion batteries via electrospray
26. Production of Mesoporous Silica Supported Metal Catalysts via Aerosol Method and its Application for Acetone Oxidation
27. First Measurements of Atmospheric Cluster and 1-2 nm Particle Number Distribution Functions During Nucleation Events
28. Assessing the charging mechanism and charging probability in cluster experiments
29. Composition and Reactivity of Sub-3 nm Ammonium/Aminium Sulfate Clusters
30. Resolving the mystery of sulphuric acid in atmospheric nucleation
31. Laboratory studies of nanoparticle formation from sulphuric acid and biogenic organic compounds at atmospheric concentrations
32. Understanding new particle formation through ion cluster dynamics
33. The composition and sources of urban nanoparticles: Results from the ULTRafine Aerosol Characterization Experiment (ULTRACE)
34. In vivo and in vitro measurements of inhaled aerosols targeted via magnetic alignment of iron oxide loaded high aspect ratio particles
35. Utilizing cloud settling for fast, efficient and dose-controlled nanoparticle exposure of lung cells cultured at the air-liquid interface

36. Nano-nebulizer: potential of a new technological concept for ventilation scintigraphy
37. Simulation of sprayed drug particles in a human nasal cavity from a nasal spray device
38. Effects on heart rate variability of exposure to nano-sized airborne particles
39. Carbon fullerene nanoparticle interaction with lung surfactant mode
40. BET Specific Surface Area Measurements of Airborne Particles
41. Gas phase synthesis of ZnO tetrapods
42. Nanoparticle penetration through mechanical and electret filters
43. Virtual Filtering of Aerosol Particles through Bipolar Coagulation
44. Evaporation of deposited micrometric heavy alkane droplets on fibers: evidences of the gap between experimentations and theory.
45. Coalesced Liquid Aerosol Droplets Sliding Along Filter Fibres – Atomic Force Microscopy Measurements
46. Preparation of a novel air filter material against bioaerosol and property evaluation
47. Effects of vehicle cabin filter efficiency on the ratio of in-cabin to on-roadway (I/O) ultrafine particle concentrations
48. Mg/Nb Nanoparticulate Composites for Hydrogen Storage
49. Formation of the colloidal quasicrystals in the spray-drying process
50. Surface morphology of materials growth from an electrosprayed liquid suspension
51. Creation of metal-semiconductor hybrid nanoparticles of tunable composition by biploar mixing
52. Multifunctional Porous Nanoparticles for Catalytic Application by an Aerosol Route
53. Controlled oxidation of the iron nanoparticles in chemical vapour synthesis
54. Control over Diameter, Density and Positioning of Carbon Nanotubes Grown on Insulators

生物氣膠

1. Inactivation of aerosolized viruses by a short-term exposure in a heated air flow
2. The use of metered dose inhalers as aerosol delivery devices
3. Physical particle size distributions of influenza A H1N1 virus bioaerosols

4. Characterization of the performances of a modified liquid sparging bioaerosol generator
5. Validation of a Bio-aerosol Exposure System Used for Medical Product
6. Efficacy Studies Aerosolizing Bacillus anthracis Spores
7. Detection and kinetics of protein nitration in bioaerosol particles by NO2 and O3
8. Control methods for emission of bioaerosols in the dental clinic
9. Long-term variation of the bioaerosol concentration in Southwestern Siberia
10. Enhancement of biological sampling efficiency for bioaerosols by using condensational growth system
11. Assessment of bioaerosol leakage into protective clothing by a fluorochrome image processor
12. Fungal concentrations in indoor air determined with qPCR and culture
13. Fluorescent biological aerosol particle concentrations and size distributions measured in different environments
14. Characterisation of fungal aerosol at occupational settings in food industry
15. Stationary versus personal measurement of exposure to airborne microorganisms and microbial components at biofuel plants and relation to respiratory symptoms
16. Phylogenetic analysis of long-range transported bacteria isolated from Asian dust (KOSA) bioaerosols
17. Pre-operational birch pollen forecast using COSMO-ART
18. Toxic microbial metabolites in moisture damaged homes
19. First measurements of the Bioaerosol single particle detector (BIO IN) for the Fast Ice Nucleus Chamber FINCH
20. Towards unified chemico-biological air quality forecasts: motivation, problems and gains
21. Innovative Radiant Heating for the Disinfection of Biologically Contaminated Filter Media
22. The effect of aerosolized method and cultivation time on fungal release in the air
23. Ambient concentrations of the major birch, grass and olive allergen
24. Bet v 1, Phleum p 5 and Ole e 1 and pollen counts in Europe: the new EU-HIALINE project
25. Rapid in-situ detection of targeted bioaerosol
26. Investigating the effects of relative humidity and nebulized medium on UV decontamination of viral aerosols loaded on a filter Back-up-talk

27. A theoretical Investigation of NO3 Initiated Nitration of Tyrosine
28. Allergenic Asteraceae in urban air: DNA analysis and relevance for human health
29. Airborne microbiology in enclosed spaces through molecular approach
30. Fluorescence of Bioparticles: On-line Detection and Microscopy
31. Associations between dust-borne and airborne bacterial exposure and the presence of pets and people in homes
32. Viability loss in heat-exposed aerosolized Bacillus subtilis spores is strongly correlated with mutational frequency
33. Wet generation of bioaerosol, based on a suspension of actinomycetes spores
34. Bacteria in the global atmosphere: estimation of sources and concentrations
35. Airborne Microorganisms in Pigeons Colonized Attics
36. Fluorescence Sensitivity of UVAPS to Bioaerosols and Standard Particles
37. Experimental infection of mice to airborne Legionella pneumophila.
38. Characterization of expiratory aerosol droplet by speech and coughing
39. Toxic microbial metabolites in moisture damaged homes
40. Electrospray-assisted UVAPS spectrometer for real-time detection of
41. biological particles

呼吸道沉積與過濾研究

1. In vitro deposition measurement of inhaled ultrafine aerosols in nasal airways of infants
2. Experimental Study of Aerosol Transport in Transparent Human Airways Model
3. Evaluation of a Simple System for the Measurement of Smoke Deposition in Volunteers
4. Airflow experiments with hollow bronchial airway model
5. Model study of biological cell exposure to aerosols in an Air Liquid Interface
6. Use of exhaled breath condensate to investigate workers exposure to heavy metals
7. Measuring the regional deposition of tobacco smoke in the human respiratory system
8. An improved nose-only flow-past chamber for chronic inhalation exposure of rats

9. Changes in structure and function in adult rat lungs due to post-natal exposure to ultrafine PM and ozone
10. Investigations into the mechanism and site of droplet generation in the human lung
11. Measurements of Respiratory Deposition of Road-Wear Particles
12. Particle deposition in the lung during domestic activities
13. An improved method and initial tests on experimental determination of respiratory tract deposition of airborne particles, 10 - 2500 nm
14. Short-term Effect of Fine and Coarse Particulate Air Pollution on Morbidity
15. Satellite Measurements to Enhance PM2.5 Air Quality Measurements
16. Summary of five experimental human exposure studies investigating the influence of aerosol properties and subject characteristics on respiratory tract deposition
17. Epidemiological studies on health effects from air pollution give inconclusive results because lack of adequate metrics of exposure, effect and susceptibility
18. Exposure to Short Duration Peaks of Indoor PM10 is not associated with clinically evident effects in children attending Primary School: a Prospective Study
19. Modelling airway deposition of aerosols in case of asthma and emphysema
20. Gas phase synthesis of ZnO tetrapods
21. Nanoparticle penetration through mechanical and electret filters
22. Virtual Filtering of Aerosol Particles through Bipolar Coagulation
23. Evaporation of deposited micrometric heavy alkane droplets on fibers: evidences of the gap between experimentations and theory.
24. Coalesced Liquid Aerosol Droplets Sliding Along Filter Fibres – Atomic Force Microscopy Measurements
25. Preparation of a novel air filter material against bioaerosol and property evaluation
26. Effects of vehicle cabin filter efficiency on the ratio of in-cabin to on-roadway (I/O) ultrafine particle concentrations

附件三　發表論文之資料目

海報論文(P2J41) Chen, Chun-Wan; Huang, Sheng-Hsiu; Chen, Chih-Chieh: Capture Efficiency of Local Exhaust Hoods for Nanoparticles (第427篇PDF)

Capture Efficiency of Local Exhaust Hoods for Nanoparticles

Chen, Chun-Wan[1], Huang, Sheng-Hsiu[2] and Chen, Chih-Chieh[2]

[1]Institute of Occupational Safety and Health, Council of Labor Affairs, Taipei 221, Taiwan.
[2]Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University, Taipei 100, Taiwan.

Keywords: nanoparticles, local exhaust hoods, capture efficiency.

Local exhaust ventilation (LEV) is widely used in industry to control airborne contaminants. So far, we have identified no relevant research that has specifically sought to evaluate the effectiveness of LEV against new nanoparticle challenges although it could in principle be used to control exposure. However, there is no reason to expect that application of LEV to nanoparticle generation processes will result in as effectively as it was previously demonstrated in gases and micro-scale aerosol particles(Bemer, 1998). Therefore, the main objective of this study was to evaluate the effectiveness of local exhaust systems for nanoparticles.

In present study, a spray-drying type aerosol generator was used to generate nanoparticles with diameter between 4 ~ 100 nm to evaluate the capture efficiency of LEV systems. A particle size spectrometer, engine exhaust particle sizer (EEPS), was used to conduct the LEV performance testing. Two aerosol emitters, outlet A & B with different emission velocity and direction were used to evaluate the LEV capture efficiency. The capture efficiency of the LEV system was also evaluated using a tracer gas (SF6 diluted in air) method. A ~30 m3 mechanically ventilated test cabin was set up as showed in Fig. 1.

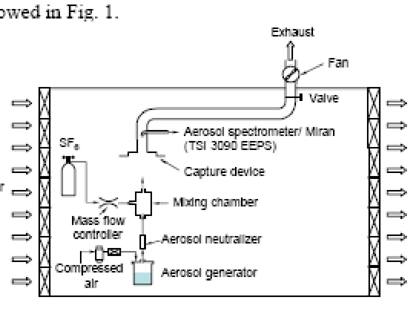

Figure 1. Experimental set-up

Preliminary test results showed that the capture efficiency did not vary significantly as a function of particle size for nanoparticles. The results did not reveal any significant difference between the efficiencies measured using the tracer gas (SF6) and nanoparticles (Fig. 2), and different nanoparticle diameters(Fig. 3).

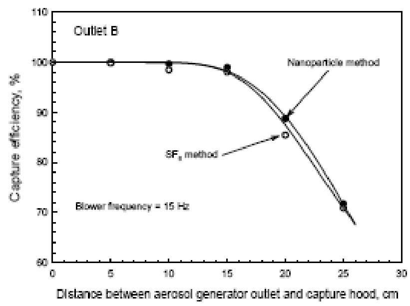

Figure 2. Capture efficiency measured using nanoparticle and SF6 methods.

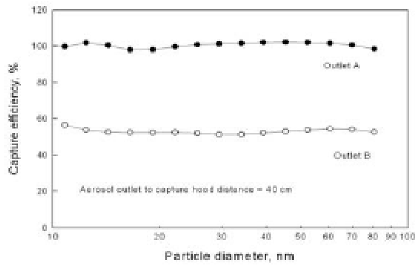

Figure 3. Capture efficiency measured in different nanoparticle diameters.

Another test showed the nanoparticles almost capture by the LEV systems in well control conditions of the push-pull(Huang et al., 2005) and air curtain fume hood (Huang, 2007) LEV systems.

Bemer, D., J. P. Muller, and J. M. Dessagne, "Comparison of Capture Efficiencies Measured by Tracer Gas and Aerosol Tracer Techniques," Indoor Air. 8: 47–60 (1998).

Huang, R.F., S.Y. LIN, S.-Y. JAN, R.H. Hsieh, Y.-K. Chen, C.-W. Chen, W.-Y. Yeh, C.-P. Chang, T.-S. Shih, C.-C. Chen, "Aerodynamic Characteristics and Design Guidelines of Push–Pull Ventilation Systems," Ann. of Occup. Hyg. 49(1):1-15(2005)

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口頭論文2E時段--Instrumentation development I，Chun-Nan, Liu; Sheng-Chieh, Chen; Chun-Wan, Chen; Chuen-Jinn, Tsai: A Novel Multi-Channel PM10-PM2.5 Sampler (MCPPS) (第759篇PDF)

A Novel Multi-Channel PM_{10}-$PM_{2.5}$ Sampler (MCPPS)

Chun-Nan Liu[1], Sheng-Chieh Chen[1], Chun-Wan Chen[2] and Chuen-Jinn Tsai[1,*]

[1]Institute of Environmental Engineering, National Chiao Tung University, Hsin Chu, Taiwan
[2]Institute of Occupational Safety and Heath, Council of Labor Affairs, Taipei, Taiwan

Keywords: PM sampler; PM_{10} and $PM_{2.5}$ impactor; solid particle bounce; ambient particles

It is desirable to have a sampler which collects many PM_{10} and $PM_{2.5}$ samples at the same time for the subsequent gravimetric as well as many different kinds of chemical analysis. A novel multi-channel PM_{10}-$PM_{2.5}$ sampler (MCPPS), which enabled the collection of four PM_{10} and four $PM_{2.5}$ samples simultaneously, was developed. The sampler used a PM_{10} impactor and a $PM_{2.5}$ impactor in series with the oil (Dow Corning 704 diffusion pump oil) coated glass fiber filters as the impaction substrates to reduce solid particle bounce. An active flow control system was introduced to adjust the actual sampling flow rate according to the ambient pressure and temperature. The MCPPS was calibrated in the laboratory for sampling efficiency curves and the field PM concentrations were compared with those of the collocated reference samplers including Dichotomous Sampler (DICHOT, SA 241, Thermo Andersen) and EPA WINS $PM_{2.5}$ sampler (Well Impactor Ninety-Six, Partisol FRM, Model 2000, Thermo Fisher Scientific Inc.).

As shown in figure 1, the aerosol is drawn from the ambient air into the MCPPS through the PM_{10} impactor at 33.4 L/min first. The flow is then divided into two streams of equal flow rate of 16.7 L/min by a flow separator, one of which is led to four PM_{10} filter cassettes while the other is introduced to the $PM_{2.5}$ impactor. After the $PM_{2.5}$ impactor, the $PM_{2.5}$ samples are collected by the other four filter cassettes. An orifice is assembled behind each filter cassette to increase the pressure drop of each sampling line which makes the flow rates through all channels even with a relative difference less than 2% when the filters are Teflon media (Teflo R2PL037, Pall Corp., USA). Thus, the MCPPS samples at a uniform flow rate of 4.17 L/min through each of the 8 filter cassettes.

In the laboratory, calibration results showed that the cutoff aerodynamic diameter of the PM_{10} and $PM_{2.5}$ impactors were 9.8±0.1 and 2.5±0.05 μm, respectively, for liquid oleic acid particles. For solid KCl particles, the corresponding cutoff diameters were 10.2±0.2 and 2.5±0.2 μm, respectively. These results revealed that the sampler was able to collect PM samples accurately and oil coating reduced the solid particle bounce effectively.

The results of field comparison tests showed that the collected PM_{10} or $PM_{2.5}$ concentrations between sampling channels were uniform with a relative standard deviation about 5% or 4%, respectively. Figure 2 shows the comparison of the $PM_{2.5}$ concentrations between the MCPPS, DICHOT and WINS $PM_{2.5}$ samplers, which indicates the sampled $PM_{2.5}$ concentrations agreed well with the other two reference samplers. The PM_{10} concentrations also agreed well with the DICHOT sampler (data not shown). The ANOVA tests showed no significant differences ($P > 0.05$) between the samplers for both PM_{10} and $PM_{2.5}$ concentrations. The collect PM samples will be analyzed for different chemical components to study the sampling artifacts of the traditional PM samplers that use one only PM_{10} or $PM_{2.5}$ sampling filters for the analysis of many different chemical components.

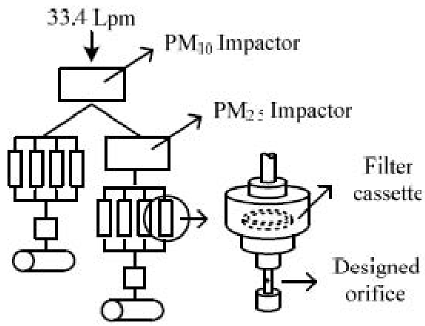

Figure 1. Schematic diagram of the MCPPS.

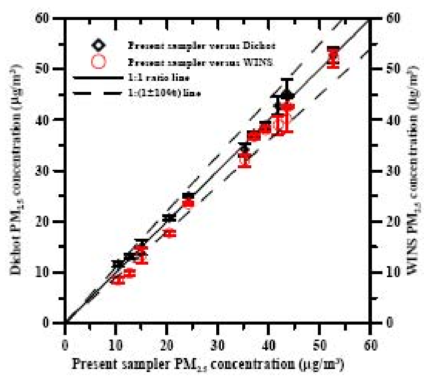

Figure 2. $PM_{2.5}$ concentration measured with the MCPPS, DICHOT and WINS samplers.

海報論文(P2L5) Chang, Yuan-Yi; Lee, Yao-Chuan; Lien, Chen-Ting; Chen, Chun-Wan; Lin, Wen-Yinn: Generation Characteristics of ZnO by Evaporation/Condensation(第1076篇PDF)

Generation Characteristics of ZnO by Evaporation/Condensation

Y. Y. Chang[1], Y. C. Lee[2], C. T. Lien[1], C. W. Chen[3], and W. Y. Lin[1]

[1]Institute of Environmental Engineering and Management, National Taipei University of Technology, Taiwan
[2]Department of Safety, Health and Environmental Engineering, Tungnan University, Taiwan
[3]Institute of Occupational Safety and Health, Council of Labor Affairs, Taiwan

Keywords: nanoparticles, evaporation/condensation, zinc oxide

The aim of this study is to develop an aerosol generating system that can produce particles of nanometer size in a convenient and efficient way. ZnO nanoparticles were produced by high-temperature furnace using commercialized zinc powder as the raw material and oxygen in the dry filtered air as the reaction gas.

The particle size generated by evaporation/condensation method is primarily determined by different temperature profile, flow rate of carrier gas and location of the boat for bulk material along the reaction tube (Scheibel & Porstendorfer, 1983; Damour, 2005; Jung *et al.*, 2006; Ku & Maynard, 2006). Although the method of zinc oxide particle generation has been studied, a systematically investigated and sintering for predicting particle size generated for easy applications has not been reported.

The experimental setup in this study consisted of three subsystems including the primary ZnO nanoparticle generation furnace, the secondary furnace for particle sintering and particles monitoring system. A quartz tube through the primary furnace served as a reactor, and commercialized zinc powders were put in a quartz boat. The zinc powders were evaporated and carried by nitrogen gas and subsequently reacted with oxygen supplied by compressor air. The gas stream with ZnO nanoparticles was then introduced into the secondary furnace for sintering the particles. The size distribution and concentration of ZnO particles generated were monitored at outlet of the secondary furnace by scanning mobility particle sizer (SMPS, TSI Inc., St. Paul, MN, U.S.A.).

The first objective was to assure that the system could generate a series of specific size of nanoparticles for comparison of the effect of different size. While setting a series of particle size ranges from 20 to 100 nm, the actual particle generated could be very close the objective size by simply adjusting the furnace temperature, reaction air flow rate and nitrogen flow rate. The size distribution curves of ZnO nanoparticles with ten nanometer mode difference were shown in Figure 1. The corresponding generation parameters of the system were summarized in table 1.

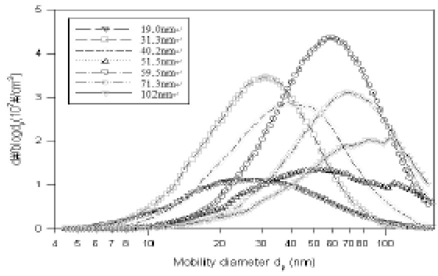

Figure 1 The size distribution of ZnO nanoparticles at difference condition.

Table 1. The generating parameters for specified size distribution of ZnO nanoparticles. (4 g zinc powder)

N_2 (L/min)	Reaction air (L/min)	Dilution air (L/min)	Furnace temperature (℃)	Mode (nm)
1	6	10	480	19.0
3	5	25	500	31.3
2	5	25	500	40.2
1	2	10	500	51.5
1	2	10	510	59.5
1	2	10	530	71.3
1	2	25	500	102

Another way to adjust the particle size is to control the secondary furnace temperature. A series of data was obtained by setting carrier gas and dilution gas flow rate in 2 L/min. In addition to The morphology variation of ZnO nanoparticles after sintering process was examined with transmission electron microscopy (TEM) photograph.

This work was supported by the Institute of Occupational Safety and Health (IOSH), Taiwan under grant IOSH97-H322.

Damour, T. M., Ehrman, S. H., Karlsson, M. N. A., Karlsson, L. S., & Deppert, K. (2005) *Aerosol Sci. Technol*, 39, 444–451.

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海報論文(P2J8) P2J8 Chuen-Jinn, Tsai; Cheng-Yu, Huang; Chun-Wan, Chen; Sheng-Chieh, Chen; Chi-En, Ho: "Measurement of nanoparticle exposure at different workplaces"(第1059篇PDF)

Measurement of nanoparticle exposure at different workplaces

Tsai, Chuen-Jinn[1*], Huang, Cheng-Yu[1], Chen, Chuen-Wann[2], Chen, Sheng-Chieh[1], Ho, Chi-En[1]

[1]Institute of Environmental Engineering, National Chiao Tung University, No. 1001, University Rd., Hsinchu 300, Taiwan
[2]Institute of Occupational Safety and Health, Council of Labor Affairs, No. 99, Lane 407, Hengke Rd., Sijhih City, Taipei County 22143, Taiwan

Keywords: nanoparticle, respirable particle

This study measured nanoparticle exposure at three different workplaces, including an epoxy molding compound plant, a synthetic rubber plant and a calcium carbonate manufacture plant. Nano-sized ($PM_{0.1}$) and respirable particle mass (RPM) concentrations were measured by micro orifice uniform deposit impactor (MOUDI), IOSH cyclone and TSI SMPS. In the epoxy molding compound plant, nano-silica particles were fed to the ball mill machine for mixing. In the synthetic rubber plant and calcium carbonate manufacture plant, generated powders were bagged by bagging machines. Figure 1 and Table 1 shows that nano-particle mass concentration in the synthetic rubber plant was the highest (average value is 10.0 μg/m^3), followed by epoxy molding compound plant and calcium carbonate plant, whose average concentrations were 2.0 μg/m^3 and 1.5 μg/m^3, respectively. Diesel forklift was used for delivering bags, which led to the highest nanoparticle concentration. For RPM concentration, the highest concentration occurred in the epoxy molding compound plant (average value is 1933 μg/m^3) followed by the synthetic rubber plant and calcium carbonate plant, whose concentrations were 159 μg/m^3 and 154 μg/m^3, respectively. There was a closed space without any general ventilation in the epoxy molding compound plant, thus RPM concentration was much higher than the other two plants. Moreover, local ventilation was utilized in the outlet of the bagging machines for reducing particle emission, therefore RPM concentrations in the bagging areas of other two plants were much lower as compared to the epoxy molding compound plant.

The mass median aerodynamic diameter (MMADs) ranges from 4.6 to 6.1 μm as shown in Table 1. This indicates that in terms of mass, airborne particles in the three workplaces are mostly respirable rather than nano-sized particles. Particle number distributions will be reported in the conference.

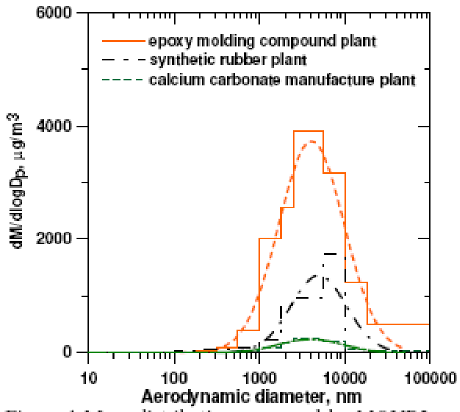

Figure 1 Mass distribution measured by MOUDI at different workplaces

Table 1 Particle concentrations at different workplaces

Item \ Site	Epoxy molding compound plant	Synthetic rubber plant	$CaCO_3$ manufacture plant
RPM conc. (μg/m^3)	1933±1105	159±52	154±74
$PM_{0.1}$ conc. (μg/m^3)	2.0±1.7	10.0±3.4	1.5±0.4
MMAD (nm)	4611±1671	6146±1700	5232±1767
GSD, σ	2.36±0.25	2.27±0.21	2.70±0.56

GSD: geometric standard deviation

海報論文(P1F43) Wen-Hai, Lin; Yen-Chuang, Huang; Po-Chen, Hung; Chun-Wan, Chen; Cheng-Ping, Chang: Control methods for emission of bioaerosols in the dental clinics(第997篇PDF)

Control methods for emission of bioaerosols in the dental clinics

Lin, Wen-Hai[1,2], Huang, Yen-Chuang[2], Hung, Po-Cheng[3], Chen, Chun-Wan[3], and Chang, Cheng-Ping[3]

[1]Department of Dental Hygiene, China Medical University, Taichung, 404, Taiwan
[2]Department of Occupational Safety and Health, China Medical University, Taichung, 404, Taiwan
[3]Institute of Occupational Safety and Health, Council of Labor Affairs, Executive Yuan, 221, Taipei, Taiwan

Keywords: bioaerosols, dental, mouse rinse, air cleaner

Bioaerosols could be generated during dental procedures and pose a hazard to dental health care workers. Some methods were used to control the emission of bioaerosols during in the dental clinics. The performance of these control methods were evaluated in this study, including chlorhexidine mouth washes and the air cleaner which were widely used in Taiwan dental clinics.

A three-chair dental clinic with a dentist and three dental assistants was selected to conduct the study. The clinic is 11.5*3.9*2.8 m and about 125 m^3. An air cleaner with a HEPA filter located near the end of the chairs was operated with a flow rate of 360 m^3/hr. A commercial chlorhexidine mouse rinse (Logothetis & Martinez-Welles, 1995; Netuschil & Brecx, 2005) was applied to some of the patients before the dental treatments. The control group used the tap water as the mouse rinse.

The bioaerosols at the chair side, preparing bench (1.5 m apart from chair side), and outdoors were collected by the MAS 100 bioaerosol samplers. Bacterial colonies were identified by the api^{TM} kits.

Figure 1 shows the bacterial bioaerosol concentrations during the afternoon of a busy-working day. The air cleaner turned off first, and the bioaerosol concentrations at the chair side were found to be higher than those at the preparing bench area (p=0.045). When the air cleaner turn on, there was no statistically-significant difference between the bioaerosol concentrations at these two sampling sites (p=0.123). However, the indoor concentrations were significantly higher than outdoors (p<0.001).

The concentrations in the mouse wash samples of patients were about $3*10^5$ CFU/ml before chlorhexidine mouse rinse application and dental treatments. No colony was recovered after the chlorhexidine mouse rinse was used, even after the dental treatments. The detection limit was as low as 10 CFU/ml.

There is no statistically-significant difference between the bioaerosol concentrations measured before and during the dental treatments when the chlorhexidine mouse rinse was used (p=0.435). However, the concentrations increased after the dental treatments were applied for the control group (p=0.023).

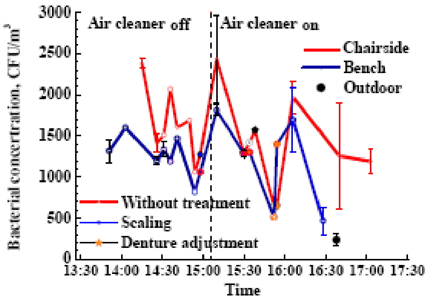

Figure 1. Bacterial bioaerosol concentrations during an afternoon with four dental treatments.

The prevalent bacterial species in the bioaerosol samples were *Micrococcus* spp. (22.8%) and *Staphylococcus xylosus* (21.3%), both of which were emitted from the skin of human body. During the scaling treatment without chlorhexidine mouse rinsing, airborne *Pasteurella pneumotropica* and *Serratia liquefaciens* could be found, which might be regarded from the mouse of the patients and pathogenic to human. Those species did not appear when the patient used chlorhexidine mouse rinse before dental treatments.

The bioaerosols concentration at chair side would not be higher than those at bench when the air cleaner turned on. However, the concentration were still higher than those outdoors, and the efficiencies of the air cleaner should be further studied when applied in the dental clinics. The usage of chlorhexidine mouse rinse could contribute to the control of emission of oral microorganisms and decreased the airborne bacterial concentrations.

This work was supported by the Taiwan Institute of Occupational Safety and Health, under grant IOSH98-H313.

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Netuschil, L., Reich E., & Brecx, M. (2005). *Journal of Clinical Periodontology*, 16, 484-8.

海報論文(P3X2) Lin, Chih-Wei; Huang, Sheng-Hsiu; Chen, Chun-Wan; Chen, Chih-Chieh: ESP generated nanoparticles (第686篇PDF)

ESP generated nanoparticles

Lin, Chih-Wei[1], Huang, Sheng-Hsiu[1], Chen, Chun-Wan[2] and Chen, Chih-Chieh [1]

[1]Institute of Occupational Medicine and Industrial Hygiene, College of Public Health, National Taiwan University, 10055, Taipei, Taiwan
[2]Institute of Occupational Safety and Health, Council of Labor Affairs, Shijr City, Taipei, Taiwan.

Keywords: aerosol generation, corona discharge, electrostatic precipitator.

The electrostatic precipitator (ESP) is widely used in industry as an indoor air cleaner and dust collector. In general, it is characterized by its low pressure drop, high collection efficiency of small particles, and high dust concentration handling capacity. However, an ESP not only collects particle but also generates particle in specific conditions (Alonso et al., 2006). The basic concepts of an ESP are to charge particles at first and collect particles by the following electric field. The particles are charged by the corona discharge. In a corona discharger the electric field strength is high enough to ionize air molecules. Therefore, the ions could get high energy to collide with discharge wire and particles are knocked out by the collisions (Biris et al., 2004). The ESP type air cleaner could become a particle generator if the ESP is not well designed and operated. The purpose of this study was to characterize the factors which affect the particle generation of an electrostatic precipitator.

A lab-scale wire-plate ESP was designed and constructed to study its aerosol generation characteristics. The discharge wire was made of 0.1 mm stainless steel and the collection plates were made of aluminum. Particle number concentration and size distribution were measured by a SMPS. The air temperature before and after ESP were monitored by two k-type thermal couples. Particle number concentration and size distribution data obtained in the power-on and power-off modes were used to estimate the particle generation of the ESP. Scanning electron microscopy and energy disperse X-ray were used to analyze the geometry and chemistry of the generated particles. The particle generation of the ESP was measured under different air flow rate, air velocity, field strength, temperature and applied voltage.

The air temperature after the ESP was higher than the upstream air due to the heat added by the corona discharge. Apparent erosion on the discharge wire after the tests was observed from SEM pictures, as shown in Figure 1. It is indirect evidence that particles were knocked out from the discharge wire. Electron microscopic photos showed that the nanoparticles generated by corona discharge ranged from nanometers to sub-micrometers, as shown in Figure 2, which agreed quite well with the SMPS measurements. The particle generation rate increased with increasing air temperature, operation time, electric current and field strength, but decreased with increasing air velocity and the distance between wire and collection plates. The particle generation rate was very sensitive to air temperature. That may be partly due to the mean free path of air molecule varied with changing air temperature.

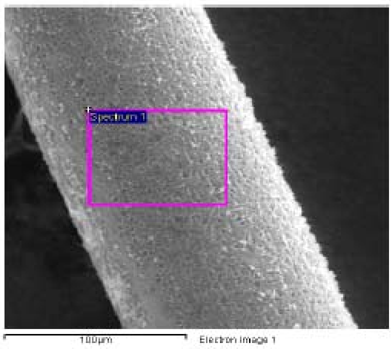

Figure 1. SEM image of discharge wire after use.

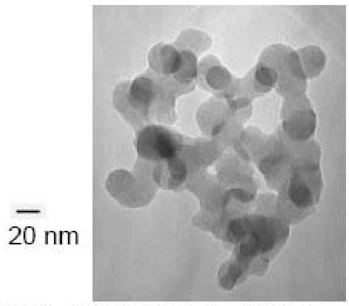

Figure 2. TEM image of nanoparticles generated from corona discharge

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Biris, A. S., De, S., Mazumder, M. K., Sims, R. A., Buzatu, D. A., Mehta, R. (2004). Particulate science and technology, 22, 405-416