

出國報告（出國類別：國際會議）

The 6th ASIA-OCEANIA CONFERENCE  
ON SUSTAINABLE AND GREEN  
CHEMISTRY (AOC-SGC6) 出國報告

服務機關：國立暨南國際大學 應用化學系

姓名職稱：李政樺 博士後研究人員

派赴國家：香港

出國期間：105 年 11 月 27 日至 105 年 11 月 30 日

報告日期：106 年 3 月 22 日

## 摘要

本次在香港城市大學舉辦之 The 6th ASIA-OCEANIA CONFERENCE ON SUSTAINABLE AND GREEN CHEMISTRY 會議，會議中有許多研究有機催化與綠色化學的大師級學者，其中包含了諾貝爾獎得主 Ei-ichi Negishi 教授…等，都是國際上知名的學者。本會主要的議題是在討論如何讓化學研究更環保，其中包含如何挑選低毒性的溶劑、使用更好的催化劑、提升產率的製程與製備可回收的材料…等等，目前國內只有少數的研究學者進行相關的推廣，在未來是非常值得化學家關注的。

## 目次:

一、參加會議之目的.....	1
二、參加會議經過 .....	1
三、與會心得.....	2
四、發表論文全文或摘要.....	2
五、建議.....	3
六、攜回資料名稱及內容.....	4

## 一、參加會議之目的

本次參加在香港舉辦之 The 6th ASIA-OCEANIA CONFERENCE ON SUSTAINABLE AND GREEN CHEMISTRY 會議，主要目的是為了瞭解環保與綠色化學的議題，這個議題在台灣目前已有少數學者如劉廣定教授與趙亦妤教授等人在推動，但真正投入相關研究的人還是在少數，筆者此次就由參加此會議，可以更了解到目前國際上相關議題的發展。

## 二、參加會議經過

本次 The 6th ASIA-OCEANIA CONFERENCE ON SUSTAINABLE AND GREEN CHEMISTRY 會議在香港城市大學舉辦，會議中有許多研究有機催化與綠色化學的大師級學者，其中包含了諾貝爾獎得主 Ei-ichi Negishi 教授、耶魯大學的 Paul Anastas 教授、東京大學的 Tadahisa Iwata 教授與香港大學的 Vivian W. W. Yam(任詠華)教授等，大家都是在探討一個觀點，那就是如何能讓化學更環保。在會議的過程中，筆者也聽到很多與金屬催化相關的研究，學者們都希望能夠開發出具有高效能的催化劑，讓化學反應更有效率;也有一些學者在研究與改進目前常用的催化反應條件，希望能夠使用更無毒的溶劑或反應條件，使其對環境更友善與環保。會中的 Prof. Tadahisa Iwata 是研究環保高分子聚合物的，他們嘗試用木材所分解出來的原料，去進行高分子聚合反應，且此高分子是具有生物分解性的。還有 Prof. Kei Saito 是做光聚合高分子研究的，藉由光學能量使單體分子在固態排列中進行聚合形成高分子，然後再使用不同波長的光去對高分子進行分解，期回收效果達到 100%，是非常值得關注的。此外，還有些學者視作二氧化碳催化的，他們希望能將二氧化碳經由還原反應變成燃料，這也是目前最被大家所注目與期待地。

### 三、與會心得

本次在會議中聆聽了許多知名學者的演講，讓筆者想到在台灣推動綠色化學的劉廣定教授與趙亦娣教授等人。近十幾年來，綠色化學研究已被多數的化學家注意，也有許多學者在討論與思考未來的綠色化學相關研究，但是台灣有在做相關研究的人真的不多。目前比較相關的研究大多是太陽能、發光材料與化合物的分解回收，但較少人去討論到化學反應過程中與反應後的廢棄物，對環境所帶來的影響。其實在化學反應中所使用的化學品、溶劑及能源都是對大自然的一種消耗與汙染，該如何挑選對環境友善的溶劑，選擇低耗能的反應與提高化合物的產率等，都是屬於綠色化學的一種，都是值得化學家們去思考研究的。在台灣常常可以看到河川與土地被化學品汙染，很多對環境的汙染與傷害都是不可挽救的，這些都讓我們更應該思考，如何降低化學對環境的傷害，更應該讓這個觀念在年輕的學生扎根，讓大家對於綠色化學能夠有更深的了解。

### 四、發表論文全文或摘要

論文摘要: A metal-organic framework,  $\{[\text{Mn}_2(2,6\text{-ndc})_2(\text{bpda})_2]\cdot 5\text{DMF}\}_n$  (1, 2,6-ndc = 2,6-naphthalene dicarboxylate, bpda = N,N'-bis(4-pyridinyl)-1,4-benzene dicarboxamide) was successfully synthesized through a single-step self-assembly process. A single-crystal X-ray diffraction analysis showed that compound 1 is comprised of a 2-fold interpenetrating network with a unique spatial arrangement of amide groups in the channels. The flexibility of the 2-fold interpenetrating framework was verified by in-situ temperature-dependent PXRD studies. The regular arrangement of the amide groups provided rare amide-CO<sub>2</sub> and amide-CO<sub>2</sub>-CO<sub>2</sub> cooperative effects that enhanced the adsorption of CO<sub>2</sub> molecules. Significantly, the findings show that the amide-CO<sub>2</sub> interactions induced gate-opening behaviour.



### Amide-CO<sub>2</sub> Interaction Induced Gate-Opening Behavior for CO<sub>2</sub>

#### Adsorption in 2-Fold Interpenetrating Framework

Cheng-Hua Lu<sup>1,2</sup>, Tang-Jia Lai<sup>1</sup>, and Kuang-Tieh Lin<sup>1</sup>

<sup>1</sup>Institute of Chemistry, Academia Sinica, Taipei 101, Taiwan  
<sup>2</sup>Department of Applied Chemistry, National Chi Nan University, Puli, Nantou, Taiwan 545  
E-mail: chlu@iic.sinica.edu.tw



#### Abstract

A metal-organic framework, [Mn(2,6-ndc)(bpda)]<sub>2</sub> (50MFI), (2,6-ndc = 2,6-naphthalene dicarboxylate, bpda = N,N'-bis(4-pyridyl)-1,4-benzene dicarboxamide) was successfully synthesized through a single-step self-assembly process. A single-crystal X-ray diffraction analysis showed that compound 1 is comprised of a 2-fold interpenetrating network with a unique arrangement of amide groups in the channels. The flexibility of the 2-fold interpenetrating framework was verified by in-situ temperature-dependent PXRD studies. The regular arrangement of the amide groups provided rare amide-CO<sub>2</sub> and amide-CO<sub>2</sub>-CO<sub>2</sub> cooperative effects that enhanced the adsorption of CO<sub>2</sub> molecules. Significantly, the findings show that the amide-CO<sub>2</sub> interactions induced gate opening behavior.

#### Experimental Section

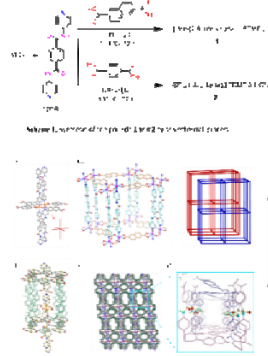


Figure 1. Synthesis of [Mn(2,6-ndc)(bpda)]<sub>2</sub> (50MFI) MOF. The reaction scheme shows the coordination of Mn(NO<sub>3</sub>)<sub>2</sub> with 2,6-ndc and bpda in DMF at 120 °C for 24 h to form the MOF. The resulting MOF structure is shown as a 2-fold interpenetrating framework.

#### Results and Discussion

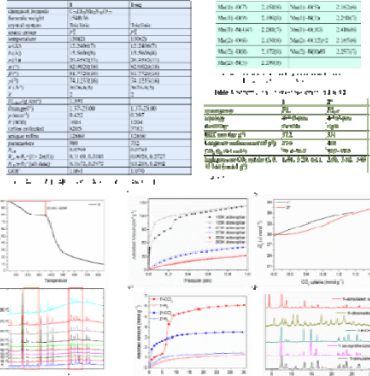


Figure 2. PXRD patterns of [Mn(2,6-ndc)(bpda)]<sub>2</sub> MOF at different temperatures. The plot shows intensity versus 2θ (degrees) for temperatures ranging from 25 °C to 150 °C. The patterns show a characteristic peak at approximately 10° 2θ, which shifts and broadens with increasing temperature, indicating structural flexibility.

Parameter	Value
Formula	C <sub>28</sub> H <sub>16</sub> N <sub>4</sub> MnO <sub>8</sub>
Formula weight	608.43
Z	4
Space group	Fm-3m
Unit cell dimensions (Å)	a = b = c = 20.15
Unit cell volume (Å <sup>3</sup> )	V = 8120.0
Density (g/cm <sup>3</sup> )	D <sub>c</sub> = 1.35
Calculated density (g/cm <sup>3</sup> )	D <sub>c</sub> = 1.35
χ <sup>2</sup>	1.02
R <sub>int</sub>	0.015
R <sub>σ</sub>	0.012
Weighted R <sub>int</sub>	0.018
Weighted R <sub>σ</sub>	0.015
Goodness of fit on S	1.02
Final R <sub>1</sub> [%]	1.82
Final wR <sub>2</sub> [%]	2.15
Final R <sub>1</sub> (I > 2σ(I)) [%]	1.55
Final wR <sub>2</sub> (I > 2σ(I)) [%]	1.85
Final R <sub>1</sub> (all data) [%]	1.82
Final wR <sub>2</sub> (all data) [%]	2.15

**Introduction**  
Metal-organic frameworks (MOFs) have attracted significant attention due to their high surface area and tunable pore size. The design of MOFs with specific functional groups is crucial for enhancing their adsorption and catalytic properties. In this study, we report the synthesis and characterization of a new MOF, [Mn(2,6-ndc)(bpda)]<sub>2</sub> (50MFI), which features a 2-fold interpenetrating framework and unique amide groups in the channels. The MOF exhibits excellent thermal stability and high surface area. The amide groups in the channels provide a unique environment for CO<sub>2</sub> adsorption, leading to enhanced adsorption capacity and gate-opening behavior. The MOF was synthesized via a single-step self-assembly process in DMF at 120 °C for 24 h. The resulting MOF was characterized by single-crystal X-ray diffraction, powder X-ray diffraction (PXRD), and thermogravimetric analysis (TGA). The MOF exhibits a 2-fold interpenetrating framework with a unique arrangement of amide groups in the channels. The MOF shows excellent thermal stability and high surface area. The amide groups in the channels provide a unique environment for CO<sub>2</sub> adsorption, leading to enhanced adsorption capacity and gate-opening behavior. The MOF was synthesized via a single-step self-assembly process in DMF at 120 °C for 24 h. The resulting MOF was characterized by single-crystal X-ray diffraction, powder X-ray diffraction (PXRD), and thermogravimetric analysis (TGA). The MOF exhibits a 2-fold interpenetrating framework with a unique arrangement of amide groups in the channels. The MOF shows excellent thermal stability and high surface area. The amide groups in the channels provide a unique environment for CO<sub>2</sub> adsorption, leading to enhanced adsorption capacity and gate-opening behavior.

Acknowledgment: Ministry of Science and Technology, ROC, and National Chi Nan University, R.O.C.

## 五、建議

本次會議屬於中小型會議，但是會議中來了許多大師級人物，會議過程中的討論非常的熱烈。在午餐的用餐過程中，並無特別的安排用餐位置，讓所有的學者可以隨意走動，相互交流聊天。讓學生也可以很輕易的與大師級學者認識交流，這對學生的眼界與膽識是非常好的磨練。國內的化學年會可以參考這種模式，中午用餐的時候不要把老師跟學生隔離，讓學生可以經由自己指導教授的介紹，可以認識更多的其他教授，這將可以提升對於不同研究領域的認識與興趣，更可能提高不同領域研究的合作機會。

## 六、攜回資料名稱及內容

會議相關照片：

