出國報告（出國類別：其他）

參加 2017 年化學材料與程序處理國際研討會

服務機關：核能研究所
姓名職稱：陳柏聞　副研究員
派赴國家：大陸
出國期間：106 年 5 月 24 日~106 年 5 月 28 日
報告日期：106 年 6 月 28 日

摘 要

2017 International Conference on Chemical Materials and Process 國際研討會於 2017 年 5 月 25 日至 27 日於大陸北京清華大學舉辦，且不乏各國材料工程相關專家學者進行技術交流與論文發表，瞭解電漿鍍膜於綠色材料相關技術研究與系統工程程序、能源與環境工程、綠色製程，參加本研討會除可了解新穎材料相關研究與電漿鍍膜技術外，也藉由這次會議與會人員建立交流合作的機會。本屆會議主題涵蓋電漿技術在材料上應用、電化學技術之應用、綠色程序系統工程、能源與環境工程等領域。議題範疇於電化學技術應用、環境友善工程、環境能源製程之關鍵技術上皆有不少研究成果發表並在此會議中獲得新穎技術之最新發展。並與本所研發電漿製程應用於材料主題息息相關。

會議安排，由四個 Keynote Speaker 和三個 Plenary Speaker 開序，在材料研析提供深入的專題演講，主演講廳可容納上近百人進行專題討論，其中 Plenary Speaker 為澳洲 Edith Cowan University 化學工程系 Assoc. Prof. Hongqi Sun 針對石墨烯的製造與應用進行簡報，其專長為化學氣相沉積技術，並在一維奈米碳管與二維石墨烯相關材料研究琢磨已久，其中以常壓化學氣相沉積技術製備單晶微米大尺度石墨烯與石墨烯三维網絡結構材料更是重要成果，其應用性也是令人印象深刻，大面積透光導電石墨烯薄膜應用於可彎曲 OLED 元件，奈米碳材料也成功應用於儲氫材料與超級電容器等儲能材料。本會議之內容以演講為主，少數以海報呈現。藉由參加此次研討會，可獲得更多新穎材料應用於綠色節能與環境能源之資訊及相關發展方向，對本所研發技術創新有相當助益。

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圖目錄

一、目 的

2017 年化學材料與程序處理國際研討會(2017 International Conference on Chemical Materials and Process，簡稱 ICCMP 2017)，主題涵蓋電漿技術在材料上應用、電化學技術之應用、綠色程序系統工程、能源與環境工程等領域。為世界各地研究人員與學者提供很好的機會發表創新研究成果及最新材料應用發展與趨勢，並提供一個互相交流分享平台。該會議關於電化學技術應用、環境友善工程、環境能源製程等之關鍵技術上皆有不少研究成果發表並在此會議中獲得新穎技術之最新發展，可作為後續本組未來電漿鍍膜技術於綠能節能相關技術開發之參考。

本所於電漿鍍膜技術之研發卓有成效，參加該研討會並發表電弧電漿源應用於全固態電致變色元件論文，除能彰顯本所於電漿鍍製薄膜技術領域外，並期望藉由發表論文與專者討論過程中瞭解國際間研發現況，尋求最新技術，強化合作關係並增益現有研發技術，以利加速本所在電漿製程設備技術之開發。

二、過 程

本次公差之行程如下：

5 月 24日 上午 08:00 自桃園國際機場出發，於當地時間11:10抵達北京首都國際機場。從機場搭乘機場快軌前往會議舉辦地點(清華校園)，並於15:00到達飯店辦理入住事宜。

5 月 25日 上午10:00辦理會議報到與註冊程序。隨後參加2017年化學材料與程序處理國際研討會、蒐集研發資料並與國際學者交流互動。

5 月 26日 參加 2017年化學材料與程序處理國際研討會及蒐集研發資料，並於16:20~16:35 口頭發表本組最新研發成果。

5 月 27日 參加 one-day visit tour，並於國外學者做一些學術上之交流。

5 月 28日 於當地時間 15:30自飯店出發，搭乘機場快軌前往北京首都國際機場。並於 20:00自北京首都國際機場返回桃園國際機場，抵達台灣時間11:30，順利完成本次公差任務。

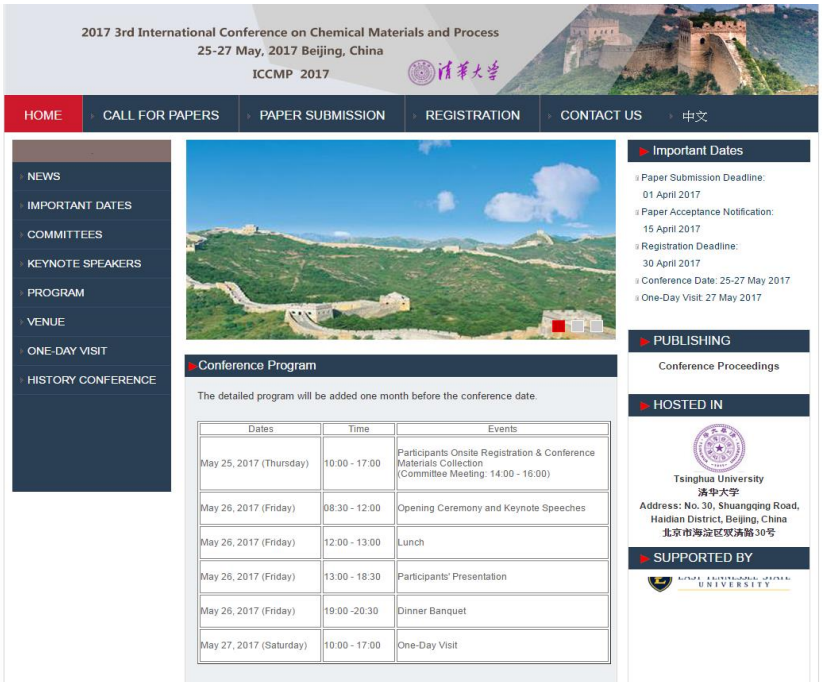
三、心 得

作者目前在核能研究所(以下簡稱本所)從事於節能技術相關研發工作，對於電弧電漿設備沉積變色電極薄膜技術有一些成果表現，並期望能更了解目前世界上對於新穎材料應用、綠色能源、環境科學、電化學技術之應用發展現況，故投稿參加 2017 年化學材料與程序處理國際研討會。藉由參加該會議可收集綠色能源技術、新穎材料應用相關資訊，作為往後研究發展參考依據。

本屆研討會的舉辦地點在北京清華大學內舉辦，如圖 1 所示。會議內容以演講為主，少數則以海報呈現。會議現場主要分為兩個演講廳。早上先由大會安排大型會議廳，並由四個 Keynote Speaker 和三個 Plenary Speaker 開序分時段進行專題演講並研析材料應用市場。在下午場次分成兩個會議廳同時進行環境保護及新穎材料應用發表研究成果並互相交流，由互動中得到相關知識以增進學者們研究質與量。

圖 1、北京清華大學西側門與 ICCMP 2017 研討會會場大樓

圖 2 為該會議地點、會議議程相關時間資訊。圖 3 為會議議程安排演講時間場次。研討會會場位於二樓，有寬敞的大廳供海報展示。在休息時間提供茶點與飲料可提供與會學者互相交流與討論。圖 4 為參加此次研討會會議學者之團體照。圖 5 為參加此次研討會口頭報告後與 chairman 合照。



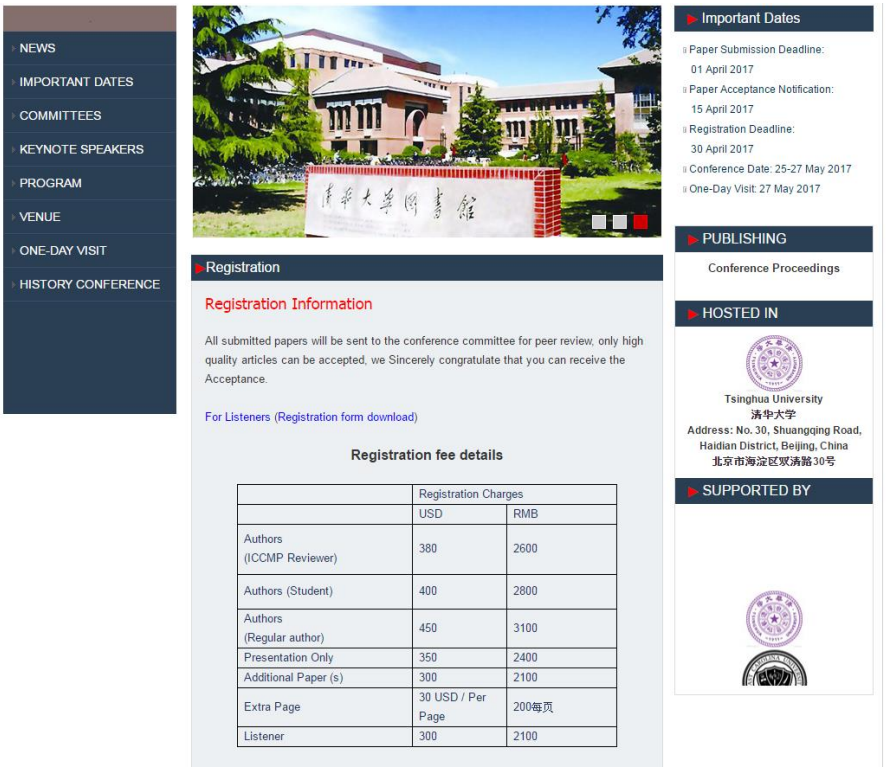


圖 2、研討會會議資訊及大會註冊收費表

Brief Schedule for Conference

Day 1	**May 25, 2017 (Thursday)**	**Venue: 1st Floor, Jia Suo**
	Arrival Registration	10:00~17:00
	Committee Meeting	14:00~16:00
Day 2	**May 26, 2017 (Friday)** 8:50~18:05 **Venue: Jia Suo Conference (2) & (3)** 清华甲所第二&三会议室 Arrival Registration, Keynote Speech, Plenary Speech, and Conference Presentations	
	Morning Conference	
	Venue: Jia Suo Conference (3) **Opening Remark** 8:50~8:55 **Keynote Speech I** 8:55~9:35 Prof. Weiyang Fei, Tsinghua University, Beijing, China **Keynote Speech II** 9:35~10:15 Prof. Yu Frank Yang, East Carolina University, Greenville, North Carolina, USA **Coffee Break & Group Photo Taking** 10:15~10:40 **Keynote Speech III** 10:40~11:20 Prof. Takashiro Akitsu, Tokyo University of Science, Japan **Keynote Speech IV** 11:20~12:00 Assoc. Prof. Zhigang Tang, Tsinghua University, Beijing, China	
	Lunch: 12:00~13:00	**Venue: Restaurant, 1st Floor, Jia Suo**
	Afternoon Conference	
	Venue: Jia Suo Conference (3) **Plenary Speech I** 13:00~13:30 Prof. Jian Chen, Tsinghua University, Beijing, China **Plenary Speech II** 13:30~14:00 Prof. K.S.K. Rao Patnaik, Osmania University, Hyderabad, India **Plenary Speech III** 14:00~14:30 Assoc. Prof. Hongqi Sun, Edith Cowan University, Australia	
	Session 1 *(Part. 1)* : 14:30~15:30 **Venue: Jia Suo Conference (2)** 4 presentations-Topic: "Material Chemistry"	**Session 2 *(Part. 1)* :** 14:30~15:30 **Venue: Jia Suo Conference (3)** 4 presentations-Topic: "Environmental and Chemical Engineering"
	Coffee Break:	15:30~15:50
	Session 1 *(Part. 2)* : 15:50~17:20 **Venue: Jia Suo Conference (2)** 6 presentations-Topic: "Material Chemistry"	**Session 2 *(Part. 2)* :** 15:50~18:05 **Venue: Jia Suo Conference (3)** 9 presentations-Topic: "Environmental and Chemical Engineering"
	Poster session 8:50~18:05	**Venue: Jia Suo Conference (2) &(3)**
	Dinner: 18:30	**Venue: Restaurant, 1st Floor, Jia Suo**
Day 3	**May 27, 2017 (Saturday)** 8:30~18:00	Academic Visit

Tip: Please arrive at the Conference Room 10 minutes before the session begins, and upload PPT/ PDF file into the conference laptop.

圖 3、會議議程安排演講時間場次

圖 4、研討會會議註冊會場以及演講會場

圖 5、口頭發表本組研究成果與大會 Session Chair 合照

圖 6 為特邀講者來自澳洲 Edith Cowan University 化學工程系 Assoc. Prof. Hongqi Sun 針對石磨烯的製造與應用進行口頭簡報，Sun 教授本身專長為化學氣相沉積技術，並在一維奈米碳管與二維石墨烯相關材料研究琢磨已久，其中以常

壓化學氣相沉積技術製備單晶微米大尺度石墨烯與石墨烯三维網絡結構材料更是重要成果。利用此材料沉積大面積透光導電石墨烯薄膜可應用於可彎曲基材 OLED 元件，也可成功應用於儲氫材料與超級電容器等儲能材料。

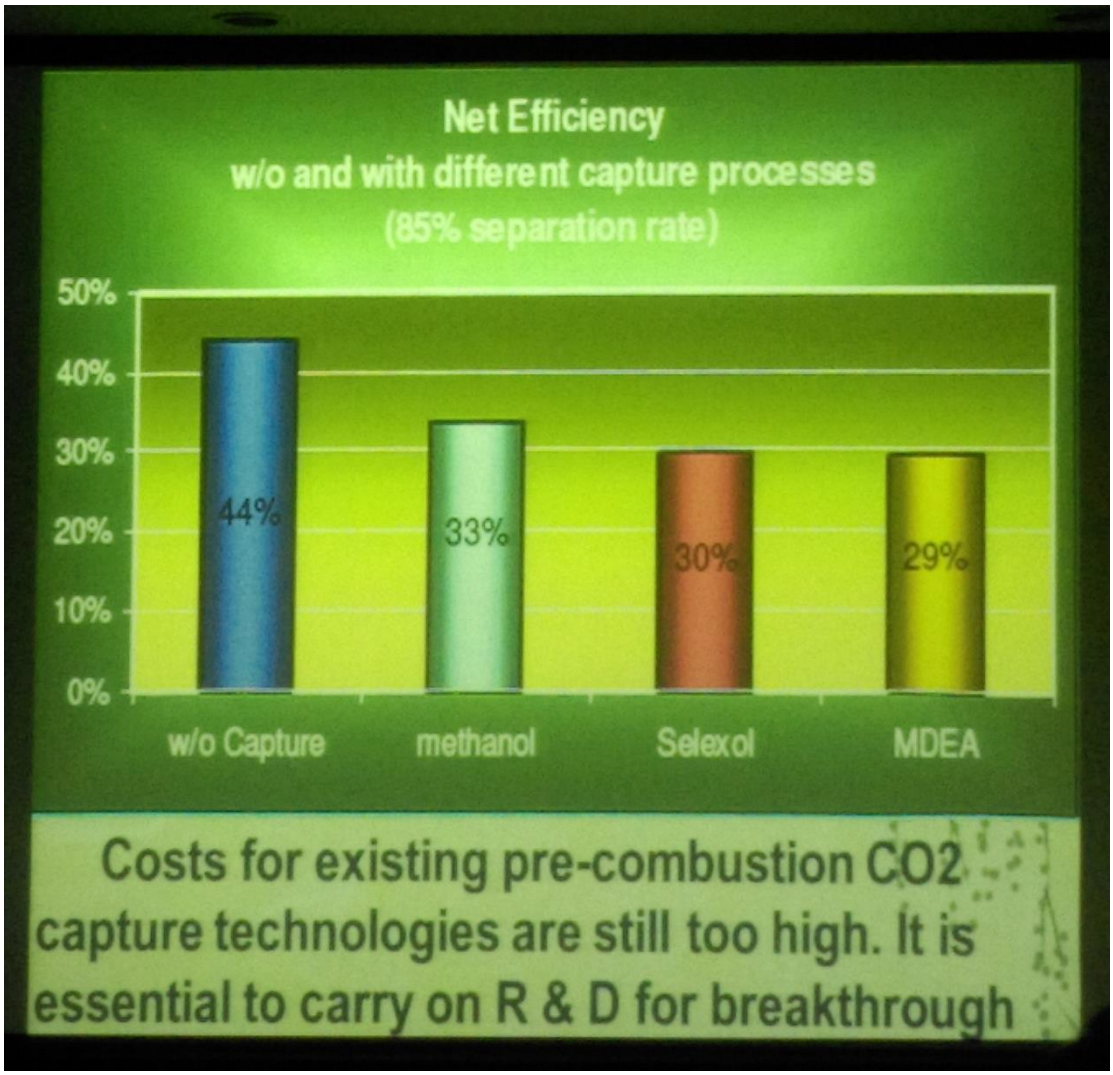


圖 6、Assoc. Prof. Hongqi Sun 針對最新研究成果進行簡報

此次 Prof. Sun 也針對如何改善環境保護提供想法與最新國際資料進行深入分析與講解。隨著環保意識的抬頭，人們也愈來愈重視地球環境和生態保護，如何有效減少污染物的產生，是現今社會重要的課題。例如，如何移除廢水中汙染物去除方法為全球研究的重點。如以光觸媒氧化還原法為主，如圖7所示。在光觸媒氧化還原法中，催化材料又以二氧化鈦最常被使用，這是由於二氧化鈦本身較其他材料對光觸媒能力具有高穩定性且具有強氧化還原能力。而二氧化鈦本身能隙為3.0~3.2 eV，其被歸類在紫外光吸收波段，紫外光僅占太陽光能的3%~5%，而不能吸收占太陽光能45%的可見光，對光能的利用率很低。

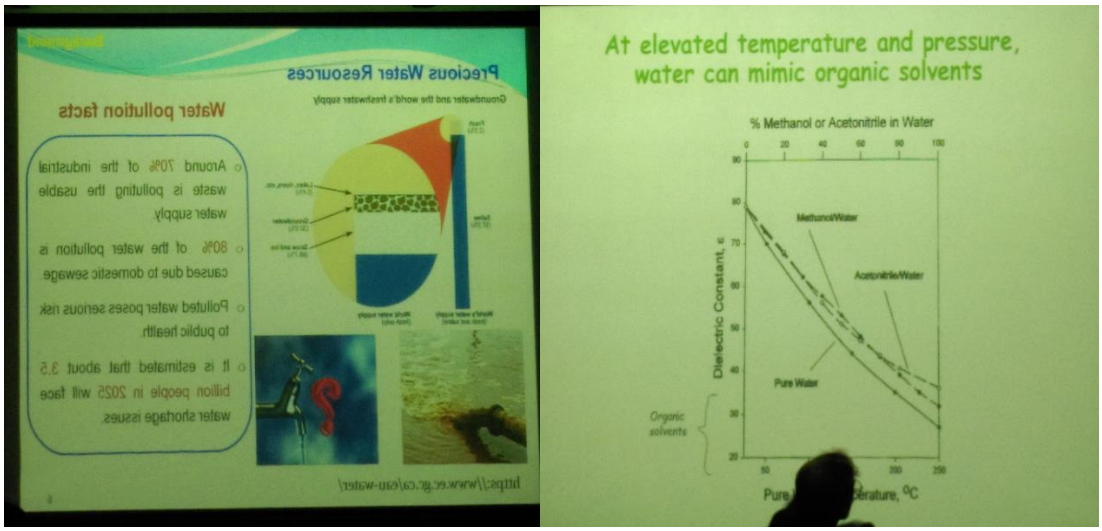


圖 7、Assoc. Prof. Hongqi Sun 移除廢水中汙染物去除因子

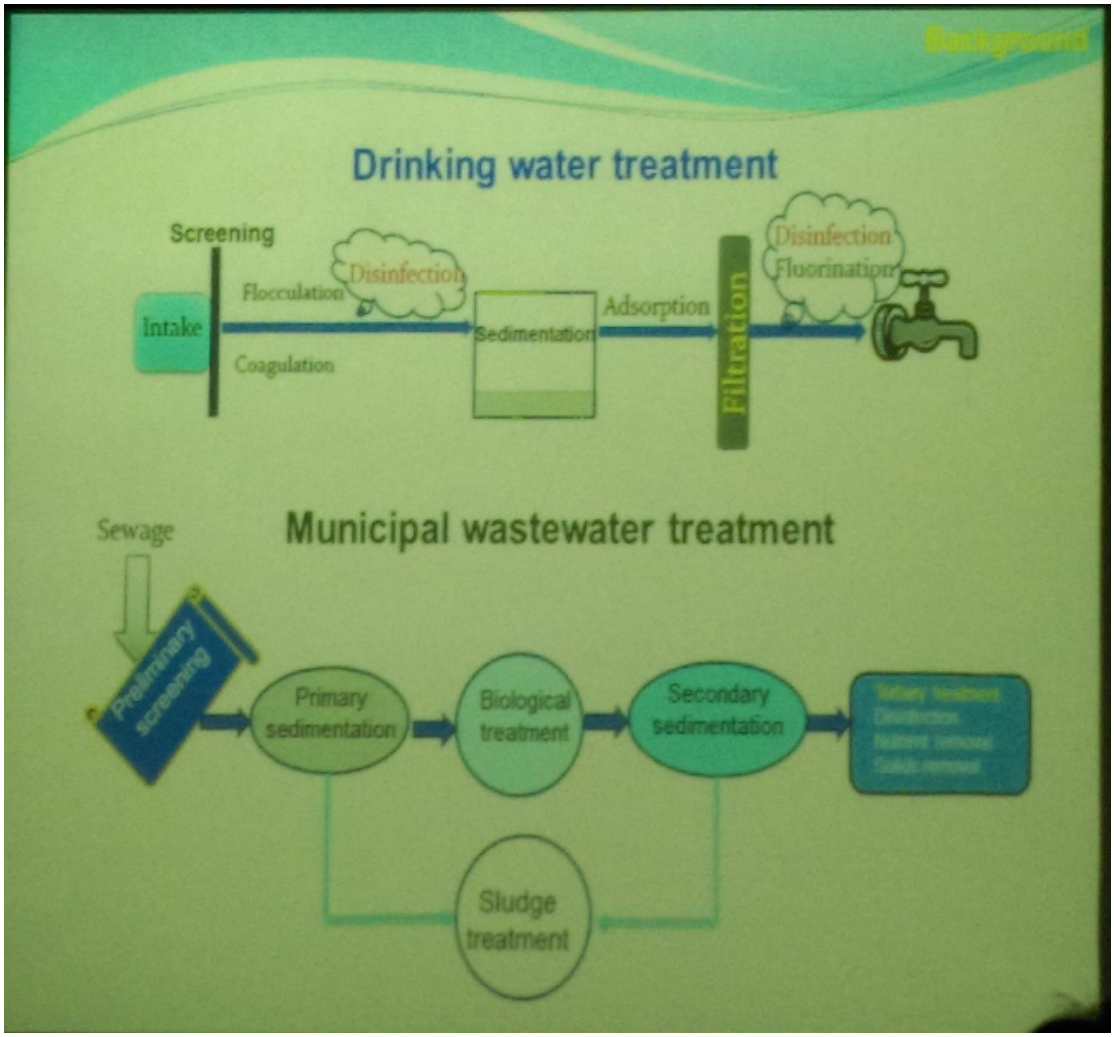


圖 8、移除廢水中金屬汙染物流程簡報

二氧化鈦可用來分解廢水，將含有毒化物質之工業廢水通過鍍有二氧化鈦之

材料進行降解反應，其流程圖為圖 8 所示。近年來則致力於新興污染物淨化系統裝置開發與研究。

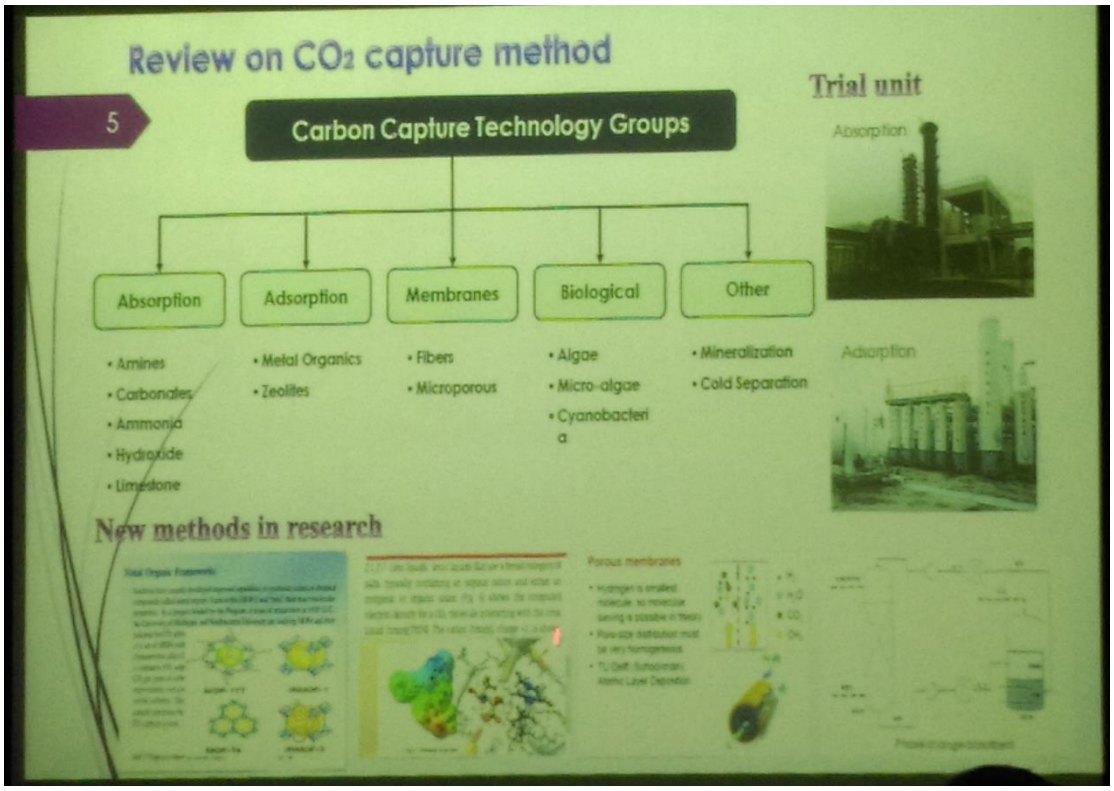


圖 9、介紹藉由燃燒方式技術來捕集 CO_2

圖 9 為北京清華大學化學工程系 Prof. Tang 口頭簡報，其中，較常見的二氧化碳分離回收方法可分為物理與化學的方式。物理方式又分為吸收、吸附、薄膜分離等。另外，化學方式則指化學吸收為主。物理吸收主要是利用亨利定律使二氧化碳氣體於低溫高壓下溶於吸收液中，達到二氧化碳回收的效果，吸收液可以利用升溫或減壓再生，此法中二氧化碳的回收須取決於壓力和二氧化碳的溶解度，所以常用於工廠排放氣體，但需多一步加壓的動作。近年來，二氧化碳濃度快速增加，導致溫室效應、氣候變遷。因此，二氧化碳的減量技術與發展亦日益重要。薄膜分離法是利用一層具有選擇性的薄膜加以分離氣體。分離機制包括分子篩、吸附及擴散。其操作簡便、節省能源，但缺點是不易製造與效率低。以物理方式回收二氧化碳的共通點為其選擇率皆不高，無法有效的只回收二氧化碳。

在圖 10 為目前工業界廣泛使用為溶劑吸收法，也就是化學吸收。常用的溶劑為醇胺官能基之鹼性溶劑，對於二氧化碳的化學吸附很強，所以選擇率很高，但液態溶劑需大量能源回收吸收液，非常耗能。而固體吸附劑開始受到重視，由於回收能力較佳。固體吸附劑中最具潛力的結構是孔洞材料，因孔洞材料具有高表面積，可以利用其高表面積吸附二氧化碳，製作分子篩。更可引入胺基官能基到孔洞中，使其對二氧化碳具有高吸附量以及高選擇率。

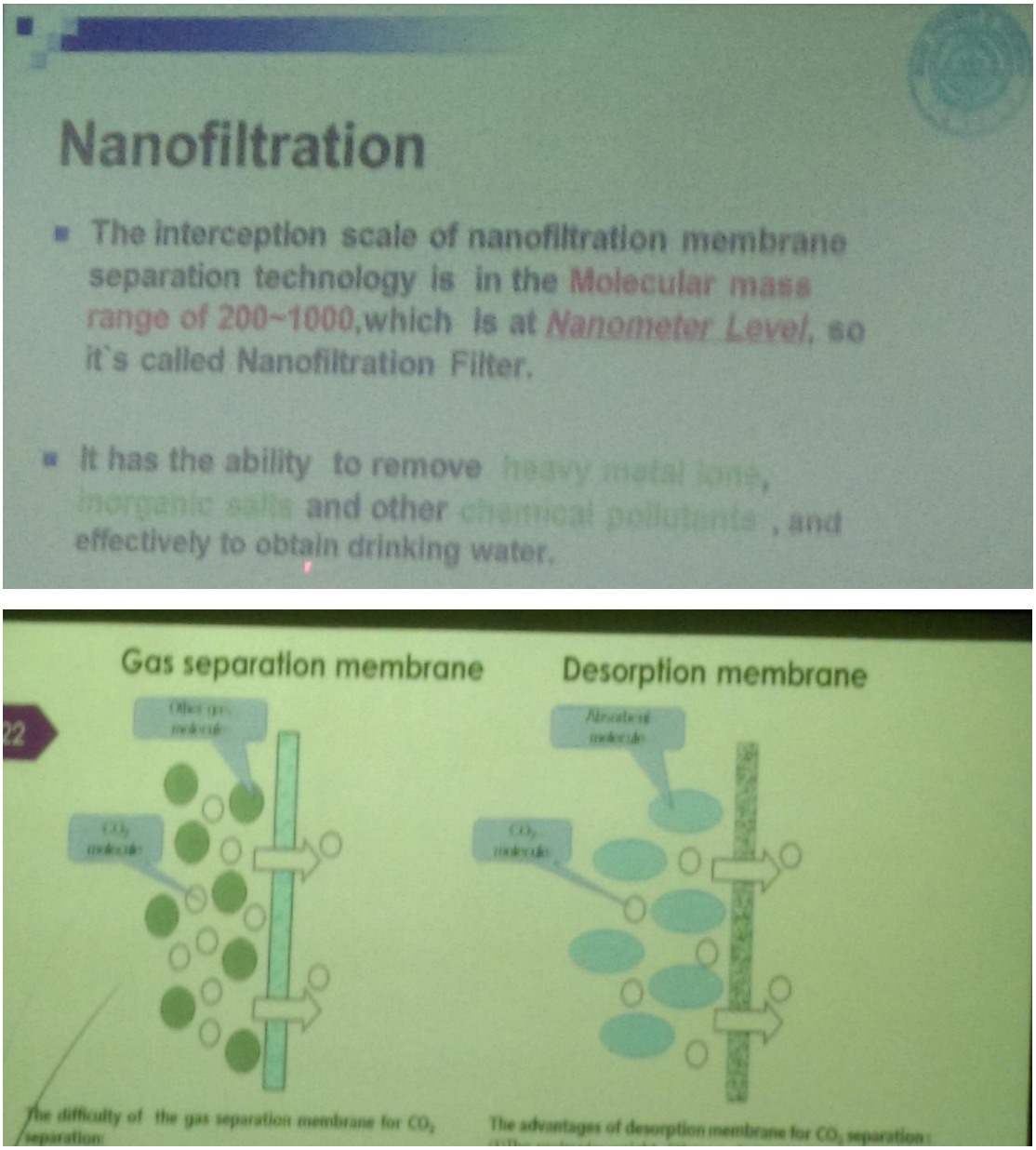


圖 10、氣體分離技術利用高表面積孔洞材料吸附或脫附二氧化碳

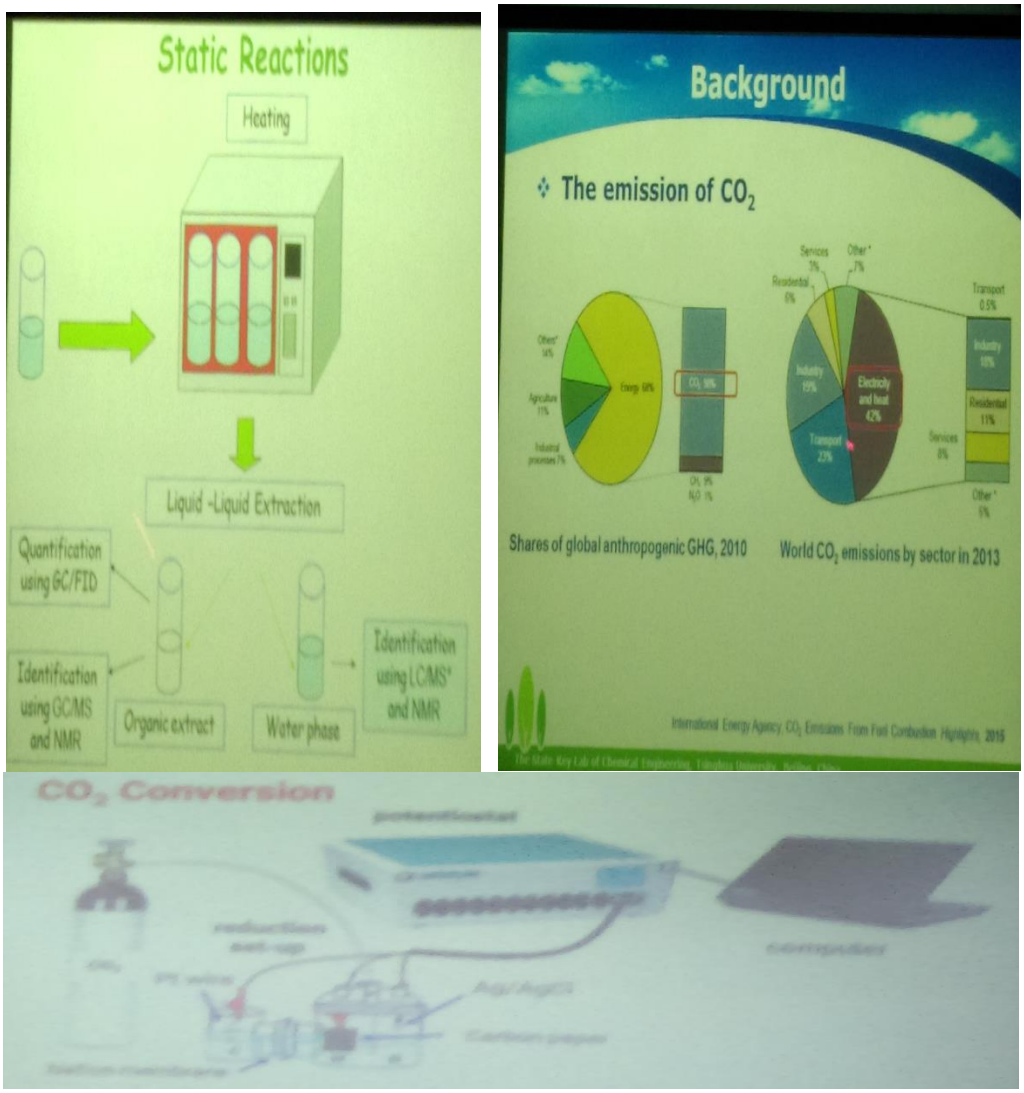


圖 11、二氧化碳的電催化還原成較小有機分子化合物

由國立菲律賓大學化學工程學系的 Ms. Bianca Christina S. Alba 介紹奈米材料研究在未來永續發展的機會與挑戰，如圖 11。演講內容較有趣的研究主題為二氧化碳經電催化後，可以還原有機小分子形成氫氣等氣體，對於未來可提供燃料，同時抑制氣候變化。同時簡報有提出此研究主題難處為選擇合適的催化劑，此項很龐大的研究議題。然而，電還原 CO_2 過程中，另一個瓶頸是如何將高穩定性的 CO_2 活化，這往往需要非常高的過電位；而過電位的存在不僅浪費大量的能源，還往往導致還原產物選擇性的降低。所以能如何將 CO_2 的還原電位降低到熱力學的最小值。使金屬表面氧化物對其自身金屬電還原性能的影響機制還不清楚，在催化劑中含有大量的微結構如介面、缺陷等，這些微結構的存在很容易掩蓋住表面金屬氧化物對其自身金屬催化性能的影響。

Ms. Bianca Christina S. Alba 目前該團對所使用的催化劑為 Sn 電極。簡報中表示 Sn 電極為有效用於二氧化碳電解還原的催化劑。

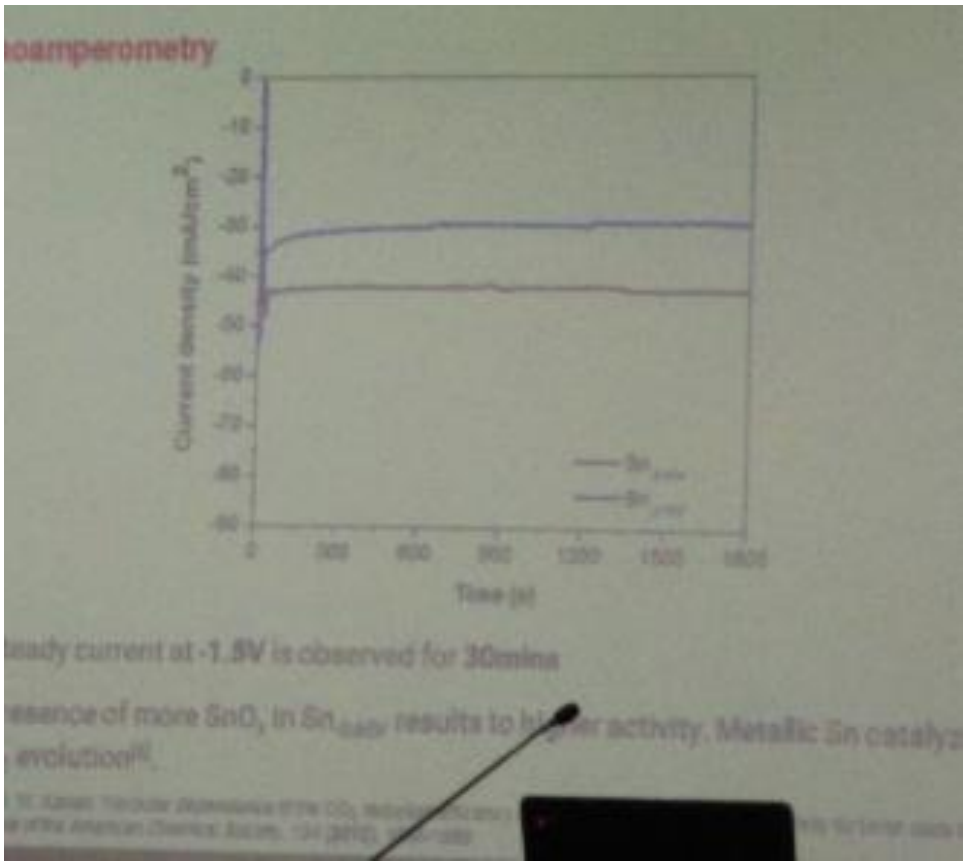


圖 12、二氧化碳的電催化還原之計時電流法

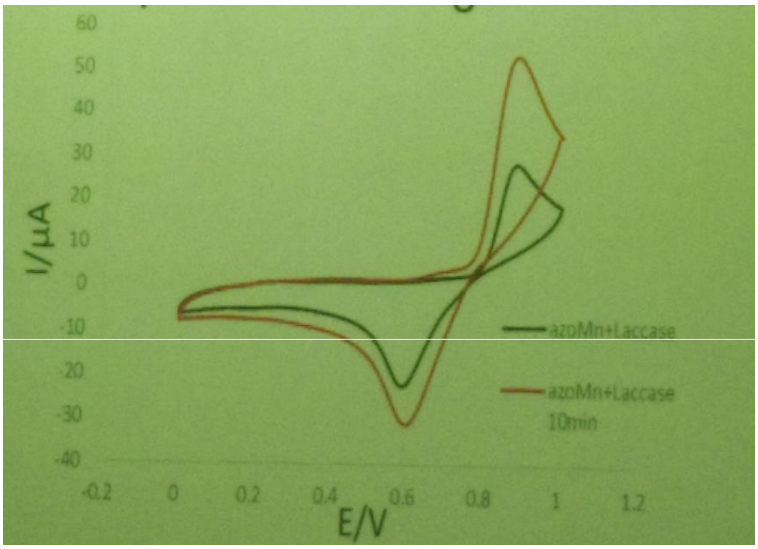


圖 13、二氧化碳的電催化還原之循環伏安法

圖 12、13 為循環伏安法和計時電流法，顯示催化劑對 CO2 還原的活性和穩定性取決於氧化錫的形態和存在。這些結果提供了對性能的更好理解電沉積的 Sn

基表面作為用於 CO_2 還原的催化劑，對於其演講內容本人受益良多。

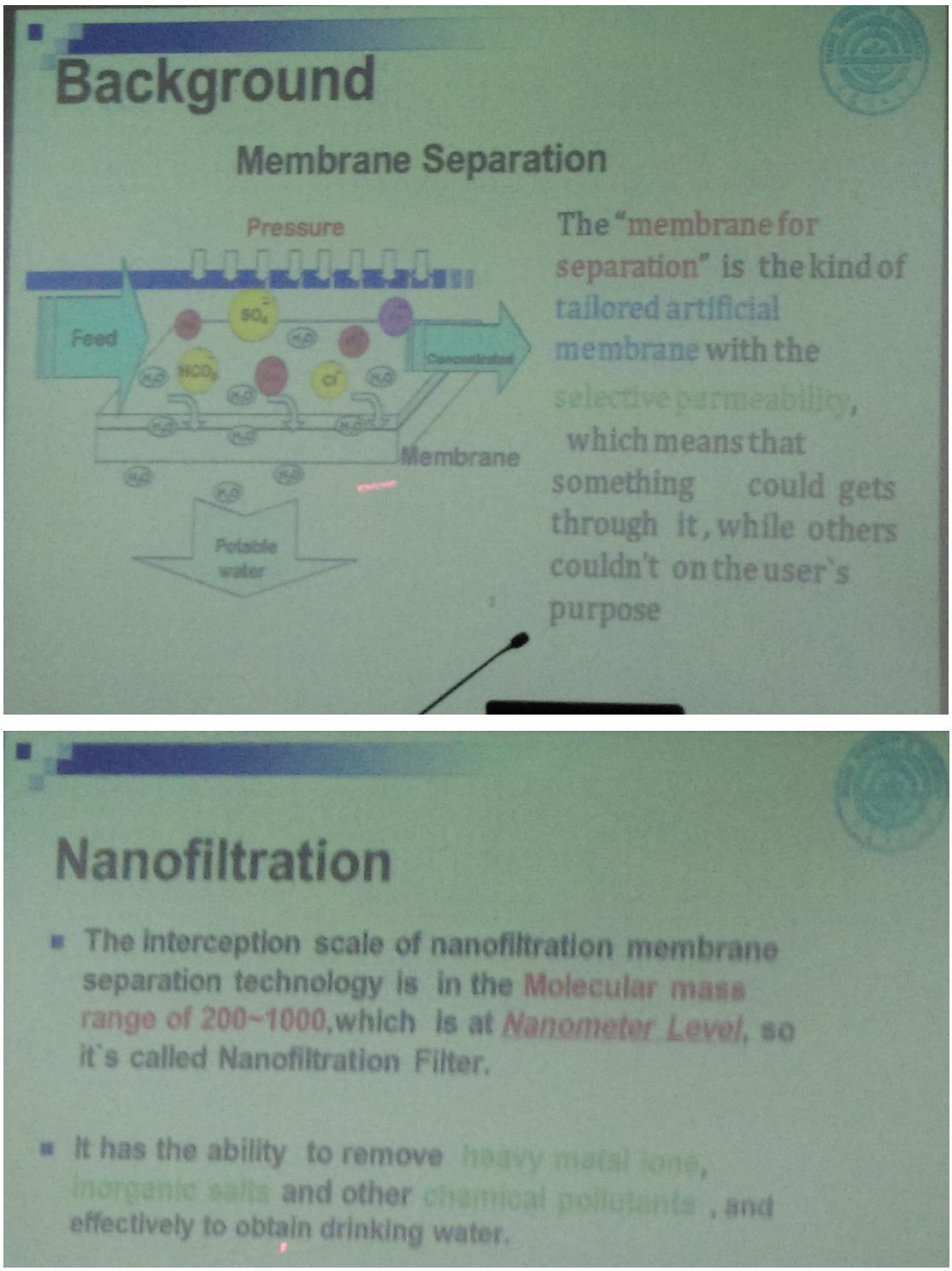


圖 14、電場控制奈米過濾技術之背景知識

另外，大連科技大學 Dr. Runlin Han 針對電場強度來控制奈米過濾技術給予簡報。如圖 14 為主要在薄膜之兩側外加直流電，可破壞溶液電中性。使價數高低及電性正負等性質在溶劑中具有分離效果。實驗結果顯示，陽離子阻擋率較

低，其主因為受電場之電荷作用力影響而往濾液端遷移；陰離子方面，則因受到與濾液端方向相反之電場作用力的影響具有較高之阻擋率，且隨電場增加，阻擋率隨之上升。

其中，在分離單價陰陽離子時，隨施加電場提昇至強度為 750V/m 時，陰離子可至 80%左右之阻擋率，而陽離子由於電場作用呈現負阻擋率，因此在分離與其他價數之陰離子，提升電場強度可有效提高分離效果。

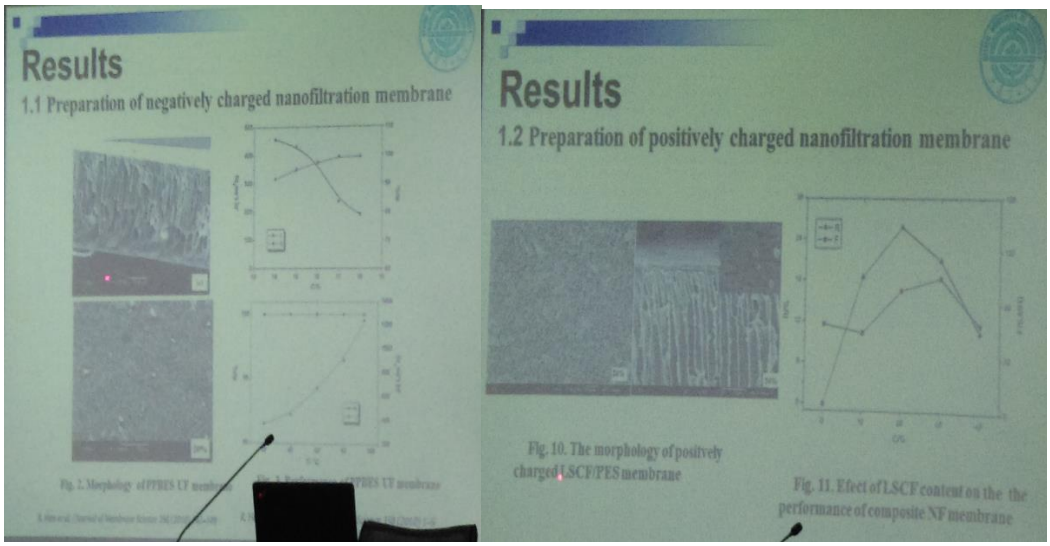


圖 15 在不同價數離子間之分離結果

如圖15為在不同價數離子間的分離結果，結果表示陰離子在較低電場下阻擋效能有較大差距；而陽離子在較低電場強度下有較高阻擋率，與離子之負阻擋率產生差距。使不論一價或是二價之陰離子其阻擋率皆可至90%以上。因此對不同電性離子而言，提高電場強度可增加選擇分離效果。

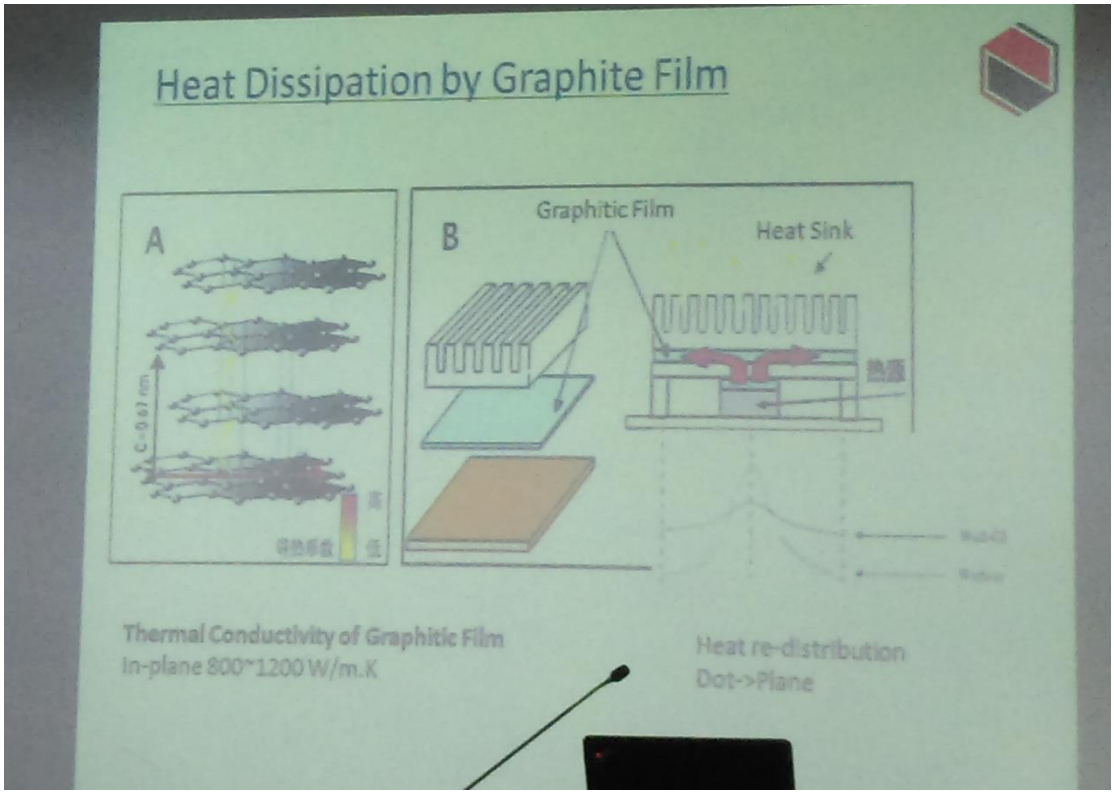


圖 16、石墨烯複合材料有較佳降溫的散熱效果

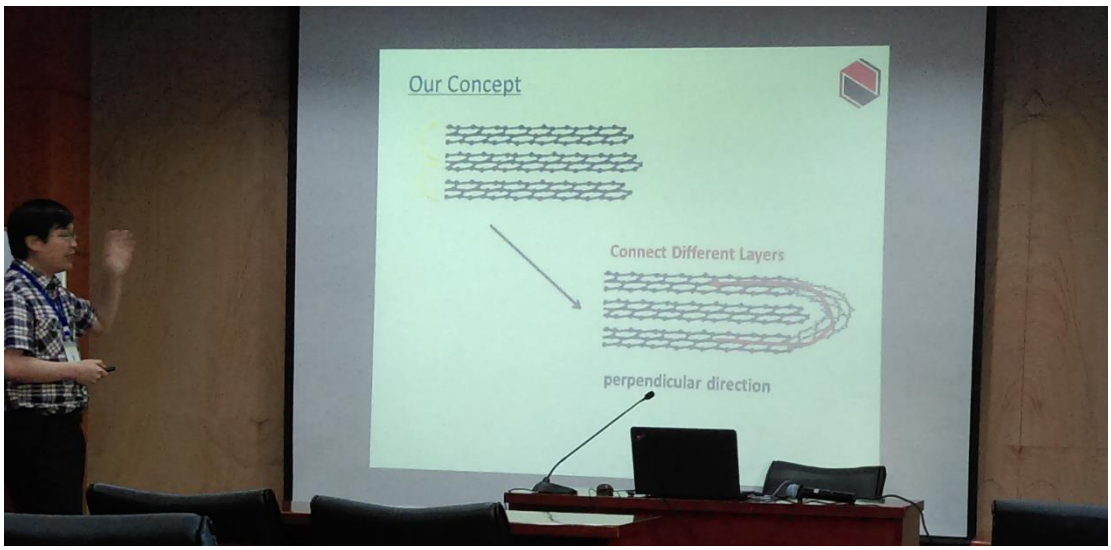


圖 17、石墨烯納米條帶具有極高的載流子遷移率和超長的平均自由路徑

中國科學院化學研究所 Dr. Liu 針對石墨烯是單層的石墨而構成，為目前最薄、最強韌的奈米材料，其獨特的材料特性如高機 械強度、高熱傳導率、高電子遷移率、低電阻率以及高透光率等。

材料熱導率提高，能傳導的熱量也隨之增加。因此，可以採用高熱導材料來解決微納元件散熱的問題。石墨烯這種單原子層納米材料的熱學性質，也引起了人們極大的研究興趣。石墨烯通常被定義為碳原子以 sp^2 雜化結構連成的單原子層蜂窩狀的結構。為了驗證此石墨烯複合材料有達到良好的熱學特性，如圖 16 將進行紅外線熱分析儀來探討有無塗料於銅箔的散熱性質，熱差越小代表效果越好，因此可得知石墨烯片散熱效果佳，且能快速降溫，找到能解決 3C 產品能快速降溫的散熱膜，改善過燙導致異常運作的現象。如圖 17 顯示，獨特的電子結構使得石墨烯具有極高的載流子遷移率和超長的平均自由程，是理想的電子材料。此外可以通過電子束刻蝕、化學反應等方法從石墨烯上裁剪出不同寬度和邊界形狀的准一維結構，即石墨烯納米條帶。根據石墨烯納米帶邊界形狀可以把它分為鋸齒型邊界納米帶和扶手椅型邊界納米帶。

四、建　議　事 項

(一)未來可開發新型多孔半導體光電薄膜，如二氧化鈦、氧化鎳、氧化鋅的材料。

(二)由於電弧電漿源所沉積的薄膜易形成多孔性結構，可增加比表面積比，具有特殊功能性。

(三)利用多孔性特性概念可導入氣體感測器薄膜開發，可以縮短與反應氣體響應時間，預期可以改善磁控濺鍍所面臨到的瓶頸。

(四)建議未來電漿設備發展嘗試不同功能性薄膜，諸如記憶合金、開發新材料儲能電池等方面進行技術整合與開發應用。

五、附　錄

附錄一、本次投稿會議全論文
附錄二、會議議程、會議論文集

附錄一、本次投稿會議全論文

Inorganic-solid-state Electrolyte Layer Deposited by Cathodic Arc Plasma for Rapidly Switching Electrochromic Device

Po-Wen Chen[1, a)], Chen-Te Chang[1], Jin-Yu Wu[1], Der-Jun Jan[1], Yu-Chen Li[1], Cheng-Chang Hsieh[1], and Wen-Fa Tsai[1]

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Abstract. This work focuses on fabricating a solid electrolyte Ta_2O_5 thin film deposited by cathodic arc plasm (CAP) deposition through three different ratio of oxygen and argon. In our experiments, refractive index of Ta_2O_5 films are taken as 2.25, 1.96, 1.9 with various O_2/Ar= 1.5, O_2/Ar= 2, O_2/Ar= 2.4, respectively. Our results show that the refractive index mostly decreased as we increase the oxygen flow rate, in which the minimum is found at 240 sccm. It provides good conduction pathways for ions through smaller thin-film's refractive index that exhibits more porosity voids. This property enhances ion's mobility for electrochromic device causing rapid coloring/bleaching phenomenon. Ta_2O_5 thin film is suitable as a solid electrolyte layer in center of electrochromic device (ECD) using CAP deposition. As a result, rapid response times were observed in fabricated device with an area of 5 cm×5 cm, exhibiting transmittance optical modulation ΔT = 61.5% (@550 nm) with the bleaching time τ = 8 s and transmittance optical modulation ΔT = 50% (@550 nm) with the coloring time τ= 10 s.

Introduction

Electrochromic device (ECD) is based on well-known electrochemical phenomena, and is an enabling technology for smart windows, energy efficient building, optical information displays, variable-reflectance mirrors, switchable mirrors, electronic papers, and other applications [1-3]. A basic multi-

layer ECD consists of five layers with an ionic conduction layer (electrolyte) in contact with an Electrochromic (EC) layer and an ion storage (complementary) layer, all sandwiched between two transparent conducting layers, the physical structure is shown in the 3D schematic diagram illustrated in Figure 1. Nickel oxide (NiO) is known as one of the most popular anodic electrochromic materials and tungsten trioxide (WO_3) as one of the widely accepted cathodic electrochromic materials, in which have been intensively investigated [4]. As a cathodic EC material, WO_3 (coloring under charge insertion) can be used as a complementary (anodic) electrode with NiO (coloring under charge extraction), where the optical modulation increases due to the simultaneous modulation of both electrodes [3]. In this study, we have adopted the usual method of producing electrochromic NiO, and WO_3 films using DC or DC-pulsed sputtering deposition.

In general, ionic conductor layer is made up of two kinds of polymeric and inorganic electrolyte in the center part of ECD. Otherwise, polymeric-type ionic conductor has better ionic capabilities than inorganic-type, but inorganic-type materials are more stable and durable. We used a solid electrolyte, Ta_2O_5 thin film, which has high transparency in the visible and UV range, a high ionic conductivity, and good chemical, thermal stability, and stabilized environment durability [5-7]. The electrolyte layer, Ta_2O_5 thin film, has been fabricated in various methods, such as chemical vapor deposition [8], the sol-gel method [9-11], electron beam evaporation [12], sputtering [13-15], and pulsed laser deposition [16]. We have developed an innovative method of CAP deposition technique owns a high deposition rate, produces good adhesion between the deposited film and substrate, and CAP source target poisoning less than sputtering case. Furthermore, this method with low cost advantage has great commercial potential in the future.

In particular, switching of the response time for coloration and bleaching state depends not only on the quality of the electrochromic layer and complementary layer, but also on the ionic conduction layer, which is controlled by the microstructure and composition of ionic conductor [13]. This work focuses on fabricating a solid electrolyte Ta_2O_5 thin film deposited by CAP deposition through three different ratio of oxygen and argon. We have demonstrated a high performance electrochromic device (ECD) developed by composing ITO/WO_3/Ta_2O_5/NiO/ITO/glass, which is fabricated using DC or DC-pulsed sputtering and using vacuum cathodic arc plasma (CAP) deposition.

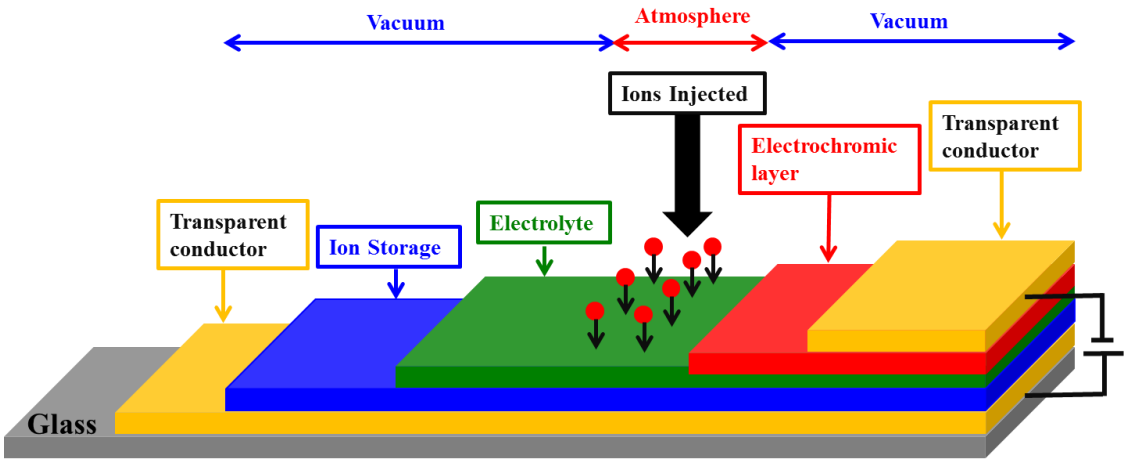

Figure 1. The typical structure of electrochromic device.

Experimental Details

The ECD was fabricated with 5 cm×5 cm sample size shown in the schematic diagram illustrated in Figure 1. Details of the device fabrication process is provided in our experimental section. First, 170 nm thickness transparent conductor ITO films coated on glass [low sheet resistance of 6.12 Ω/□ and high visible light transparency of 81% (@550 nm)] were deposited as transparent conducting layers. The 60 nm thickness NiO thin film was deposited on ITO/glass substrate at room temperature using DC-pulsed sputtering with the pure (99.99 wt%) nickel (Ni)-metal target. A 130 nm thickness Ta_2O_5 film was deposited on NiO/ITO/glass substrate by using CAP deposition with pure (99.99 wt%) Tantalum (Ta)-metal target the deposition process of temperature was fixed at 100^0C. We focus on considering three different oxygen mass flow of 150 sccm, 200 sccm and 240 sccm with a fixed 100 sccm argon mass flow for the reactive gasses, and the corresponding working pressure are 2.9×10^{-2} torr, 3.4×10^{-2} torr and 4.6×10^{-2} torr, respectively. After Ta_2O_5 film was deposited on NiO/ITO/glass substrate, we injected lithium ions (Li^+) or hydrogen ions (H^+) ions into NiO film (ion storage layer) by applying a voltage of -2.5V in the electrolyte composed of $LiClO_4$ and propylene carbonate (PC) solution. After the sample Ta2O5/NiO/ITO/glass was cleaned in distilled water and dried, we continued to the WO_3 (160 nm) and ITO (100 nm) layers deposition using DC sputtering. More details of the ECD on thedeposition parameters are presented in Table I.

Table 1 Deposition parameters for the ECD multilayered electrochromic device.

Target	Power	Working pressure	Reactive gas	Thickness	Time
Metal-oxide WO_3	500 W	10 mTorr	Ar: 100 sccm O_2: 90 sccm	160 nm	120 min

Metal Ni	500 W (f=350 kHz)	10 mTorr	Ar: 100 sccm O_2: 60 sccm	60 nm	30 nm
ITO	500 W	3 mTorr	Ar: 100 sccm O_2: 0.9 sccm H_2: 2.5 sccm	100 nm	30 in

Results and Discussion

In this study, we have fabricated a solid electrolyte layer with varying ratio of oxygen and argon using a fixed DC arc current of 50 *A* and for magnetically "steered arc" for a fixed maximum magnitude of transverse magnetic field (TMF), $B_{//}$=1240 G on the target surface is applied [17]. We have investigated the dynamics of cathode spot which is highly unusual physical objects and notoriously difficult to measure, but using fast video camera we captured could the image of the light emission from spots [17]. A schematic illustration and transient cathode spot morphologies with different oxygen reactive mass flow are shown in Figure. 2.

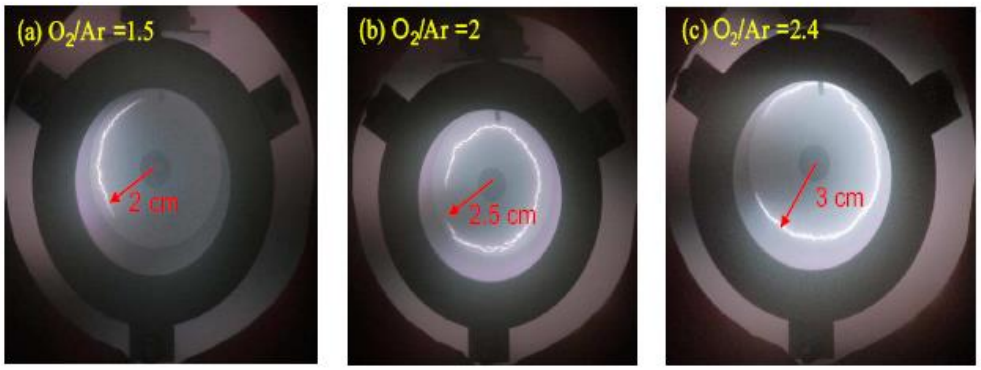

Figure 2 Schematic images of cathodic spotmotion under different relative ratio of oxygen and argon

To get trajectory of cathodic spot, we set a fixed exposure time as 1/2000 sec for three different ratio of oxygen and argon: (a) O_2/Ar= 1.5, (b) O_2/Ar= 2, (c) O_2/Ar= 2.4. In Figure. 2 (a), with a relatively smaller ratio of oxygen (150 sccm) and argon (100 sccm), a dark cathode spot moves slowly on the cathode surface (average velocity $\bar{v}$ = 83 m/s) and is confined to a smaller circular trajectory and the arc voltage intensity is V =30 V. In Fig. 2 (b), with ratio of oxygen (200 sccm) and argon (100 sccm), a cathode spot moves slowly on the cathode surface (average velocity $\bar{v}$ = 251 m/s) where the arc voltage intensity is *V* =32 V. In Fig. 2 (*c*), with ratio of oxygen (240 sccm) and argon (100 sccm), a cathode spot moves quickly on the cathode surface (average velocity $\bar{v}$ = 376 m/s) and is confined to a larger circular trajectory where the arc voltage intensity is *V* =34 V. Our results show that increasing the oxygen reactive mass flow intensity, we can accelerate the rotational velocity of cathode spot and increase the arc voltage. Ta_2O_5 thin-film microstructure are quantified by refractive index measurements through three different

relative ratio of oxygen and argon*:* In our experiments, refractive index of Ta2O5 films are taken as 2.25, 1.96, 1.9 with various O_2/Ar= 1.5, O_2/Ar= 2, O_2/Ar= 2.4, respectively. Our results show that the refractive index mostly decreased as we increase the oxygen flow rate, in which the minimum is found at 240 sccm. It provides good conduction pathways for ions through smaller thin-film's refractive index that exhibits more porosity voids [18]. The optical transmittance spectra of ECD in the visible wavelength region is controlled between colored (using applied voltage of 3.5 V), bleached states (using applied voltage of -4 V). In our experiments, we find that higher optical density, $\Delta OD=0.63=\log_{10}(T_{bleached}/T_{colored})$ at a stronger ratio of oxygen and argon due to smaller intrinsic refractive index correlation, providing a good conduction pathway for ions. In Figure 3 (*a*)-(*c*), we show the temporal response and switching times at a wavelength of 550 nm of the ECD. The ECD was tested under a switched pulse potential between +3.5 V and -4 V for three different relative ratio of oxygen and argon. Here, the temporal response is measured using a transmitter laser source of 550 nm with a photo detector receiver. We can use notation of Tbleached/colored ($\Delta T\%$)=τ, and τ is defined as the switching time to reaching transmittance optical modulation. In Figure 3 (a), the optical modulation, ΔT = 41.8 from 81%→39.2% (colored state) is taken coloration time 300 s and from 39.2%→81% (bleached state) is taken bleaching time 15 s as used (a) O_2/Ar= 1.5. In Figure 3 (*c*), the transmittance optical modulation, ΔT = 61.5 from 81%→19.5% (colored state) is taken coloration time 300 s and the transmittance variation from 19.5%→81% (bleached state) is taken bleaching time 8 s as used (*c*) O_2/Ar= 2.4. In inset Figure 3 (c), our results show that the transmittance optical modulation 81% →31% (23%) may be attained with a coloring time of 10 s (90 s) as used O2/Ar= 2.4. As a result, high performance ECD have been fabricated with innovative method of CAP deposition in a solid electrolyte obtained optical modulation ΔT = 61.5% of the bleaching time τ= 8 s and transmittance variation ΔT = 50% of the coloring time τ= 10 s that fabricated device at a stronger ratio of oxygen and argon occurs rapidly response times.

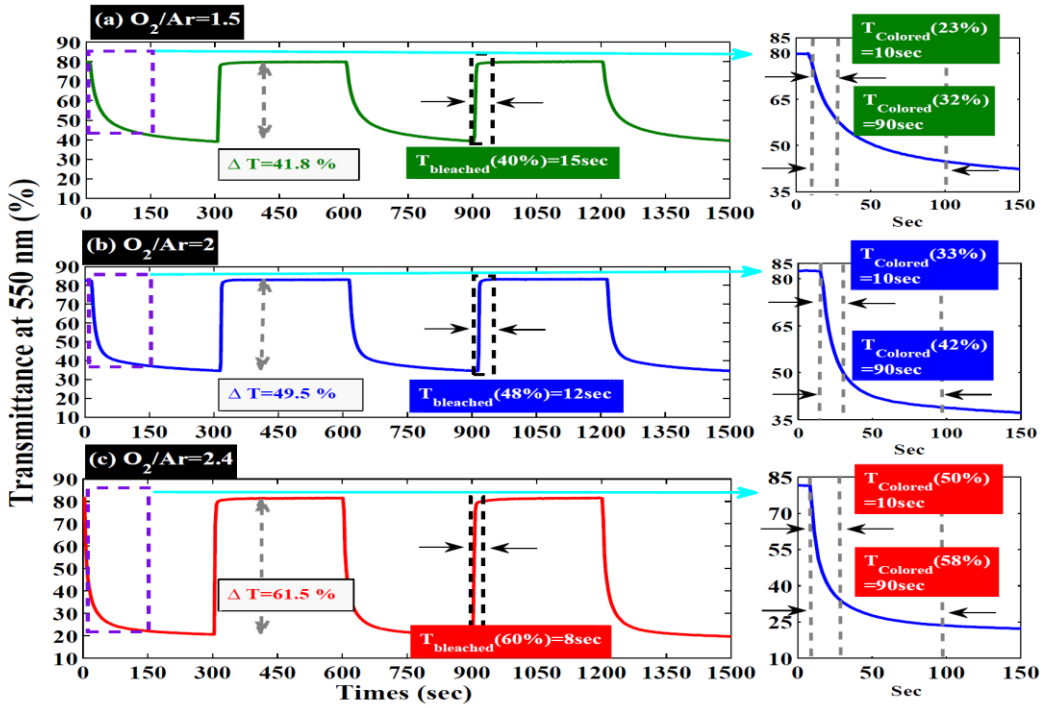

Figure 3 Temporal switching time characteristics between bleached states and colored states for the Ta_2O_5 with electrolyte ECD for different relative ratio of oxygen and argon using applied voltages of +3.5 V (bleached state) and -4 V (colored state) while the duration time were fixed at 300 s (@550 nm). Inset Figure 3 (a) - (c), we are shown shortly duration time for 150 s

DISCUSSION

In summary, we find that optical modulation of ECD transmittance optical modulation ΔT reaches high value at a larger ratio of oxygen and argon due to smaller intrinsic refractive index correlation providing good conduction pathways for ions. The device have been fabricated with key factor using CAP deposition in a solid electrolyte and demonstrate particularly impressive with respect to rapid switching times, the transmittance optical modulation $\Delta T = 61.5\%$ of the bleaching time $\tau = 8$ and transmittance optical modulation $\Delta T = 50\%$ of the coloring time $\tau = 10$ s.

Acknowledgments

We thank Chi-Fong Ai for their assistance and for useful comments and discussions. Po-Wen Chen would also like to acknowledge support from Division of Physics, Institute of Nuclear Energy Research, Taiwan.

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Session 2 ***(Part. 1)***

Session 2 ***(Part. 2)***

Poster Session

2017 Beijing Conference Introductions

Welcome to CMS-CBEES 2017 conference in Beijing, China. The conference is held annually with high quality. The objective of the Beijing conference is to provide a platform for researchers, engineers, academicians as well as industrial professionals from all over the world to present their research results and development activities in Chemical and Process Engineering & Chemical Materials and Process.

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PowerPoint or PDF Files (Files should be copied to the Conference laptop at the beginning of each Session.)

Duration of each Presentation (Tentatively):

Regular Oral Presentation: about **12** Minutes of Presentation and **3** Minutes of Question and Answer
Keynote Speech: about **35** Minutes of Presentation and **5** Minutes of Question and Answer
Plenary Speech: about **25** Minutes of Presentation and **5** Minutes of Question and Answer

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Dress code

Please wear formal clothes or national representative of clothing.

Keynote Speaker Introductions

Keynote Speaker I

Prof. Weiyang Fei

Department of Chemical Engineering, Tsinghua University, Beijing, China

Prof. Weiyang Fei received his B.Sc. in chemical engineering at Department of Engineering Chemistry, Tsinghua University from September 1957 to July 1963. He has worked as a teaching assistant in the Department of Chemical Engineering, Tsinghua University from September 1963 to August 1978 and as a lecturer from September 1978 to January 1985, becoming a professor since 1988 and the deputy director of the State Key Laboratory of Chemical Engineering and director of Solvent Extraction Laboratory since 1991. He has worked as a visiting scholar in Department of Chemical Engineering, The University of Bradford, The United Kingdom from August 1981 to September 1983.

Professor Fei's research covers the broad fields of solvent extraction with interests ranging from the fundamental mechanisms to the industrial applications of solvent extraction equipment and process. A major research effort is being made in modeling and intensification of extraction columns, development of high efficiency packing for separation processes, application of non-equilibrium stage model for liquid-liquid extraction, liquid-liquid two-phase flow and transport phenomena, CAD of complex separation processes and etc.

Topic: "*Studies on Separation Process Intensification for Pre-combustion CO_2 Capture*"

Weiyang Fei and Zhigang Tang

Department of Chemical Engineering, Tsinghua University, China

Abstract- Separation Processes is widely used in Energy, Resource, Environmental Control and etc. It usually contains 40-70% of equipment and operation cost of process engineer-ing. Considering the urge demands on CO_2 Capture, Usage and storage (CCUS), fur-thermore, the studies on separation process intensification are essential indeed.

The Integrated Gasification Combined Cycle (IGCC) is a clean coal technology with potential for the low carbon development. It is essential to intensify the per-combustion CO_2 capture process. Therefore, systematical studies on process intensi-fication of pre-combustion CO_2 capture are carried out and introduced here.

Green absorbents, such as Dimethyl Carbonate (DMC), is proposed as new solvents for pre-combustion CO_2 Capture. The Plum Flower Mini Ring (PFMR) was used as the high efficiency column internal. A new CO_2 absorption - membrane hybrid pro-cess was developed too. It is shown from the simulation andpilot plant test that the new process could save energy and reduce solvent loss substantially.

Key words: separation process intensification, per-combustion CO_2 capture, green absorbent, Plum Flower Mini Ring, hybrid process.

Keynote Speaker II

Prof. Yu Frank Yang

East Carolina University, Greenville, North Carolina, USA

Prof. Yu Frank Yang is a Professor and Director of Chemistry Graduate Studies at East Carolina University, located in Greenville, North Carolina, USA. Dr. Yang received his Ph.D. in Chemistry from University of Mainz, Germany in 1993. He joined the Department of Chemistry at East Carolina University as an assistant professor in 1997, tenured in 2003, and promoted to full professor in 2007.

Dr. Yang's principal areas of interest and expertise include green chemical processes, environmental chemistry, subcritical water chromatography and extraction. The main goal of Dr. Yang’s research programs is to eliminate or minimize the use of toxic organic solvents in extraction, chromatography, environmental remediation, and other chemical processes. Honors include the University Five-Year Achievement for Excellence in Research Award, the Sigma Xi Helms Research Award, University of North Carolina Board of Governors Distinguished Professor for Teaching Award, Cottrell College Science Awards from Research Corporation, and the Starter Grant Award from the Society for Analytical Chemists of Pittsburgh.

Topic: "*Green Chemical Processes under Subcritical Water Conditions*"

Yu Frank Yang

Professor and Director, Graduate Studies, Department of Chemistry, East Carolina University, Greenville, NC, USA

Abstract- It is well-known that ambient water is very polar. However, the polarity of water is dramatically reduced by increasing temperature, causing the solubility of nonpolar compounds enhanced by 4-5 orders of magnitudes by simply raising the temperature from ambient to 200-250 ℃. Thus, subcritical water behaves like a polar organic solvent and can replace hazardous organic solvents used in several chemical processes to achieve efficient extraction, chromatographic separation, environmental remediation, and chemical synthesis. The major advantage of subcritical water technology is the elimination or minimization of toxic extraction fluid, mobile phase organic solvents used in high-performance liquid chromatography, and common organic solvents required for environmental cleanup and chemical synthesis. Therefore, the subcritical water technique offers both economical and environmental benefits. Additional advantages of subcritical water chromatography are fast analysis time; temperature-dependent efficiency, selectivity, and resolution; temperature-programmed elution; and ability to accommodate both gas- and liquid-phase detectors. Most importantly, after years of academic studies industry started paying attention to this economical and green subcritical water technique. For example, Procter & Gamble has recently funded us a project in developing green subcritical water chromatography methods for the analysis of skincare products.

Keynote Speaker III

Prof. Takashiro Akitsu

Department of Chemistry, Faculty of Science Division II, Tokyo University of Science

Prof. Takashiro Akitsu received the B.Sc. degree in Chemistry from Department of Chemistry, Faculty of Science, Osaka University, Japan in 1995, and the M. Sc. in Inorganic and Physical Chemistry as well as the Ph.D in Chemistry from Department of Chemistry, Graduate School of Science, Osaka University, Japan in 1997 and 2000.

Recent Academic Carrier:

2007-2008 Visiting Scholar at Department of Chemistry, Faculty of Humanities and Sciences, Stanford University, USA

2012-2016 Associate Professor at Department of Chemistry, Faculty of Science, Tokyo University of Science, Japan (Principal Investigator).

2016-present Professor at Department of Chemistry, Faculty of Science, Tokyo University of Science, Japan (Principal Investigator).

Recent Activities:

2015- Editorial Board of Jacobs Journal of Inorganic Chemistry

2016- Editorial Board of Current Research on Chemical Sciences (ScienceVier)

2016-2017 Editorial Board of Journal of Electrical Engineering

2016- Editor-in-Chief of Advances in Applied Science Research

Area of Interest:

Inorganic coordination chemistry, physical inorganic chemistry (magnetism and spectroscopic properties), structural chemistry (X-ray crystallography), bioinorganic chemistry, nano-materials

Topic: "*Hybrid Materials of Chiral Schiff Base Metal Complexes towards Theoretical Treatments*"

Takashiro Akitsu

Department of Chemistry, Faculty of Science, Tokyo University of Science, Japan

Abstract- So far we have been interested in not only geometrical (structural) but also electronic (spectroscopic, magnetic or theoretical) states of orientated chiral meal complexes. In recent years, we have studied on organic/inorganic hybrid materials composed of chiral Schiff base metal complexes and other functional materials and their photo-functions such as non-expensive metal complex dyes for DSSC on semiconductors, photo-induced molecular orientation of a mediator complex for oxygen-reducing metalloenzyme of biofuel cell cathodes, metal complex fluorescence probes for binding several proteins. (Proceedings will be describes about a focused system among them.)

Besides conventional ordered packing in single crystals, we have employed new environment such as surface of inorganic solid materials, three-dimensionally ordered protein structures, or flexible polymer matrix with linearly or circular polarized and light-induced and light vortex-induced orientation in order to make anisotropic alignment and supramolecularly chiral (herical) ordering of the molecules. We used not only continuous wavelength UV light in the laboratory system but also selective wavelength UV light in the laboratory system of synchrotron radiation for comparison. This structural information could be detected by means of several spectroscopic measurements, which could be also interpreted with theoretical or computational calculations. Indeed, compared with our previous studies, interpretation of experimentally spectral data and discussion of optimized structures of the complexes were successfully supported by TD-DFT computational data.

However, some electronic functions, for example current density of electron transfer from cathodes to a metalloenzyme via a mediator complex depends on molecular orientation clearly. Herein we will discuss to compare with the experimental facts and some theoretical frameworks towards theoretical interpretation of them or innovative material design of new systems organic/inorganic hybrid including chiral complexes.

Keynote Speaker IV

Assoc. Prof. Zhigang Tang

Tsinghua University, China

Assoc. Prof. Zhi-Gang Tang was born in Lanzhou City, Gansu Province, China, on April 1, 1970. He got his bachelor degree at Chemical Engineering Department, Tsinghua University, Beijing, in June of 1993. He got his Ph.D. at Chemical Engineering Department, Tsinghua University, Beijing, in April of 1998. In 1998, he was hired as Lecturer of Chemical Engineering Department, Tsinghua University, Beijing. In 2000 (to now), he was hired as Associate Professor of State Key Laboratory of Chemical Engineering, Chemical Engineering Department, Tsinghua University, Beijing. He teaches two graduate-oriented courses “Fundamental in Separation Process” and “Generality of low-carbon process”. His current research interests cover 1) Fundamental and application of identified methods in vapor-liquid mass transfer; 2) Process and equipments in clear and low-carbon industrial production; 3) Trapping CO_2 from syngas by hybrid technology.

Topic: "*Development in CO_2 Capture for Pre-Combustion*"

Tang Zhigang, Ebrahim Ataey, Li Hongwei, He ZhImin, Zhao Zhijun and Chen Jian

State Key Laboratory of Chemical Engineering, Department of Chemical Engineering, Tsinghua University, Beijing, China

Abstract- Pre-combustion CO_2 capture is regarded as an effective way of CCS. Although solvent absorption is a relatively mature technique, but during the process of solvent regeneration, heating desorption consumes much energy and gas stripping desorption will also cause gas mixing which need secondary separation. Aimed at that, this paper puts forward a novel CO_2 capture technology: solvent absorption-membrane desorption hybrid process.

Firstly, combined with molecular simulation and experimental studies, three kinds of carbonate dimethyl carbonate (DMC), diethyl carbonate (DEC) or diethyl succinate(DES) are developed as new absorbent. By the results (under temperature 298.15~323.15 and pressures no more than 1 MPa) the new developed absorbent DMC, DEC and DES has higher CO_2-solubility than the traditional absorbent PC. The quantum chemistry calculation results with GAUSSIAN09 programs package also show that the interaction energy between carbonates and CO_2 is in the order: PC < DMC < DEC < DES which coordinates with the experimental results.

Secondly, six kinds of cross-linking agents Ethyl orthosilicate (TEOS), Tetraethyl Titanate (IV), N1-[3-(Trimethoxysilyl)propyl] ethane-1,2-diamine (DAMO), 3-Aminopropyltriethoxysilane (APTES), Phenyltriethoxysilane (PTES) and Triethoxyvinylsilane (VTEO) are chosen to added in Polydimethylsiloxane (PDMS) membrane to improve the membrane separation performance by enhancing the dissolution activity, the reaction activity and the diffusion activity, separately. Fig 3 shows the schematic molecular structure using different cross-linking agents in membrane preparation. Table 1 shows the separation performance of CO_2 from DMC-CO_2 mixture with different cross-linking agent. By results (under temperature 25 ℃, with 1 wt% CO_2 dissolved in DMC), it can be found that the amino group (such as DAMO,APTES) and the ether bond (such as IV) can promote the selectivity of the membrane by chemical action or strong molecular interaction, while the phenyl group (PTES) and the alkenyl group(VTEO) can improve the membrane flux by improving the dissolution and diffusion of the membrane.

It also can be found, the membrane flux and separation factor shows the opposite trend of growth when single cross-linking agent is adopted. But after hybrid cross-linking agent is utilized, a synergistic effect appears. The flux of APTES-PTES-PDMS composite membrane reaches 4970 g • m-2 • h-1, and the separation factor also reaches 79.3, quite better than that of classical TEOS-PDMS membrane. It also confirms the feasibility of improving the membrane separation performance by improving the activity, reactivity and diffusion activity of the CO_2 permeation and vaporization separation process

Finally, by the preliminary simulation using Pro-II software, the novel solvent absorption-membrane desorption hybrid process can save 30% energy consumption than the traditional process, is expected to promote in industry application.

Keywords: Pre-combustion CO_2 capture, Solvent adsorption-membrane desorption hybrid process, Carbonate absorbent.

Plenary Speaker I

Prof. Jian Chen

Department of Chemical Engineering, Tsinghua University, Beijing, China

Education and Experience:

Professor CHEN Jian received his B.Sc., M.Sc. and Ph.D. in chemical engineering at Department of Chemical Engineering, Tsinghua University in 1985, 1990 and 1994, respectively. He has worked in the department since 1990, becoming Professor of Chemical Engineering in 2001. He worked as a visiting scholar in Schlumberger, Canada in 2002.

Research interests:

Thermodynamics and Separation Engineering

Research interests cover 1) Molecular thermodynamics of fluid properties and phase equilibria for fluids across the critical point, unsymmetrical fluids in size or interaction, fluids with association. 2) Molecular design for solvents based on the quantitative structure-property relationship. 3) Engineering thermodynamics and process design for separation processes such as gas absorption, solvent extraction, and so on.

CO_2 capture technology

Recently CO_2 absorption used for greenhouse gas CO_2 capture and sequestration CCS is the main research area, including molecular design of new capture solvents, thermodynamics and kinetics of vapor-liquid absorption systems, process simulation and optimization, technological design and intensifications.

Topic: "*CO_2 Capture with Aqueous Mixtures of Amines and Sulfolane*"

Weiliang Luo, Yanmei Yu and **Jian Chen**

State Key Laboratory of Chemical Engineering, Tsinghua University, Beijing, China

Abstract- Absorption technology is looked as the main one for CO_2 capture from flue gases. In this paper, absorption behaviour of CO_2 in aqueous solutions of amine with a physical solvent sulfolane were determined. The phase separation of aqueous solutions with different types of amines and different concentrations of sulfolane was studied. The phase separation mechanism of the biphasic solvents is proposed and proved by the compositional distribution of each component in the upper and lower phases. It was found that the addition of sulfolane has no significant effect on the thermodynamics and kinetic properties of the aqueous amine solution, such as the rich loading, the absorption enthalpy and the total mass transfer coefficient. However, it decreases the water evaporation at high temperature, resulting in a lower lean loading of the solution. Therefore, the cyclic absorption capacity of the biphasic solvent is 13% higher than that of the conventional 30% MEA aqueous solution. The energy consumption of solvent regeneration in the CO_2 desorption process was studied, consisting of three parts: sensible heat, water vaporization heat and desorption heat. Compared with the conventional 30% MEA aqueous solution, The desorption heat of the upper phase of amine / sulfolane biphasic solution remains essentially unchanged, while sensible heat and water vapor are reduced by 20% and 50%, respectively, leading to a decrease of 22.5% in the overall energy consumption. Through the absorption - desorption cycle experiment, it is verified that the energy consumption of solvent regeneration of the upper phase solution decreases significantly compared with the single phase aqueous solution, and the descending rate is 32%. The results prove that the aqueous mixture of amine and sulfolane could be the promising solvent for CO_2 capture with low energy consumption.

Plenary Speaker II

Prof. K.S.K. Rao Patnaik

Department of Chemical Engineering (A), UCT, Osmania University, Hyderabad, India

Prof. K.S.K. Rao Patnaik obtained his Bachelor's Degree from University College of Engineering, Andhra University, Visakhapatnam and M.Tech. and Ph.D. Degrees from University College of Technology, Osmania University, Hyderabad in Chemical Engineering discipline. He has more than 32 years of experience in teaching and 30 years in research. He was former Dean, Faculty of Technology and also the Dean I/c, Faculty of Pharmacy, Osmania University. He served as former Head, Department of Technology and Head, Department of Chemical Engineering (A), Osmania University. He served as Principal, PG center, Mirzapur, Medak Dist., OU and also worked as Chairman, Board of Studies HM&CT, OU. Presently he is working as Professor of Chemical Engineering, Department of Chemical Engineering (A), OU and Dean, FOP, Palamuru University. At present, he is working as Co-ordinator, under TEQIP-II, Centre of Excellence (COE), Process Intensification for Chemical and Bio-Chemical Processes.

Dr. Rao Patnaik acted as Panel Speaker, Session Chair, Program Chair and Member, Technical Committee for International Conferences were held in USA, Japan, Hong Kong and Netherlands. He has visited Research Centers/Universities at USA, Canada, UK, Singapore, Thailand, Malaysia, Hong Kong, Japan, Dubai, and Paris.

Dr. Rao Patnaik delivered more than 40 invited lectures at UGC Academic Staff Colleges of AU, OU, and JNTU. He has participated in TV and AIR Panel discussions. His Research Interest Areas are advancing the Fluidization Engineering Methodology, Hydrodynamics & Heat Transfer of Three-Phase Reactors, Energy / Bio- Energy Conversions, Process Intensification, Plant Design, Nano Science and Nano Technology. He worked as President, Karthikeya Nagar Welfare Association, Nacharam (V).

Topic: "*Production of Biodiesel from Different Biomass Sources by using Green Catalysts: Process Intensification*"

K.S.K. Rao Patnaik

Department of Chemical Engineering (A), UCT, Osmania University, Hyderabad, India

Abstract- Important aspects of commercial viability of biodiesel production depend upon the price of catalyst and feed stock. Crystalline manganese carbonate and Nano zinc oxide were found to be low cost, non corrosive and versatile green catalysts. This communication explores the feasibility of biodiesel production from a plant Pongmia Pinnata, Guizotia Abyssinica, Cucumis Sativus Seed oils. Biodiesel, an alternate fuel has attracted considerable attention during the past decade as a renewable, biodegradable and non- toxic fuel. As a future prospective fuel, biodiesel has o compete economically with petroleum diesel fuels. One way of reducing the biodiesel production costs is to use the less expensive feedstock containing fatty acids. The availability and sustainability of sufficient supplies of less expensive feedstock will be a crucial determinant delivering a competitive biodiesel price. Recent food verses fuel controversy makes edible oil not an ideal feed stock for biodiesel production. In this competition the non edible oil sources are preferred as feed stock for the production of biodiesel. The use of the demand for biodiesel is expected to increase sharply in the near future. Increasing demand about global energy production and supply, environmental concerns due to the use of fossil fuels, rising petroleum prices ay rive to search for alternative source of energy. Commercial viability of biodiesel production mainly depends upon the cost of catalyst and a diesel substitute. Moreover, biodiesel fuel has become more attractive because of its environmental benefits under process intensification. In the present study, transesterification process involving ethanol and seed oil of Pongmia Pinnata (Karanji) Guizotia Abyssinica, Cucumis Sativus were carried out. Crystalline manganese carbonate and Nano zinc oxide (25- 40nm) were found to be a low cost, non-corrosive and a versatile green catalysts. The chemical composition of the biodiesel product was examined by GC-MS analysis, comparative study of catalysts were studied, analyzed and reported for biodiesel yields. The effect of ethanol quantity, catalyst properties, catalyst amount, reaction time and temperature on the production of biodiesel from different biomass sources by using green catalysts were determined under process intensification. Important conclusions are presented.

Plenary Speaker III

Assoc. Prof. Hongqi Sun

Department of Chemical Engineering, Edith Cowan University, Australia

Assoc. Prof. Hongqi Sun received the BEng and the Ph.D in Chemical Engineering (Top 5 in China) from Nanjing University of Technology from 1997 to 2001 and from 2003 to 2008.
Recent Professional Appointments:
April. 2016 – present: Associate Professor (Ongoing, Vice Chancellor's Professorial Research Fellow), School of Engineering, Edith Cowan University, Australia.
April. 2016 – present: Adjunct Professor, Department of Chemical Engineering, Curtin University, Australia.
Dec. 2015 – Mar. 2016: Senior Research Fellow, Department of Chemical Engineering, Curtin University, Australia.
Mar. 2014 – Nov. 2015: Curtin Early Career Research Fellow, Department of Chemical Engineering, Curtin University, Australia.
International Standing:
Associate Editor, RSC Advances (IF: 3.289)
Associate Editor, Journal of Advanced Oxidation Technologies (IF: 0.738)
Guest Editor, Special Issue "Nanoscale in Photocatalysis" in Nanomaterials (IF: 2.690)
Assessor (DP, DECRA, and Future Fellowship), Australian Research Council
Organizing Committee Member, 19th International Zeolite Conference, Perth, Australia.
Research Fields:
Water treatment, Environmental catalysis, Advanced oxidation processes, Renewable energy, Solar fuels and solar cells.

Topic: "*Metal-free Activation of Peroxymonosulfate for Novel Advanced Oxidation Processes (AOPs)*"

Hongqi Sun

School of Engineering, Edith Cowan University, Perth, Australia

Abstract- Advanced oxidation processes (AOPs) have been widely used for removal of toxic organic pollutants in waste water that traditional biodegradation cannot deal with. The key in AOPs is the activation process that generates reactive radicals. Both the catalyst and the oxidant control the AOPs induced oxidation. Compared to Fenton reaction, which uses Fe^{2+} to activate H_2O_2 to produce hydroxyl radicals, sulfate radicals based AOPs hold a number of advantages due to the wide pH flexibility, no sludge production and higher oxidation ability of the sulfate radicals. Recently, we found that nanocarbons, such as reduced graphene oxides, carbon nanotubes, nanodiamonds, and porous carbons, can be used as excellent alternatives to metal-based catalysts, such as transition metal ions or oxides, for catalytic activation of peroxymonosulfate (PMS) to produce reactive radicals. For the first time, we proved that metal-free, reduced graphene oxide can show a higher activity for PMS activation than cobalt oxide (Co_3O_4). We proposed that the active sites could be (a) sp^2 carbon framework, (b) defective sites, and (c) oxygen functional groups. We applied delicate material design and comprehensive experiments to testify the three proposed active sites by the experiments and computational studies. The research findings provide insights into the novel environmental catalysis on carbon materials as alternatives to metal-based materials, leading to the development of novel, metal-free remediation technologies.

Brief Schedule for Conference

<table>
<tr><td>Day 1</td><td>May 25, 2017 (Thursday) Venue: 1st Floor, Jia Suo
Arrival Registration 10:00~17:00
Committee Meeting 14:00~16:00</td></tr>
<tr><td rowspan="11">Day 2</td><td>May 26, 2017 (Friday) 8:50~18:05
Venue: Jia Suo Conference (2) & (3) 清华甲所第二&三会议室
Arrival Registration, Keynote Speech, Plenary Speech, and Conference Presentations</td></tr>
<tr><td>Morning Conference</td></tr>
<tr><td>Venue: Jia Suo Conference (3)
Opening Remark 8:50~8:55
Keynote Speech I 8:55~9:35
Prof. Weiyang Fei, Tsinghua University, Beijing, China
Keynote Speech II 9:35~10:15
Prof. Yu Frank Yang, East Carolina University, Greenville, North Carolina, USA
Coffee Break & Group Photo Taking 10:15~10:40
Keynote Speech III 10:40~11:20
Prof. Takashiro Akitsu, Tokyo University of Science, Japan
Keynote Speech IV 11:20~12:00
Assoc. Prof. Zhigang Tang, Tsinghua University, Beijing, China</td></tr>
<tr><td>Lunch: 12:00~13:00 Venue: Restaurant, 1st Floor, Jia Suo</td></tr>
<tr><td>Afternoon Conference</td></tr>
<tr><td>Venue: Jia Suo Conference (3)
Plenary Speech I 13:00~13:30
Prof. Jian Chen, Tsinghua University, Beijing, China
Plenary Speech II 13:30~14:00
Prof. K.S.K. Rao Patnaik, Osmania University, Hyderabad, India
Plenary Speech III 14:00~14:30
Assoc. Prof. Hongqi Sun, Edith Cowan University, Australia</td></tr>
<tr><td>Session 1 (Part. 1) : 14:30~15:30
Venue: Jia Suo Conference (2)
4 presentations-Topic: “Material Chemistry”</td><td>Session 2 (Part. 1) : 14:30~15:30
Venue: Jia Suo Conference (3)
4 presentations-Topic: “Environmental and Chemical Engineering”</td></tr>
<tr><td colspan="2">Coffee Break: 15:30~15:50</td></tr>
<tr><td>Session 1 (Part. 2) : 15:50~17:20
Venue: Jia Suo Conference (2)
6 presentations-Topic: “Material Chemistry”</td><td>Session 2 (Part. 2) : 15:50~18:05
Venue: Jia Suo Conference (3)
9 presentations-Topic: “Environmental and Chemical Engineering”</td></tr>
<tr><td colspan="2">Poster session 8:50~18:05 Venue: Jia Suo Conference (2) &(3)</td></tr>
<tr><td colspan="2">Dinner: 18:30 Venue: Restaurant, 1st Floor, Jia Suo</td></tr>
<tr><td>Day 3</td><td>May 27, 2017 (Saturday) 8:30~18:00 Academic Visit</td></tr>
</table>

Tip: Please arrive at the Conference Room 10 minutes before the session begins, and upload PPT/ PDF file into the conference laptop.

Detailed Schedule for Conference

May 25, 2017 (Thursday)

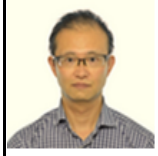
Venue: 1st Floor, Jia Suo

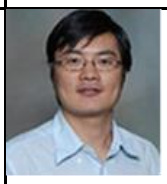
10:00~17:00	**Arrival and Registration**

Note: (1) The registration can also be done at any time during the conference.
(2) The organizer doesn't provide accommodation, and we suggest you make an early reservation.
(3) One Best Oral Presentation will be selected from each oral presentation session, and the Certificate for Best Oral Presentation will be awarded at the end of each session on May 26, 2017.

May 26, 2017 (Friday)

Venue: Jia Suo Conference (2) & (3)

8:50~8:55		**Opening Remark** Prof. Weiyang Fei Tsinghua University, Beijing, China
8:55~9:35		**Keynote Speech I** Prof. Weiyang Fei Tsinghua University, Beijing, China Topic: "*Studies on Separation Process Intensification for Pre-combustion CO_2 Capture*"
9:35~10:15		**Keynote Speech II** Prof. Yu Frank Yang East Carolina University, Greenville, North Carolina, USA Topic: "*Green Chemical Processes under Subcritical Water Conditions*"
10:15~10:40		**Coffee Break & Group Photo Taking**
10:40~11:20		**Keynote Speech III** Prof. Takashiro Akitsu Tokyo University of Science, Japan Topic: "*Hybrid Materials of Chiral Schiff Base Metal Complexes towards Theoretical Treatments*"
11:20~12:00		**Keynote Speech IV** Assoc. Prof. Zhigang Tang Tsinghua University, Beijing, China Topic: "*Development in CO_2 Capture for Pre-Combustion*"
12:00~13:00		**Lunch**
13:00~13:30		**Plenary Speech I** Prof. Jian Chen Tsinghua University, Beijing, China Topic: "*CO_2 Capture with Aqueous Mixtures of Amines and Sulfolane*"

13:30~14:00		**Plenary Speech II** Prof. K.S.K. Rao Patnaik Osmania University, Hyderabad, India Topic: "*Production of Biodiesel from Different Biomass Sources by using Green Catalysts: Process Intensification*"
14:00~14:30		**Plenary Speech III** Assoc. Prof. Hongqi Sun Edith Cowan University, Australia Topic: "*Metal-free Activation of Peroxymonosulfate for Novel Advanced Oxidation Processes (AOPs)*"
14:30~15:30		**Session 1:** 4 presentations-Topic: "Material Chemistry" **Session 2:** 4 presentations-Topic: "Environmental and Chemical Engineering"
15:30~15:50		**Coffee Break**
15:50~18:05		**Session 1:** 6 presentations-Topic: "Material Chemistry" **Session 2:** 9 presentations-Topic: "Environmental and Chemical Engineering"

Session 1

Tips: The schedule for each presentation is for reference only. In case of missing your presentation, we strongly suggest you attend the whole session.

Afternoon, May 26, 2017 (Friday)

Time: 14:30~15:30

Venue: Jia Suo Conference (2)

Session 1 *(Part. 1)*: 4 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P0002 Presentation 1 (14:30~14:45)

Synthesis and Aggregation Structure of Perylene Bisimides with Different Alkyl Chains Length

Hai-Jie Ben

School of Materials Science and Engineering, Tianjin University, China

Abstract— A kind of novel organic-inorganic hybrid perylene-3,4,9,10-tetracarboxylic acid bisimide (PBI) derivatives has been designed and synthesized to reveal the effect of the alkyl chains length on the aggregation structure. The phase behavior and crystal structures of the compounds with different alkyl chains length are performed by a combination of various measurements such as differential scanning calorimetry (DSC), one-dimensional small-angle X-ray diffraction (1D SAXD) and two-dimensional wide-angle X-ray diffraction (2D WAXD). The experiment results reveal that longer alkyl chains can help the organic-inorganic hybrid material generate better flexibility and long-range ordered structure, providing the theory basis to produce the luminescence devices in practical use.

Afternoon, May 26, 2017 (Friday)

Time: 14:30~15:30

Venue: Jia Suo Conference (2)

Session 1 *(Part. 1)*: 4 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P0004 Presentation 2 (14:45~15:00)

Electrocatalytic Reduction of Carbon Dioxide on Electrodeposited Tin-based Surface

Bianca Christina S. Alba, John Carl A. Camayang, Marlon L. Mopon Jr. and **Julie Anne D. del Rosario**

University of the Philippines, Philippines

Abstract— The electrocatalytic reduction of carbon dioxide to small organic molecular compounds provides a means of generating alternative fuel source while suppressing climate change. Suitable catalysts, however, are necessary to optimize its reaction kinetics towards more valuable products. Consequently, in this study, electrodeposited Sn electrodes have been developed as catalysts for CO_2 electroreduction. Deposition potential was varied to produce different Sn catalysts. SEM showed varying morphologies and increasing amount as the applied potential becomes more negative. Cyclic voltammetry and chronoamperometry showed that the activity and stability of the catalysts towards CO_2 reduction depend on the morphology and presence of tin oxides. These results provide a better understanding on the performance of electrodeposited Sn-based surfaces as catalysts for CO_2 reduction.

Afternoon, May 26, 2017 (Friday)

Time: 14:30~15:30

Venue: Jia Suo Conference (2)

Session 1 *(Part. 1)*: 4 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P0005 Presentation 3 (15:00~15:15)

Effect of Electric Field Intensity on the Performance of Charged Nanofiltration Membranes

Runlin Han

Dalian University of Technology, China

Abstract— In this work, nanofiltration membranes with different charge type were prepared with different methods and effect of electric field intensity on the membrane performance was also investigated. It was found that the negatively charged poly (piperazine amide) nanofiltation membrane prepared with interfacial polymerization has obvious rejection improvement while the flux changed slightly when applied electric field intensity is elevated from 0 to 16V/cm. The membrane with low rejection has remarkable increase in rejection of Na2SO4 when electric field is used and the membrane is applied as the anode. The positively charged chitosan nanofiltration membranes are prepared with different content of polymer and cross-linking agent. The same phenomena was observed when electric field is utilized. The membrane rejection to MgCl2 was increased about 4 times with the increase of electric field intensity when the membrane is applied as the cathode. The increase of membrane rejection maybe caused by the increase of surface charge density and strengthen the Donnan effect in the filtration process which is very useful for the desalination and treatment of wastewater containing heavy metal ions.

Afternoon, May 26, 2017 (Friday)

Time: 14:30~15:30

Venue: Jia Suo Conference (2)

Session 1 *(Part. 1)*: 4 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P0007 Presentation 4 (15:15~15:30)

A Research on Polyether Glycol Replaced Apcp Rocket Propellant

Tianyou Lou, Chunjia Bao and Yiyang Wang

Zhejiang Fuyang High School; Zhejiang Hangzhou High School; Hangzhou Foreign Language School, China

Abstract— Ammonium perchlorate composite propellant (APCP) is a modern solid rocket propellant used in rocket vehicles. It differs from many traditional solid rocket propellants by the nature of how it is processed. APCP is cast into shape, as opposed to powder pressing it with black powder. This provides manufacturing regularity and repeatability, which are necessary requirements for use in the aerospace industry.
For traditional APCP, ingredients normally used are ammonium peroxide, aluminum, Hydroxyl-terminated polybutadiene(HTPB), curing agency and other additives, the greatest disadvantage is that the fuel is too expensive. According to the price we collected in our country, a single kilogram of this fuel will cost 200 Yuan, which is about 35 dollars, for a fan who may use tons of the fuel in a single year, it definitely is a great deal of money. For this reason, we invented a new kind of APCP fuel. Changing adhesive agency from cross-linked htpb to cross linked polyether glycol gives a similar specific thrust, density and mechanical property while costs a lower price.

15:30-15:50	**Coffee Break**

Afternoon, May 26, 2017 (Friday)

Time: 15:50~17:20

Venue: Jia Suo Conference (2)

Session 1 *(Part. 2)*: 6 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P0008 Presentation 5 (15:50~16:05)

Effect of Growth-Vessel Design on the Properties of P-Terphenyl Single Crystals Grown by Vertical Bridgman Technique

Qing Ai, Peifeng Chen, Yuxiang Feng and Yebin Xu

Huazhong University of Science and Technology, China

Abstract— Bulk transparent p-terphenyl single crystals have been successfully grown in a single-wall ampoule and a double-wall ampoule by the vertical Bridgman technique, respectively. Effects of the growth-vessel design on the crystal growth are discussed. Results of a comparative study on the two grown crystals in the same experimental set-up and the same experimental conditions are presented. Powder X-ray diffraction analyses suggest the increase in crystallinity of the double-wall-grown crystal. Raman spectrum studies exhibit the presence of impurities in the single-wall-grown crystal. The results show that the chemical impurities can be effectively reduced in the process of crystal growth by using the double-wall ampoule.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~17:20

Venue: Jia Suo Conference (2)

Session 1 *(Part. 2)*: 6 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P0012 Presentation 6 (16:05~16:20)

Synthesis and Characterization of Activated Carbon from White Lotus via Single Step Chemical Activation

Jeyashelly Andas and Muhammad Dzulfiqar Midon

Faculty of Applied Sciences, Universiti Teknologi MARA, Malaysia

Abstract— Highly porous activated carbon was successfully fabricated from the stalk of *Nymphaea odorata* via single step chemical activation. $ZnCl_2$ was used as the chemical activating agent in the activation process. The raw material was preliminary characterized using Fourier Transform Infrared (FTIR), ultimate analysis (CHNS/O Analyzer) and Scanning Electron Microscope (SEM). The percentage yield, iodine number (IN) and the textural properties of the activated carbon were optimized under the influence of several synthesizing parameters such as impregnation ratio, activation temperature and activation time using $ZnCl_2$. High IN (750.11 mg/g – 967.16 mg/g) was obtained from Sodium thiosulphate volumetric method and represents the porosity of the synthesized materials. Reduction in several functional groups was observed in the FTIR spectrum of the synthesized activated carbon. SEM analysis of the activated carbon verified the formation of highly porous surface compared to the raw *Nymphaea odorata*. This study provides a facile synthesis of activated carbon from waste natural resources at benign condition.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~17:20

Venue: Jia Suo Conference (2)

Session 1 *(Part. 2)*: 6 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P0013 Presentation 7 (16:20~16:35)

Inorganic-solid-state Electrolyte Layer Deposited by Cathodic Arc Plasma for Rapidly Switching Electrochromic Device

Po-Wen Chen, Chen-Te Chang, Jin-Yu Wu, Der-Jun Jan, Yu-Chen Li, Cheng-Chang Hsieh and Wen-Fa Tsai

Institute of Nuclear Energy Research, Taiwan

Abstract— This work focuses on fabricating a solid electrolyte Ta_2O_5 thin film deposited by cathodic arc plasm (CAP) deposition through three different ratio of oxygen and argon. In our experiments, refractive index of Ta_2O_5 films are taken as 2.25, 1.96, 1.9 with various O_2/Ar= 1.5, O_2/Ar= 2, O_2/Ar= 2.4, respectively. Our results show that the refractive index mostly decreased as we increase the oxygen flow rate, in which the minimum is found at 240 sccm. It provides good conduction pathways for ions through smaller thin-film's refractive index that exhibits more porosity voids. This property enhances ion's mobility for electrochromic device causing rapid coloring/bleaching phenomenon. Ta_2O_5 thin film is suitable as a solid electrolyte layer in center of electrochromic device (ECD) using CAP deposition. As a result, rapid response times were observed in fabricated device with an area of 5 cm×5 cm, exhibiting transmittance optical modulation ΔT = 61.5% (@550 nm) with the bleaching time τ = 8 s and transmittance optical modulation ΔT = 50% (@550 nm) with the coloring time τ= 10 s.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~17:20

Venue: Jia Suo Conference (2)

Session 1 *(Part. 2)*: 6 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P0021 Presentation 8 (16:35~16:50)

Nanostructure Tailoring of Graphitic Film for Achieving Ultra-High Thermal Conductivity Along its Perpendicular Direction

Yaodong Liu

Institute of Coal Chemistry, CAS, China

Abstract— Graphite film is the most common and important materials for heat transfer and dissipation. The in-plane thermal conductivity of graphite film is extremely high, > 1000W/m.K; however, the thermal conductivity along its perpendicular direction is very low, 10~20 W/m.K. This distinct difference was ascribed to their different heat transfer mechanisms which were caused by the anisotropic atomic structure of graphite film. Here, we tailored the nanostructure of graphite film from layer-by-layer to interconnected graphitic rings to improve the thermal conductivity along film's perpendicular direction. CNTs were added into its precursor, here PAN, to induced the formation of graphitic rings in their vicinities or interphase regions after high temperature carbonization. So far, we observed that when two or more graphitic rings contacted with each other, they would merge together and form interconnected structures. Our assumption is that with the structural development of high content of graphitic rings, these graphitic rings would merge together and form interconnected graphitic structures. The keys for obtain the above newly designed graphitic structure are the following points: (1) exfoliation and orientation of CNTs; and (2) development of interphase structure. The exfoliation of CNTs was obtained by dispersing oxidized ultra-short SWNT in DMSO by sonication, the orientation of CNTs was achieved by stretching the PAN/CNT film at a high ratio by gel-drawing method, and the further development of interphase was promoted by applying external dynamic force. By combining all these ideals, we are working on the fabrication of new type of graphitic films with high thermal conductivity along all directions.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~17:20

Venue: Jia Suo Conference (2)

Session 1 *(Part. 2)*: 6 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P2001 Presentation 9 (16:50~17:05)

Characterization of the Roman Curse Tablet

Wen Liu, **Boyang Zhang** and Lin Fu

Johns Hopkins University, USA; Chongqing Foreign Language School, China; University of Cambridge, UK

Abstract— The Roman curse tablet, produced in ancient Rome period, is a metal plate that inscribed with curses. In this research, several techniques were used to find out the physical structure and chemical composition of the Roman curse tablet, and testified the hypothesis that whether the tablet is made of pure lead or lead alloy. A sample of Roman Curse Tablet from the Johns Hopkins Archaeological Museum was analyzed using several different characterization techniques to determine the physical structure and chemical composition. The characterization techniques used were including optical microscopy, scanning electron microscopy (SEM), atomic force microscopy (AFM), and differential scanning calorimetry (DSC). Because of the small sample size, X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and X-ray fluorescence (XRF) cannot test the sample. Results from optical microscopy and SEM, enlarged images of the sample surface were studied. The result revealed that the sample surface has a rough, non-uniform, and grainy surface. AFM provides three-dimensional topography of the sample surface, studying the sample surface in atomic level. DSC studies the thermal property, which is most likely a lead-alloy, not a pure lead. However, none of these tests indicated anything about the chemical composition. Future work will be required due to the lack of measures finding out its chemical composition. Therefore, from these characterization techniques above, the Roman curse tablet sample is consisted of lead alloy, not pure lead.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~17:20

Venue: Jia Suo Conference (2)

Session 1 *(Part. 2)*: 6 presentations- Topic: "Material Chemistry"

Session Chair: Prof. Yang-Xin Yu

P3003 Presentation 10 (17:05~17:20)

Purification of Heavy Metal Ion-Polluted Water by a Magnetized Coal Fly Ash

Ya-Na Zhang, Yi-Bai He and **Yang-Xin Yu**

Laboratory of Chemical Engineering Thermodynamics, Department of Chemical Engineering, Tsinghua University, China

Abstract— Nowadays water pollution by heavy metals is becoming more and more serious and efficient treatment of the heavy metal ion polluted water is an urgent task for chemical and environmental engineers. This work investigated the performance of magnetized coal fly ash in removal of heavy metal ions Cr^{3+}, Cu^{2+} and Ni^{2+} from aqueous solutions. The magnetic nanoparticles of Fe_3O_4-fly ash (MNFFA) were synthesized by the co-precipitation method at 298.15 K and 101.3 kPa. The structures of the synthesized MNFFA were characterized by the scanning electron microscope, X-ray diffraction and surface area analyses. The result showed an average nanoparticle size of 3.78 nm. The effects of adsorbent composition and dosage, equilibration time, temperature, pH and co-existing ions on the adsorption were investigated to optimize the operating condition for the use of MNFFA to remove Cr^{3+}, Cu^{2+} and Ni^{2+}. After adsorption, the MNFFA can be rapidly separated from aqueous solutions without the secondary pollution. A high adsorption capacity was kept after five cycles, indicating that the adsorbent is stable enough to be regenerated and re-used efficiently. The results of this work demonstrated that our synthesized magnetized coal fly ash is an effective, low-cost, and environmentally friendly adsorbent and therefore is very promising to be applied in the adsorption treatment of the water polluted by heavy metals.

Dinner	
18:30	**Restaurant, 1st Floor, Jia Suo**

Session 2

Tips: The schedule for each presentation is for reference only. In case of missing your presentation, we strongly suggest you attend the whole session.

Afternoon, May 26, 2017 (Friday)

Time: 14:30~15:30

Venue: Jia Suo Conference (3)

Session 2 *(Part. 1)*: 4 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

P0009 Presentation 1 (14:30~14:45)

Polychlorinated Biphenyls Degradation in Subcritical Water

Ninad Doctor, Larry Yang and **Yu Yang**

Department of Chemistry, East Carolina University, USA

Abstract— In this work, the degradation of PCB-118, PCB-156, and PCB-180 congeners under subcritical conditions has been investigated. Stainless reaction vessels were used to carry out the heating of reaction mixtures. Liquid-liquid extraction of the reaction mixtures was conducted prior to GC analysis. Approximately 30% PCBs were degraded by 30% hydrogen peroxide after 24 hours of reaction time but without heating the mixtures. The percent degradation of PCBs was however improved to approximately 60% after heating the mixtures at 300 ℃ for an hour. In general, the PCB degradation efficiency was enhanced by increasing the reaction temperature from 300 and 350 ℃. The percent degradation of PCBs was mostly improved by increasing the heating time from 1 hour to 6 hours. In addition, increasing the percentage of hydrogen peroxide significantly increases the rate of PCB destruction.

Afternoon, May 26, 2017 (Friday)

Time: 14:30~15:30

Venue: Jia Suo Conference (3)

Session 2 *(Part. 1)*: 4 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

B0003 Presentation 2 (14:45~15:00)

EKF Composition Estimation and GMG Control of a Reactive Distillation Column

Sirivimon Tintavon and Paisan Kittisupakorn

Chulalongkorn University, Thailand

Abstract— This research work proposes an extended Kalman filter (EKF) estimator to give estimates of product composition and a generic model controller (GMC) to control the temperature of a reactive distillation column (RDC). One of major difficulties to control the RDC is large time delays of product composition measurement. Therefore, the estimates of the product composition are needed and determined based on available and reliable measured tray temperature via the extended Kalman Filter (EKF). With these estimates, the GMC controller is applied to control the RDC's temperature. The performance of the EKF estimator under the GMC control is evaluated in various disturbances and set point change.

Afternoon, May 26, 2017 (Friday)

Time: 14:30~15:30

Venue: Jia Suo Conference (3)

Session 2 *(Part. 1)*: 4 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

B0005 Presentation 3 (15:00~15:15)

Mathematical Modeling for Temperature and Concentration Study Inside a Thermal Drying Oven

Surasit Tanthadiloke and Paisan Kittisupakorn

Chulalongkorn University, Thailand

Abstract— In order to investigate the dynamic behavior for further performance improvements of a thermal drying oven in a can production plant, mathematical models based on continuity equations are developed and validated with COMSOL simulation result. Profiles of temperature and the concentration of evaporated solvent (Ethylene glycol monobutyl ether; $C_6H_{14}O_2$) in three different volumetric air flow rates such as 1.67, 1.00 and 0.33 m^3/s are investigated and compared with the simulation results. The results demonstrated that the developed models for the thermal drying oven provide good prediction with a very small error from the validating data and the coefficient of determination (R^2) of these models is 0.9926. Furthermore, these models can keep a good evaluation of both temperature and the concentration of evaporated solvent when changing the volumetric air flow rates. The simulation results from the developed models in all cases have the similar trends when compared with the COMSOL results. In addition, the results in this work guarantee that the developed models can provide the dynamic behavior inside the thermal drying oven and are applicable for the future improvements of the thermal drying oven performance.

Afternoon, May 26, 2017 (Friday)

Time: 14:30~15:30

Venue: Jia Suo Conference (3)

Session 2 *(Part. 1)*: 4 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

B0006 Presentation 4 (15:15~15:30)

Heat Transfer Enhancement in Turbular Heat Exchanger Fitted with Twin Twisted Tape Swirl Generators

Anucha Saysroy, **Varesa Chuwattanaku**l and Smith Eiamsa-ard

King Mongkut's Institute of Technology Ladkrabang

Abstract— An experimental investigation was made with aim to enhance heat transfer in a double-tube heat exchanger fitted with twin twisted tapes. The effects of the twin twisted tape inserts on heat transfer rate, friction factor and thermal performance behaviors were studied in turbulent region of Reynolds number between 5000 and 15,000. The twin twisted tapes with three twist ratios (y/w = 1.5, 2.0 and 2.5) were used for generating two longitudinal swirl flows along the test section. The experimental result indicates that heat transfer rate in term of Nusselt number (Nu) and friction loss in term of friction factor (f) increase as twisted ratio (y/w) decreases. The twin twisted tapes with y/w = 1.5 yield higher Nusselt number (Nu) than the ones with y/w = 2.0 and 2.5 up to 16% and 38%, respectively which are accompanied with the higher friction factor up to 15% and 35%, respectively. Among the tested twisted tapes, the twin twisted tapes with the smallest twist ratio (y/w = 1.5) offer the maximum thermal performance factor of 1.64. In addition, the flow structure, temperature field, turbulent kinetic energy and local heat transfer coefficient in tube fitted twin twisted tapes are also presented.


15:30-15:50	**Coffee Break**

Afternoon, May 26, 2017 (Friday)

Time: 15:50~18:05

Venue: Jia Suo Conference (2)

Session 2 *(Part. 2)*: 9 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

B0007 Presentation 5 (15:50~16:05)

Heat Transfer and Fluid Flow Behaviors in a Five-Start Spiral Corrugated Tube

Pitak Promthaisong, Withada Jedsadaratanachai, **Varesa Chuwattanakul** and Smith Eiamsa-ard

King Mongkut's Institute of Technology Ladkrabang, Thailand

Abstract— This paper presented a numerical investigation on turbulent periodic flow, heat transfer, pressure loss and thermal enhancement factor in a 3D five-start spiral corrugated tube. Air was used as the working fluids through the tube for Reynolds numbers of about 5000-20,000. In the current studied, the five-start spiral corrugated tube with six relative pitch ratios (p/D, PR=1.0, 1.5, 2.0, 2.5, 3.0 and 3.5) with constant depth ratio (e/D, DR=0.06). The numerical results reveal that the five-start spiral corrugated tube can generated a swirl flow, main swirl flow and five-secondary swirl flow. This behavior lead to the major change of temperature in transverse plane, reduced thermal layer thickness and enhanced heat transfer on the tube wall. The five-start spiral corrugated tube in range investigated provided the heat transfer rate and friction factor up to 2.02 and 6.12 times, respectively, over the straight circular tube. The thermal enhancement factor of the five-start spiral corrugated tube in the range of 0.89-1.16 where its maximum found as the optimum point is at PR=2.0.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~18:05

Venue: Jia Suo Conference (2)

Session 2 *(Part. 2)*: 9 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

B0008 Presentation 6 (16:05~16:20)

Simulation of Turbulent Heat Transfer Characteristics in a Corrugated Tube with Five-Channel Twisted Tape Inserts

Pitak Promthaisong, Withada Jedsadaratanachai, Varesa Chuwattanakul and Smith Eiamsa-ard

King Mongkut's Institute of Technology Ladkrabang, Thailand

Abstract— The article presents a numerical analysis of turbulent periodic flow and heat transfer characteristics in a five-start spiral corrugated tube combined with five-channel twisted tape. Influences of the five-channel twisted tape with tape width ratio, w/D=0.10, 0.20, 0.30, 0.40 and 0.44 at constant the twisted length ratio, y/D=2.0 were described. The results were reported in term of flow structure, temperature distribution, TKE field, local Nusselt number distribution on the wall, Nusselt number ratio, friction factor ratio and thermal enhancement factor. The five-start spiral corrugated tube combined with five-channel twisted tape showed a main swirl flow and secondary swirl flow along the tube due to the induction of the spiral groove while the smooth circular tube appeared the straight only and the five-start spiral corrugated tube with the five-channel twisted tape at w/D=0.44 appeared the main swirl flow only. The swirl flow help to increase fluid mixing and increase in heat transfer rate over the smooth circular tube. The increase in the w/D lead to the rise of Nusselt number and friction factor. The result showed that the optimum thermal enhancement factor of about 1.16was found at the five-start spiral corrugated tube without the five-channel twisted tape and at w/D=0.44.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~18:05

Venue: Jia Suo Conference (2)

Session 2 *(Part. 2)*: 9 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

B0009 Presentation 7 (16:20~16:35)

Devise of an Exhaust Gas Heat Exchanger for a Thermal Oil Heater in a Palm Oil Refinery Plant

Panom Chucherd and Paisan Kittisupakorn

Chulalongkorn University, Thailand

Abstract— This paper presents the devise of an exhaust gas heat exchanger for waste heat recovery of the exhausted flue gas of palm oil refinery plant. This waste heat can be recovered by installing an economizer to heat the feed water which can save the fuel consumption of the coal fired steam boiler and the outlet temperature of flue gas will be controlled in order to avoid the acid dew point temperature and protect the filter bag. The decrease of energy used leads to the reduction of CO_2 emission. Two designed economizer studied in this paper are gas in tube and water in tube. The gas in tube exchanger refers to the shell and tube heat exchanger which the flue gas flows in tube; this designed exchanger is used in the existing unit. The new designed water in tube refers to the shell and tube heat exchanger which the water flows in the tube; this designed exchanger is proposed for new implementation. New economizer has the overall coefficient of heat transfer of 19.03 W/m2.K and the surface heat transfer area of 122 m^2 in the optimized case. Experimental results show that it is feasible to install economizer in the exhaust flue gas system between the air preheater and the bag filter, which has slightly disadvantage effect in the system. The system can raise the feed water temperature from 40 to 104℃ and flow rate 3.31 m^3/h, the outlet temperature of flue gas is maintained about 130 ℃.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~18:05

Venue: Jia Suo Conference (2)

Session 2 *(Part. 2)*: 9 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

B0010 Presentation 8 (16:35~16:50)

Critical Parameters for Sterilization of Oil Palm Fruit by Microwave Irradiation

Maya Sarah and M.R Taib

University of Sumatera Utara, Indonesia

Abstract— Study to evaluate critical parameters for microwave irradiation to sterilize oil palm fruit was carried out at power density of 560 to 1120 W/kg. Critical parameters are important to ensure moisture loss during sterilization exceed the critical moisture (M_c) but less than maximum moisture (M_{max}). Critical moisture in this study was determined according to dielectric loss factor of heated oil palm fruits at 2450 MHz. It was obtained from slope characterization of dielectric loss factor-vs-moisture loss curve. The Mc was used to indicate critical temperature (T_c) and critical time (t_c) for microwave sterilization. To ensure moisture loss above critical value but not exceed maximum value, the combinations of time–temperature for sterilization of oil palm fruits by microwave irradiation were 6 min and 75^0C to 17 min and 82^0C respectively.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~18:05

Venue: Jia Suo Conference (2)

Session 2 *(Part. 2)*: 9 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

B0012 Presentation 9 (16:50~17:05)

The Utilization of Oil Palm Fronds in Producing Oxalic Acid through Oxidation

Seri Maulina and Ihwan Rahmadi

University of Sumatera Utara, Indonesia

Abstract— As one of the solid waste generated by palm oil plantations, Oil Palm Fronds have the potential to be further processed into useful products since the presence of cellulose, hemicellulose and lignin. Hence, the objective of this study was to utilize oil palm fronds in producing oxalic acid through oxidation process using. To achieve the objective, this study assessed conversion of cellulose, yield and quality of oxalic acid produced. Two stages are carried out, namely oxidation and crystallization. Assays on raw materials revealed the cellulose content of 29.2 percent. The largest yield of oxalic acid was 43.31 percent, the highest conversion of cellulose was 58.86 percent. FTIR and melting point analysis were employed in this study. These analyses indicated that the functional groups have reached the standard of oxalic acid with a melting point of 102.1 ^{0}C, which showed that the oxalic acid obtained was oxalic acid dehydrate.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~18:05

Venue: Jia Suo Conference (2)

Session 2 *(Part. 2)*: 9 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

P3001 Presentation 10 (17:05~17:20)

Supercritical Solvent Extraction of Oil Sand Bitumen

Imanbayev Ye.I., Ongarbayev Ye.K., Tileuberdi Ye., Mansurov Z.A., Golovko A.K. and Rudyk S.

Al-Farabi Kazakh National University, Kazakhstan

Abstract— The supercritical solvent extraction of bitumen from oil sand was studied with organic solvents. The experiments were performed in autoclave reactor at temperature above 255 ℃ and pressure 29 atm with stirring for 6 h. The reaction resulted in the formation of coke products with mineral part of oil sands. The remaining products were separated into SARA fractions. The properties of the obtained products were studied. The supercritical solvent extraction significantly upgraded extracted natural bitumen.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~18:05

Venue: Jia Suo Conference (2)

Session 2 *(Part. 2)*: 9 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

P3004 Presentation 11 (17:20~17:35)

Experimental and Quantum Chemical Studies of CO_2 Solubility in Carbonates, Ionic Liquids and their Mixtures

Zhijun Zhao, Xiao Xing, Jie Hu, Zhigang Tang, Weiyang Fei, Xiangfeng Liang and Dong Guo

State Key Laboratory of Chemical Engineerin, Department of Chemical Engineering, Tsinghua University, China

Abstract— Outdoor design temperature is important for selecting the proper capacity of heating and cooling systems of a building to save building energy. The purpose of the study is to investigate the change of South Korea outdoor design temperatures according to the assigned period. When heating design temperature was calculated by 8-year period, Seoul region was found to be the lowest at -10.86℃ with data period from 1982 to 1989, while Jeju region was the highest at 1.57℃ with data period from 1988 to 1995. When cooling design temperature was calculated by 8-year period, Daegu region showed the highest at 33.54℃ with data period from 1988 to 1995, while Incheon region showed the lowest at 29.48℃ with data period from 2008 to 2015. As for the correlation between heating design temperature and mean temperature, Gwangju and Jeju were found to be lower than 0.5, with 0.2798 and 0.2777, respectively, showing little correlation with the mean temperature. However, as for the correlation between cooling design temperature and mean temperature, Gwangju and Jeju were found to be higher than 0.5, with 0.6822 and 0.7879, respectively, showing strong correlation with mean temperature.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~18:05

Venue: Jia Suo Conference (2)

Session 2 *(Part. 2)*: 9 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

P3005 Presentation 12 (17:35~17:50)

Extraction of Nickel from Ramu Laterite by Sulphation Roasting-Water Leaching

Weiwei Wang, Shangchao Du, Jianwen Tang, Guo Liu, Yeda Lu and Dong Lv

China ENFI Engineering Corporation, China Nonferrous Engineering and Research Institute, China

Abstract— The laterite ore used in the Ramu NiCo project in PNG (Papua New Guinea) contains about 1% of nickel, while the contents of impurities including iron, aluminium, magnesium and manganese are high, such as, about 40% of iron. Currently, nickel is recovered from the ores at high efficiency by a hydrometallurgical process, HPAL (high pressure acid leaching). The soluble iron in limonite and saprolite minerals can be transferred into in-soluble hematite in the process. However, the investing and operating costs are high due to the harsh requirements under high pressure and high temperature. Recovery of nickel from a PNG nickel laterite with high content of iron by a sulphation roasting-water leaching has been studied. The influences of sulfuric acid consumption and temperature of sulphating roasting on leaching efficiencies were investigated. Over 90% of nickel ions were co-leached by water with less than 10% of iron under the optimal conditions of sulfuric acid roasting. The effective separation of nickel over the co-existed elements including iron and aluminium can be achieved by the process.

Afternoon, May 26, 2017 (Friday)

Time: 15:50~18:05

Venue: Jia Suo Conference (2)

Session 2 *(Part. 2)*: 9 presentations- Topic: "Environmental and Chemical Engineering"

Session Chair: Prof. Jian Chen

P3006 Presentation 13 (17:50~18:05)

Performance Evaluation of CO_2 Capture with Diethyl Succinate

Hongwei Li, Zhigang Tang, Zhimin He, Dong Guo, Zhijun Zhao and Xian-zhong Mao

Division of Ocean Science and Technology, Graduate School at Shenzhen, Tsinghua University, China

Abstract— The global CO_2 emission reduction requirements become more and more serious due to the high cost of carbon capture. It is urgent to develop high efficiency and low cost capture technology. Diethyl succinate (DES) is a new and highly efficient carbon dioxide (CO_2) absorption solvent. Vapor-liquid equilibrium (VLE) data for the CO_2 + DES system were determined experimentally from 288.15 K to 318.15 K by the gas-phase recirculation method, and modeled using the Kritchevsky-Kasarnovsky model and Peng-Robinson equations of state. The vapor-liquid equilibrium data of the DES system were compared with those of the diethyl carbonate (DEC) and dimethyl carbonate (DMC) systems, and Henry constant was found to follow DES < DEC < DMC. The absorbed and released energy as simulated using Gaussian 09 software shows that the CO_2 absorption capacity of DES is better than that of the DEC and DMC. A continuous absorption-desorption experimental setup was established for the CO_2-DES system to determine the optimum operating conditions of a liquid-gas ratio of 1.337, an absorption temperature range from 291.15 to 293.15 K, a desorption temperature range from 433.15 to 443.15 K, and a nitrogen (N_2) flow of 0.5 NL/min.

Dinner	
18:30	**Restaurant, 1st Floor, Jia Suo**

Poster Session

May 26, 2017 (Friday)

Time: 8:50~18:05

Venue: Jia Suo Conference (2) & (3)

Poster session: 4 presentations

P0003 Poster 1

Peptoid-Conjugated PEGlated PAMAM as a Dual-targeting Aβ42 Oligomerization Inhibitor for treating AD

Zijian Zhao, Iman Rostami, Ling Zhu, Mingzhu Liu and Zhiyuan Hu

National Center for Nanoscience and Technology, China

Abstract— The conversion of proteins or peptides from their normally soluble, functional states into insoluble aggregates is involved in the pathogenesis of many amyloidogenic diseases. Typically, the cerebral accumulation and deposition of amyloid β (Aβ), especially the isoform Aβ42, is the essential event in the pathogenesis of Alzheimer's disease (AD), the most common form of dementia. Treatment of AD after the onset of clinical symptoms has little effect on the cognition of patients. Therefore, early intervention such as strategies to disturb the accumulationof Aβ is essential for the treatment of AD. Many short peptides and small molecules have been developed to inhibit the aggregation of Aβ, most of which are focused on Aβ fibrils. However, recent evidence has suggested that early stage accumulates such as soluble oligomers are the primary toxic species leading to the neurodegeneration and cell death in AD, while the inhibitors targeting Aβ oligomers are scarce.

In the present study, we tend to inhibit the oligomerization of Aβ42 using peptoids that are N-substitute oligoglycines. Peptoids are resistant to enzymatic degradation and can therefore overcome the rapid metabolism as with peptides. They have higher chemical diversity compared to peptides, and can be easily chemically functionalized for increased BBB penetration, which has been challenging in the development of central nervous system (CNS) active drugs. In this study, we developed a dual-targetingAβ42Oligomerization Inhibitor with Transferrin(Tf) and amyloid inhibitory peptoid 1 (AIP1) functionalized PAMAM dendrimer (fourth feneration), which could effectively inhibit the oligomerization and fibrillation of Aβ42 in CSF, and rescue Aβ42-induced cytotoxicity through decreasing the content of Aβ42 oligomers. It could target and transport across the blood-brain barrier (BBB) and hold promising potential for the therapeutic application in AD.

May 26, 2017 (Friday)

Time: 8:50~18:05

Venue: Jia Suo Conference (2) & (3)

Poster session: 4 presentations

P0006 Poster 2

Loading of Fe_3O_4 Nanoparticles into the UCNPs Surface Modificated with PAMAM as a Magnetic Biosensor with Low-Power Energy Excitation Sources

Iman Rostami, Zijian Zhao, Ling Zhu and Zhiyuan Hu

National Center for Nanoscience and Technology, China

Abstract— In this study, a novel nanosensor was observed for the bioimaging and cancer treatment and drug delivery. Poly(amidoamine) or PAMAM is a hyperbranched polymers with unparalleled molecular uniformity which is able to tightly bind to surfaces of upconversion nanoparticles (UCNPs).

UCNPs are new generation of fluorophores which have the ability to turn near infrared radiations with lower energy into visible radiations with higher energy via a nonlinear optical process. Benefiting from the effective penetration depth of near-infrared (NIR) photons in biological tissues and minimized auto-fluorescence background, UCNPs are widely utilized for a variety of biological applications. Incorporation of PAMAM dendrimer and UCNPs provides a type of low toxic nanoparticle for bioimaging that might be used with near-infrared (NIR) stimulator for fluorescence imaging. In most cases, these UCNPs are doped simultaneously with sensitizer ions (for example, Yb^{3+}) and activator ions (for example, Er^{3+}, Tm^{3+}, or Ho^{3+}). These typical upconversion nanoparticles can be excited in different wavelengths (740, 800 and 980 nm) based on doped sensitizers.

These biosensors enable us to know when, where and how the desired drug molecules were delivered, and even detected the release of active drugs in a noninvasive manner. There was no significant change with the emission spectra of UCNPs before and after modification with PAMAM G4 and TEM images showed a bigger gap between nanoparticles after modification.

In this study, in order to understand the performance of modified UCNPs as an adsorbent for hydrophilic protein/peptides sample preparation, UCNPs-based support magnetic nanoparticles and cyanopropyltriethoxysilane (Fe_3O_4@G-CNPrTEOS) was developed using a simple sol-gel method. The unique structure of the proposed Fe_3O_4@G-CNPrTEOS nanocomposite does not only provide extended planes with hydrophilic surface, but also offers a large number of CNPrTEOS-modified mesopores with high surface area that can ensure significant effect of drug isolation through hydrophilic-hydrophilic and electrostatic interactions.

May 26, 2017 (Friday)

Time: 8:50~18:05

Venue: Jia Suo Conference (2) & (3)

Poster session: 4 presentations

P0011 Poster 3

Multicolor Photoluminescence of Carbon Dots with Excitation Wavelength Independence

William Yu, Chun Sun, Yu Zhang, Shengnian Wang and Hua Wang

Jilin University, China

Abstract— Carbon dots (CDs) usually emit strong blue light and weak long wavelength lights and the latters are dependent on the excitation wavelength. But for most applications, strong fluorescence emission colors from blue to red are all needed, especially from green to red. Therefore, it is highly desirable to make CDs with various bright emissions, and these emissions should ideally be excitation wavelength independent, just like the traditional metal chalcogenide quantum dots. We found a type of CDs could emit multicolor lights strictly excitation wavelength independent (green to red) when they were dispersed in different solvents. Such multicolor emission could be maintained when the same CDs were mixed with selected polymers as solid state phosphors and the solid state emissions were still excitation wavelength independent. We also demonstrated color LEDs using the CDs. To our knowledge, this is the first report for the CDs to display completely excitation wavelength independent broad long wavelength emissions, and all colors can be achieved from the same CD particles.

May 26, 2017 (Friday)

Time: 8:50~18:05

Venue: Jia Suo Conference (2) & (3)

Poster session: 4 presentations

P0022 Poster 4

Direct Investigations of Temperature Related Structure Transitions in Strained Poly (Butylene Succinate) with SAXS and WAXS

Wenyang Zhang and Shichun Jiang

Tianjin University, China

Abstract— The deformation behavior is closely related to the structures and mechanical properties of polymers. The structural evolution during deformation is fundamental to understand the deformation mechanism and control the properties of polymers. Deformation induced structure transitions contain a stable structure to metastable one or metastable structure to a stable one. The structures of the uniaxially stretched poly (butylene succinate) (PBS) at different temperatures were directly investigated by in situ synchrotron wide-angle X-ray scattering (WAXS) and small-angle X-ray scattering (SAXS). The data reveal the initial strain of the α-β transition increases with the stretching temperatures. A quantitative analysis was performed to explore the crystal transition mechanisms of the stretched PBS.

One Day Visit & Tour

May 27, 2017 (Saturday) 8:30~18:00

(Tip: Please arrive at the First Floor, Jia Suo before 8:30 a.m. The following places are for references, and the final schedule should be adjusted to the actual notice.)

1. (8:30) Assemble at First Floor, Jia Suo, Tsinghua University

2. Visit State Key Laboratory of Chemical Engineering

The State Key Laboratory of Chemical Engineering was established with the approval of Ministry of Education of China in 1987. It was opened and started operation in 1991. The State Key Laboratory of Chemical Engineering has four branches located in Zhejiang University, Tsinghua University, Tianjin University and East China University of Science and Technology respectively.

3. Visit Library

Tsinghua University Library's collection is emphasized on Science and Technology and also covers broad subjects of Humanities, Social Sciences and Management. Tsinghua University Library was established in 1912, just one year after the university was built. Now it had 28,000 square meters of floor space. The total collection amounts to more than 4.51 million items.

4. Visit Tsinghua University Art Museum

The mission of Tsinghua University Art Museum is to spread the historical achievements of human civilization. For the purpose of enhancing cultural accomplishment of both Tsinghua students and the public, we will spare no effort to build up an open window for international cultural exchanges and to carry forward the traditional culture and create the modern culture as well.

♥ *The following schedule is only for participants who registered the tour.*

5. Have Lunch Together

6. Visit Tian'anmen Square

Tian'anmen Square, the heart of Beijing, is the world's largest city center square. The ground of the square is all paved with specially processing light-colored granite stone. The ceremony of raising the national flag in every morning and dropping flag in every sunset time is the most solemn ceremony. Tian'anmen Square was the locality of numerous major political and historical events. It is the witness of Chinese development. While strolling in Tian'anmen Square, looking up at the magnificent layout, the majestic momentum, the vast and deep landscape, you will feel China's rapid development. Tiananmen Square is the Holy Land in the hearts of the Chinese people, and is the heart of great China.

7. Visit Monument to the People's Heroes

The Monument to the People's Heroes is a ten-story obelisk that was erected as a national monument of the People's Republic of China to the martyrs of revolutionary struggle during the 19th and 20th centuries. It is located in the southern part of Tiananmen Square in Beijing, to the north of Mausoleum of Mao Zedong. The monument was built in accordance with a resolution of the First Plenary Session of the Chinese People's Political Consultative Conference adopted on November 30, 1949, with construction lasting from August 1952 to May 1958.

8. Visit The Great Hall of the People

The magnificent Great Hall of the People is a modern structure in China. It has absorbed both Chinese and foreign architectural influences, and it also presents a distinct national style. Since its inception, the Great Hall has always been the important venue for the Party and the state affairs and diplomatic activities. It is here that many earth-shaking historical events, which have changed the development course of China, have taken place. As the country's political, economic, cultural and diplomatic center and the symbol of the People's Republic, it symbolizes the pride and dignity of the Chinese people of all nationalities. The Hall has, too, witnessed China's vicissitudes over the past years. For all of these reasons, the Great Hall of the People has commanded respect, admiration and yearning of the Chinese people and naturally become a place that attracts worldwide attention.

9. Visit Forbidden City

Forbidden City, also known as the Palace Museum, and Gu Gong in Chinese, lies at the city center of Beijing, and once served as the imperial palace for 24 emperors during the Ming and Qing Dynasties (1368-1911). It was first built throughout 14 years during the reign of Emperor Chengzu in the Ming Dynasty (1368-1644). Ancient Chinese Astronomers believed that the Purple Star (Polaris) was in the center of heaven and the Heavenly Emperor lived in the Purple Palace. The Palace for the emperor on earth was so called the Purple City. It was forbidden to enter without special permission of the emperor. Hence its name "The Purple Forbidden City", usually "The Forbidden City". Now known as the Palace Museum, it is to the north of Tiananmen Square.

10. Visit Old Summer Palace

Also known as the Ruins of the Yuanmingyuan (the Garden of Perfection and Light), the Old Summer Palace is located northwest of Beijing and to the east of the present-day Summer Palace. The Garden was first constructed in the year of 1709 during the reign of the Emperor Kangxi of the Qing Dynasty (1644-1911). Over the next 150 years, this Garden was expanded into a large-scale Chinese emperors' private pleasure garden, covering a total area of over 864 acres (350 hectares). Generally speaking, the old Summer Palace consists of three parts- Yuanmingyuan, Wanchunyuan (the Garden of Blossoming Spring) and Changchunyuan (the Garden of Eternal Spring).

11. (18:00)Back to Tsinghua University

Conference Venue

Tsinghua University

清华大学

Address: No. 30, Shuangqing Road, Haidian District, Beijing, China

北京市海淀区双清路 30 号

Tsinghua University is a research university located in Beijing, China, established in 1911. With strong research and training, Tsinghua University is consistently ranked as one of the top academic institutions in China, alongside Peking University. It is one of the nine members in the C9 League of universities.

Most national and international university rankings place Tsinghua amongst the best universities in Mainland China. Admission to Tsinghua is extremely competitive. According to a report in 2008, 215 out of 300 students who placed within the top 10 in the 30 tested provinces and regions chose Tsinghua and 21 out of the 30 top scorers in each province and region chose the university. Admission to Tsinghua's graduate schools is also very competitive, with, for example, only about 16% of MBA applicants admitted each year.

Campus Map

♥ *Check the whole campus map in your e-mail box.*

Note

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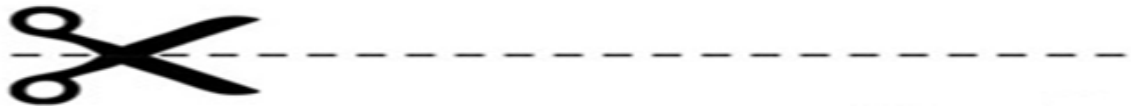

Feedback Information

(Please fill this form and return it to conference specialist during the conference days.)

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Please indicate your overall satisfaction with this conference with "√"

	Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Very Dissatisfied
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Where did you get the conference information?	
Would you please specify the main reason for attending this conference?	
Did the conference fulfill your reason for attending?	Yes– Absolutely □ Yes- But not to my full extent □ No□ (If "No", please tell us the main reason)

Would you please list the top 3 to 5 universities in your city?	
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Any Other Suggestions/Comments	

Thank you for taking time to participate in this conference evaluation. Your comments will enable us to execute future conferences better and tailor them to your needs!