

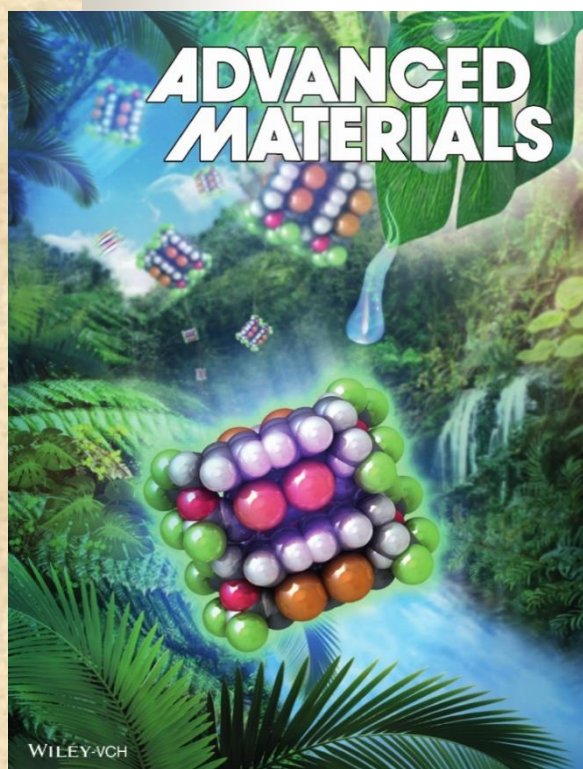
# Prof. Dr Norman Lu's group (呂良賜 博士)研究室

## ■ Research Interests:

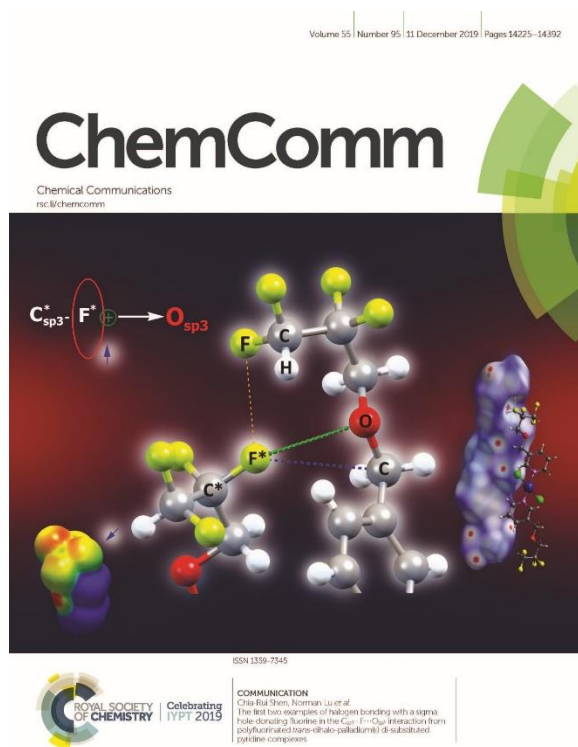
1. Green Technology
2. Novel Dye for Dye-sensitized Solar Cell
3. Li ion battery
4. Organometallic Chemistry
5. Fuel Cell (PEM membrane); Fluoropolymer
6. Supercritical CO<sub>2</sub> (ScCO<sub>2</sub>) research

# Recent results and awards

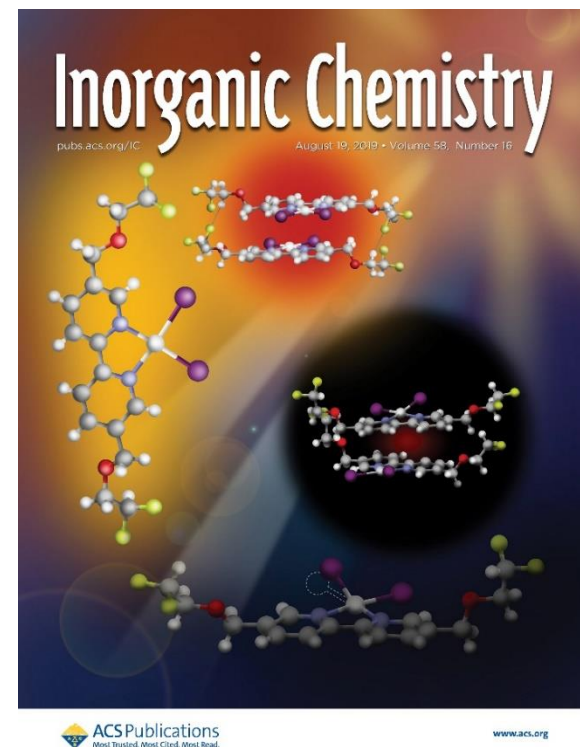
## Advanced Materials



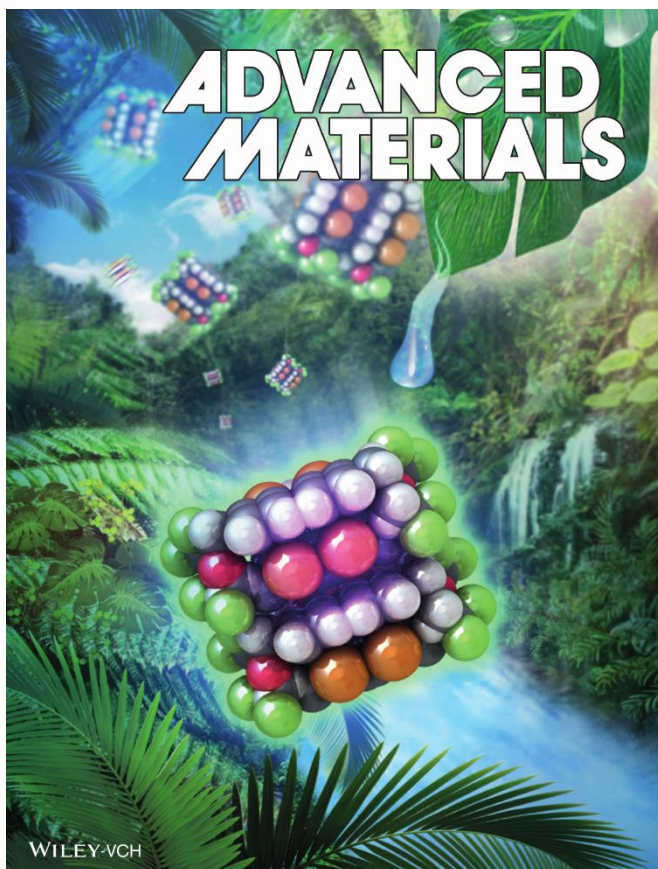
## ChemComm



## Inorganic Chemistry



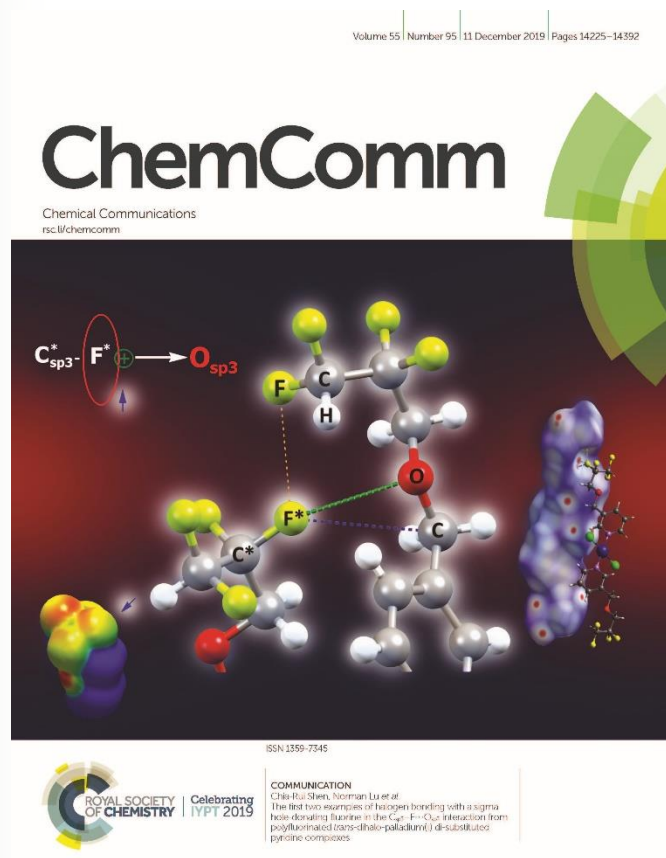
# Back Cover of Advanced Materials



- Fast-Response, Highly Air-Stable, and Water-Resistant Organic Photodetectors Based on a Single-Crystal Pt Complex
- Advanced Materials 2020, 32(2), 1904634
- <https://doi.org/10.1002/adma.201904634>

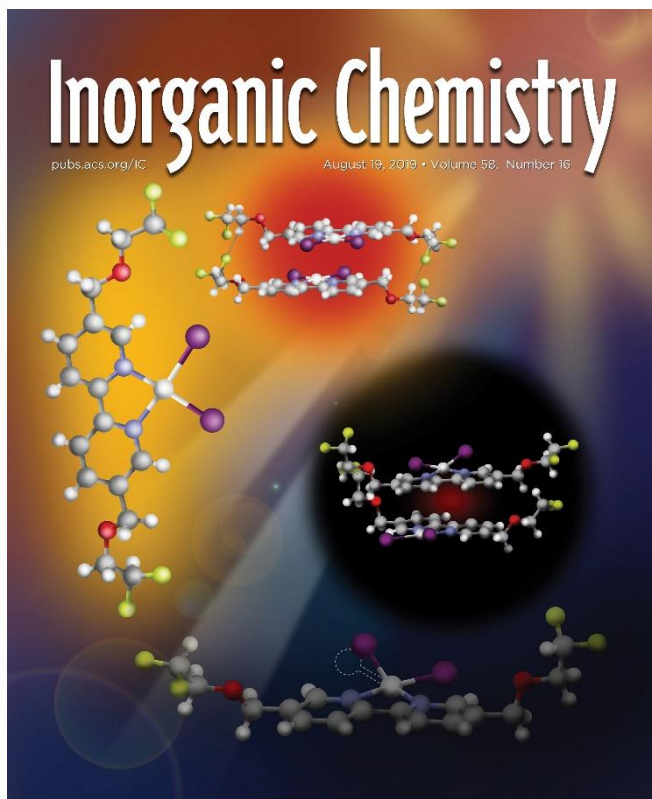


# Inside Front Cover of ChemComm



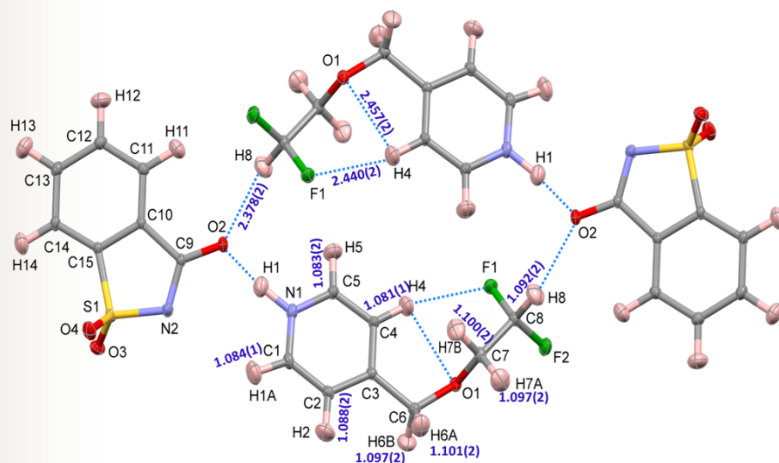
- The first two examples of halogen bonding with a sigma hole-donating fluorine in the  $C_{sp^3}-F \cdots O_{sp^3}$  interaction from polyfluorinated trans-dihalo-palladium(II) di-substituted pyridine complexes
- Chem. Commun., 2019,55, 14259-14262
- <https://doi.org/10.1039/C9CC06731K>

# Cover page of Inorganic Chemistry



- Synthesis, Luminescence, and Structure of a Polymorphic Polyfluorinated Diiodoplatinum(II) Diimine Complex
- *Inorg. Chem.* 2019, 58, 16, 10716–10724
- <https://doi.org/10.1021/acs.inorgchem.9b00669>

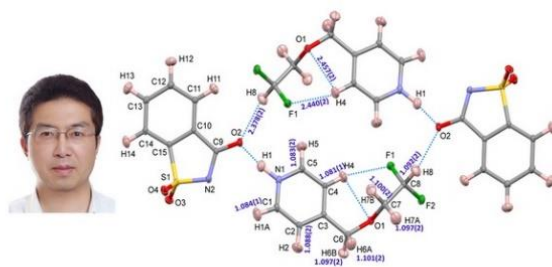
# Recent results and awards



- Neutron Diffraction Study of Significant  $sp^3$  and  $sp^2$  C–H Bond Shortening in a Fluorinated Pyridinium Saccharinate
- J. Am. Chem. Soc. 2021, 143, 5550–5557
- <https://doi.org/10.1021/jacs.1c02570>



# Recent results and awards



## Neutron Diffraction Study of Significant $sp^3$ and $sp^2$ C–H Bond Shortening in a Fluorinated Pyridinium Saccharinate

Norman Lu, Vijayanath Elakkat, Joseph S. Thrasher, Xiaoping Wang, Eskedar Tessema, Ka Long Chan, Rong-Jun Wei, Tarek Trabelsi, and Joseph S. Francisco  
Journal of the American Chemical Society 2021 143 : 5550-5557

國立臺北科技大學  
分子科學與工程系暨有機高分子所/  
智慧紡織科技研究中心 呂良賜教授

本文是用中子鏡射結構解析研究  $sp^3$  C8-H8 和  $sp^2$  C4-H4 中氫鍵縮短和環上鄰位 C-H 鍵收縮。通常超共軛和軌域的再混成化是兩個相斥的因子，來分別主導控制氫鍵(HB)是紅移或藍移。在典型氫鍵下(如 N-H 或 O-H 等)，當電荷從接受體原子的孤對電子轉移到 D-H (D=提供者:H-氫)的  $\sigma^*$  軌域時，會發生超共軛，從而導致 D-H 鍵的削弱；但在非典型氫鍵時，軌域的再混成化是主要的主導因子，D-H 鍵的再混成造成  $s$ -軌域增加，故導致 D-H 鍵的增強。換言之，當再混成軌域主導時，HB 呈現藍移。故在我們這篇中子的研究，含  $sp^3$  和  $sp^2$  的非典型氫鍵，均受 Bent's 規則的支配影響，在此軌域再混成是主要的決定因子。故本篇研究，簡言之是利用中子精確的量到毫埃的個位數，且發現最短的  $sp^3$  和  $sp^2$  的 C-H 鍵各是 1.092(2) 和 1.081(1) 埃。另外，在(非氫鍵的)鄰位 C-H 鍵收縮例子裡，顯示出 D-H 鍵的  $\sigma^*$  軌域的佔據率降低。因此，當吡啶環上的氮被質子化時，電子雲密度可從吡啶上的氮和兩個 C-N 鍵經由共振移動。但經由吡啶環上的共振， $C_{ortho}-C_{meta}$  和  $C_{ortho}-H$  鍵中的電子密度就增加了。同理當超共軛的因子降低時， $C_{ortho}-H$  (D-H) 軌域的  $s$ -軌域特性為因此增加，且  $C_{ortho}-H$  (D-H) 鍵縮短了。因此，在鄰位 C-H 鍵收縮的情況下；Bent's 規則也可擴充來解釋在非氫鍵的情況下，類似氫鍵的所謂環鄰位 C-H 鍵收縮。最後我們發現 C-H 鍵類似變形蟲，其長度可隨環境變短或變長。

[註：Bent's 規則 對於一特定分子，其中心原子上的  $s$ -軌域性質，傾向於集中在帶較多正電基團的鍵上]

文章連結

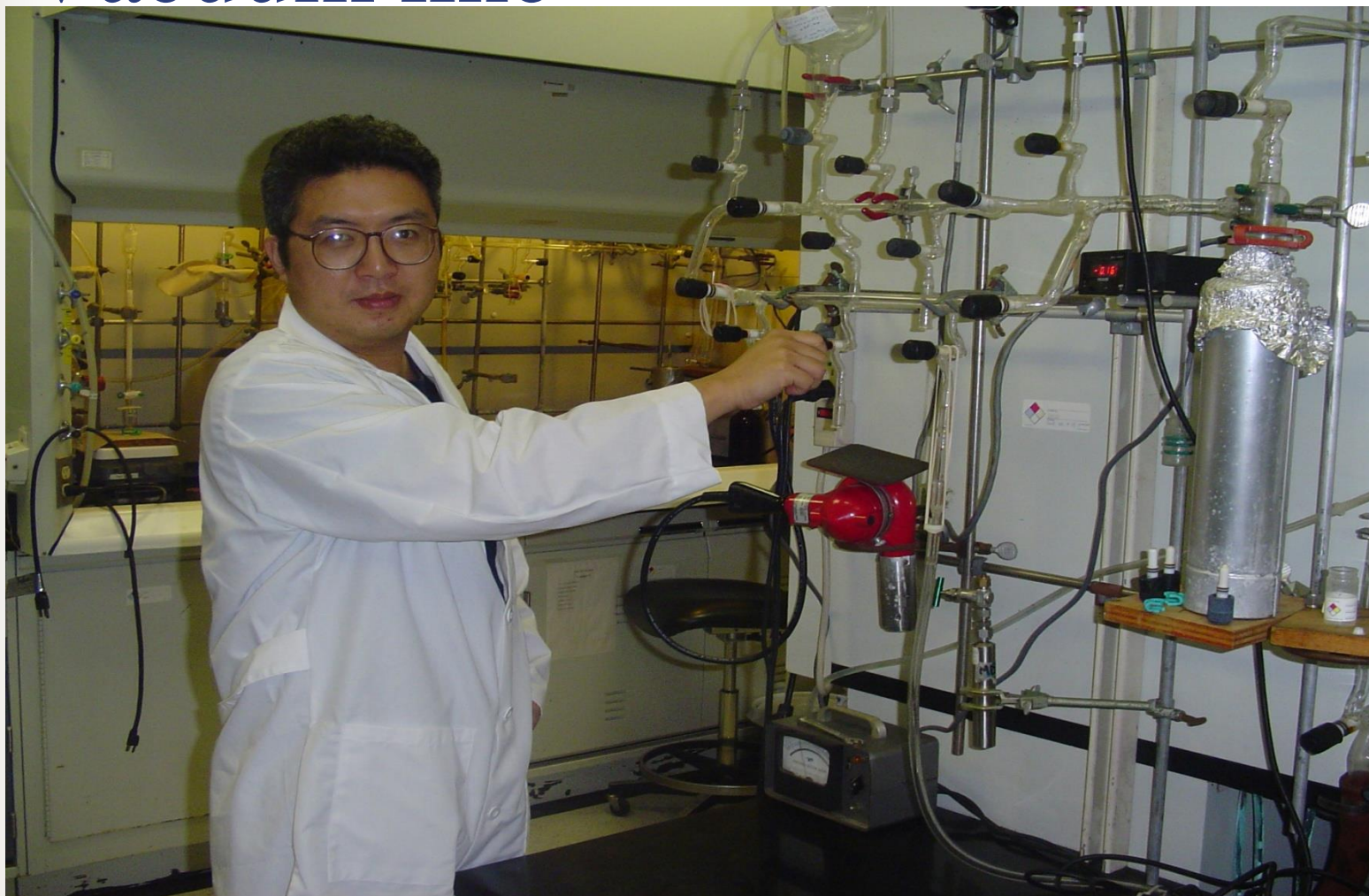
- Neutron Diffraction Study of Significant  $sp^3$  and  $sp^2$  C–H Bond Shortening in a Fluorinated Pyridinium Saccharinate
- This publication is also announced on 化學圖書電子報六月號
- [https://archive.benchmarkemail.com/beer\\_beer/newsletter/%E5%8C%96%E5%AD%B8%E5%9C%96%E6%9B%B8%E9%9B%BB%E5%AD%90%E5%A0%B1%E5%85%AD%E6%9C%88%E8%99%9F](https://archive.benchmarkemail.com/beer_beer/newsletter/%E5%8C%96%E5%AD%B8%E5%9C%96%E6%9B%B8%E9%9B%BB%E5%AD%90%E5%A0%B1%E5%85%AD%E6%9C%88%E8%99%9F)

# Neutron diffraction Experiment at Oak Ridge National Laboratory, Tennessee, **USA,**





# Vacuum line





# Current Research Projects

**Main two areas: Energy(A) & Green Chemistry(B)**

A1. Sn-based Perovskite

A2. Novel Dye w/ Special Polytail (Solar Cell)

(Several patents under application)

A3. Lithium ion battery (solid electrolyte)

A4. Neutron studies (at USA Lab)

B. Catalysis



# Current Research Projects

## B1. Green Chemistry

- ✿ Fluorous Biphasic System (FBS)
- ✿ Aerobic Alcohol Oxidation under FBS
- ✿ ATRP (Recoverable; thermomorphing)

## B2. Catalysis (Organometallics)

## B3. ScCO<sub>2</sub> Studies

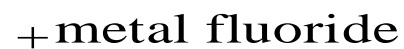
## B4. X-Ray Crystal Growing (Catalysts)



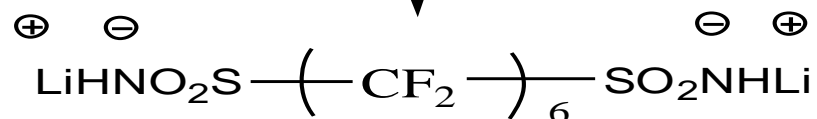


# 1. Lithium Battery Electrolyte

- See the next chart for the procedure

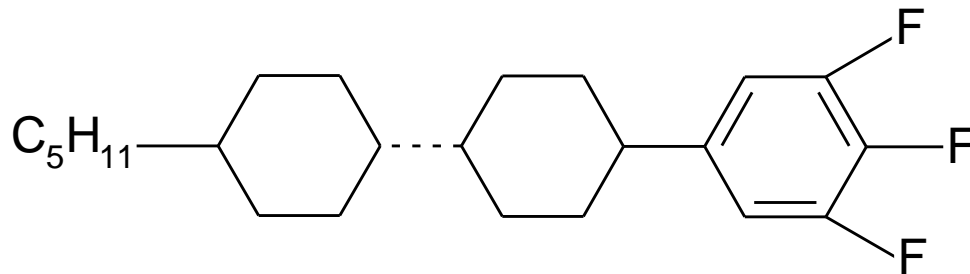


(A)

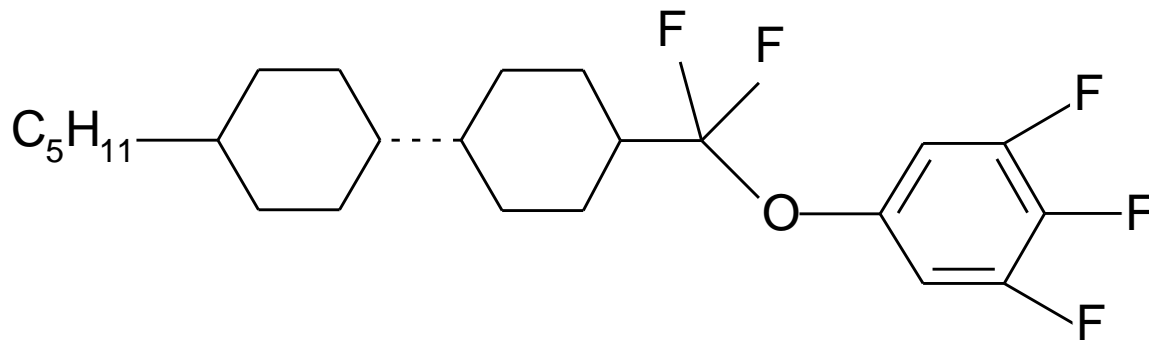


(B)

## 2. Liquid Crystal Materials



1



2

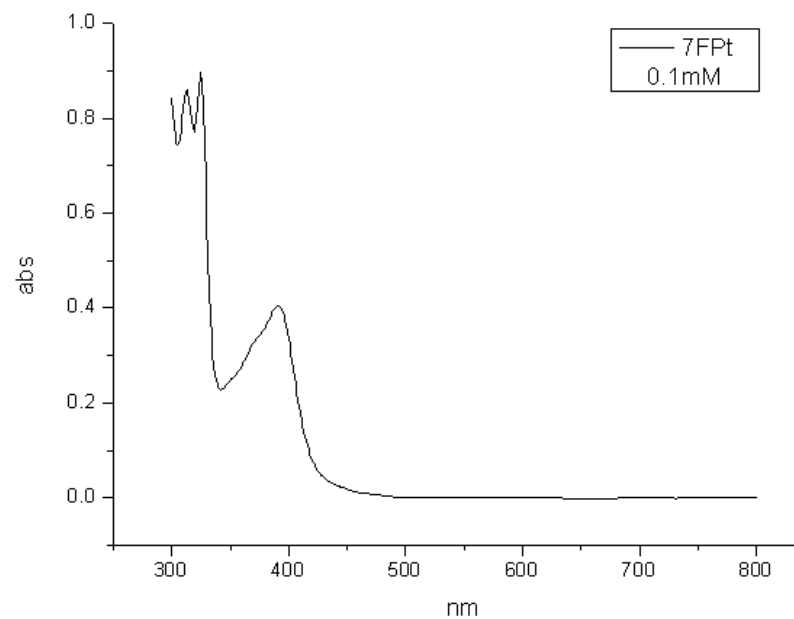
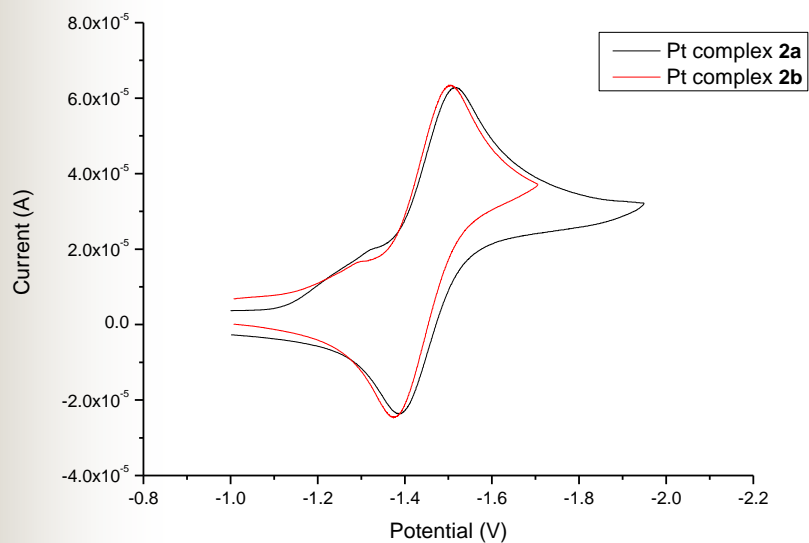




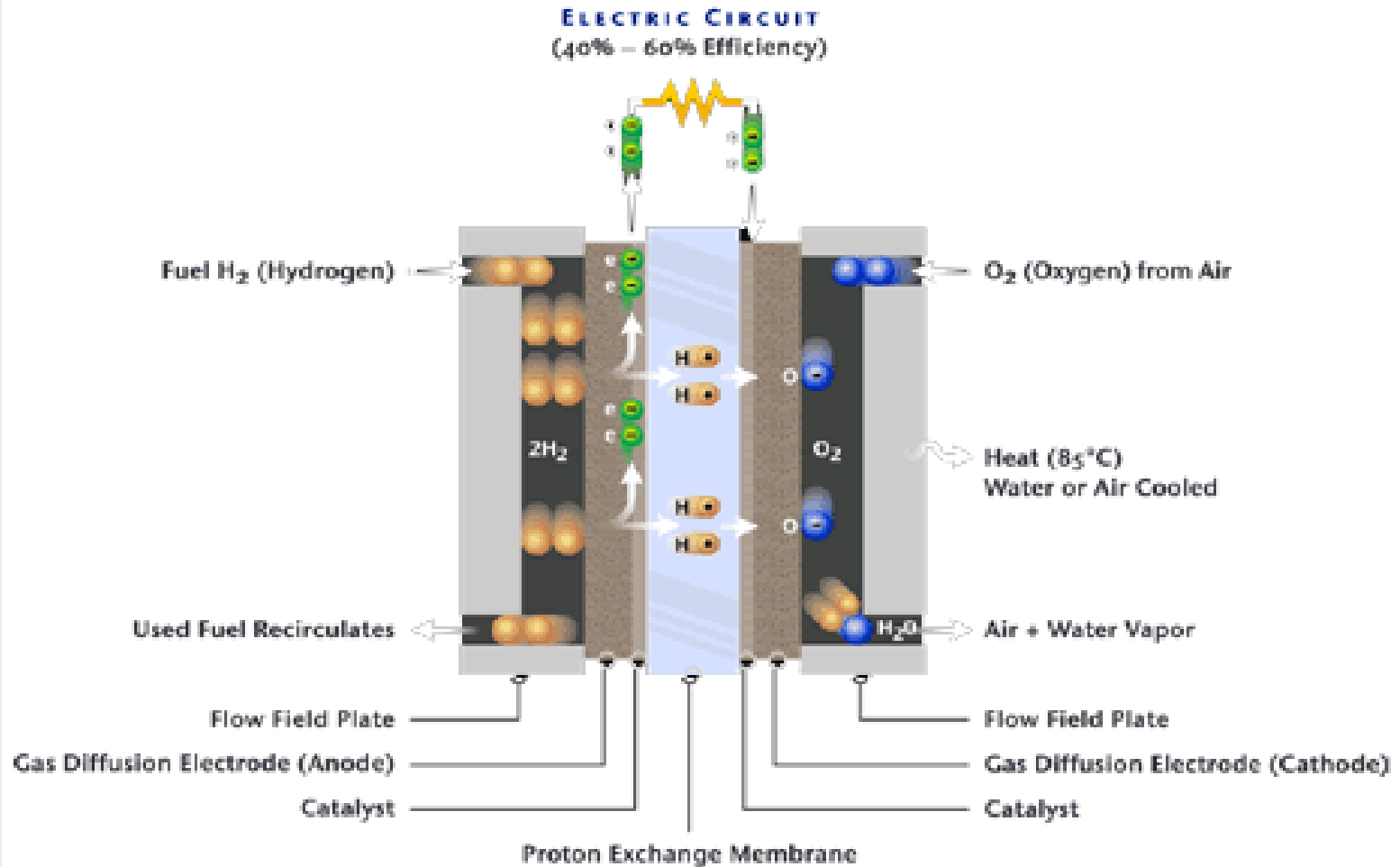
# Novel Dye For DSSC

- Novel ponytailed Dye for Solar Cell  
w/ good stability and lifetime.

# CV and UV/VIS Studies of Pt-based DSSC



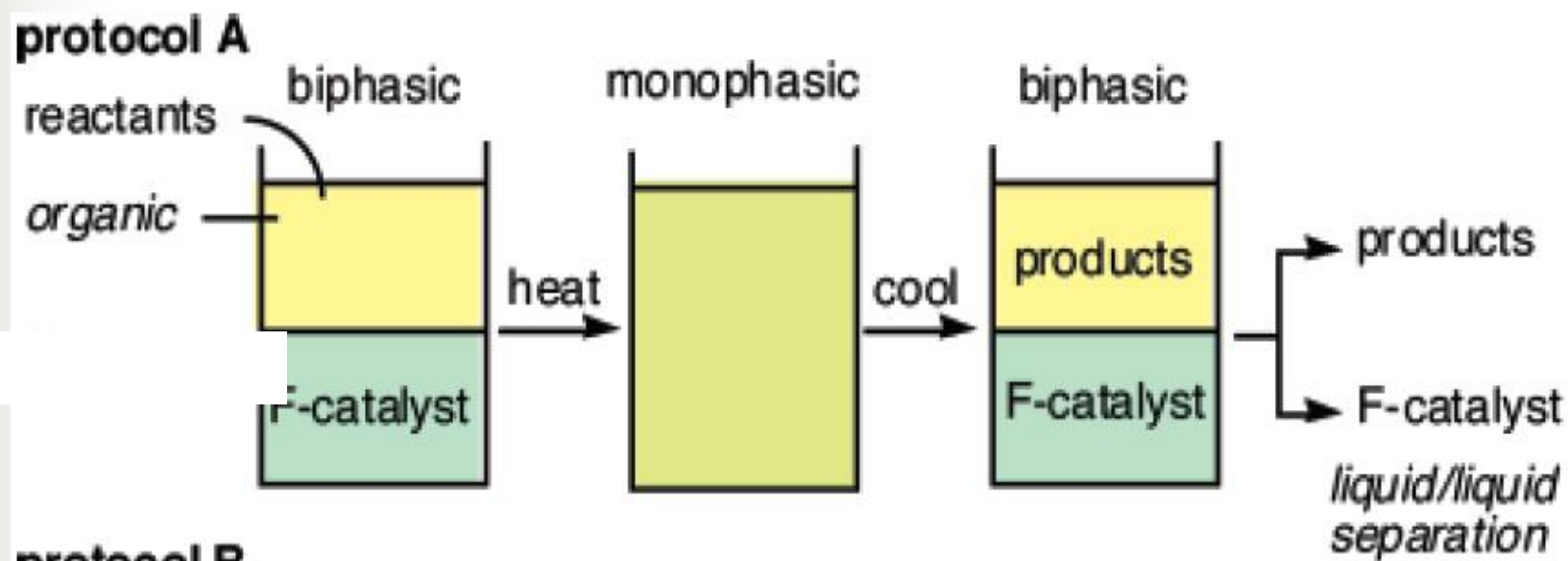
# Fuel Cell (Proton Exchange membrane)





# Green Chemistry

## 1. FBS: Fluorous biphasic system



## 2. Aerobic Alcohol Oxidation under FBS



**biphasic**

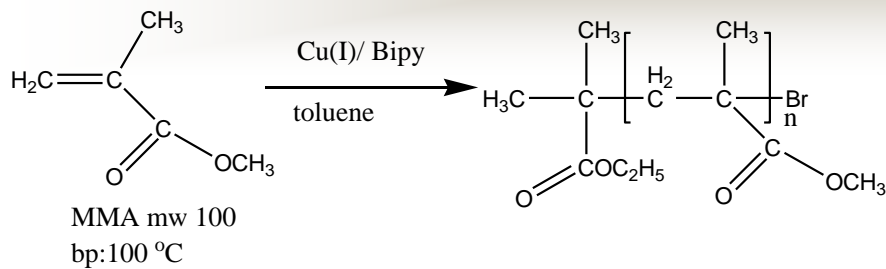


**monophasic**



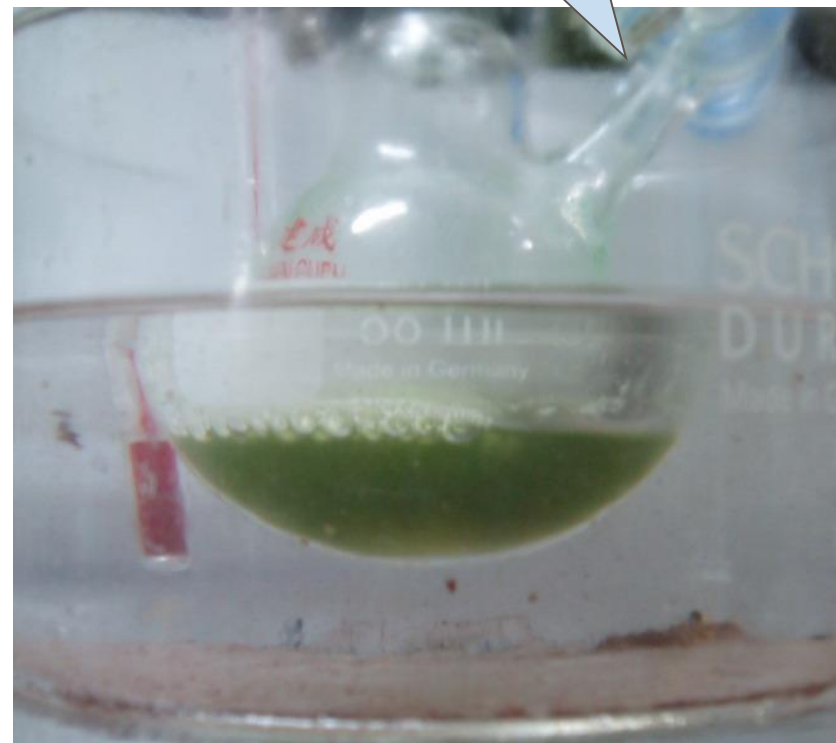
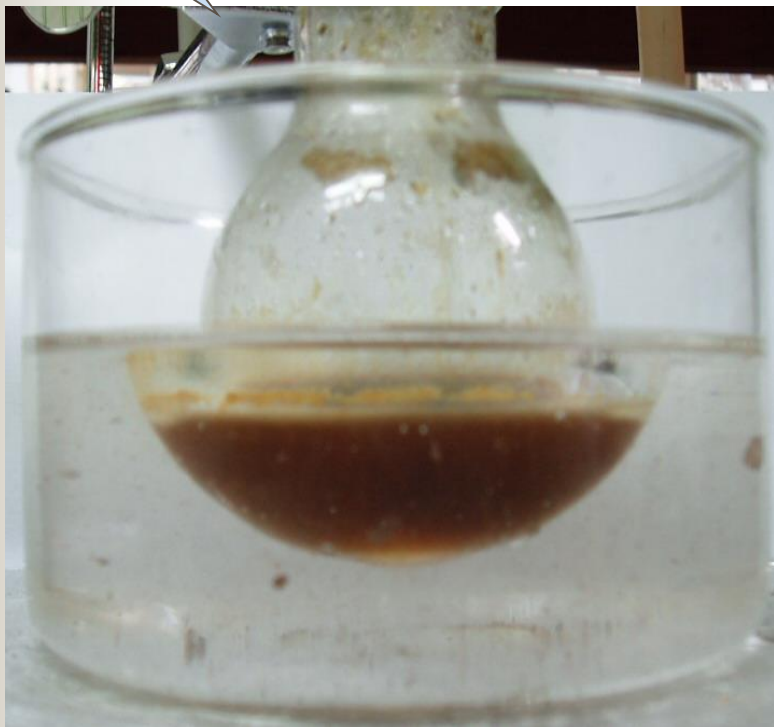
**biphasic**

# 3. ATRP (Cu recoverable)



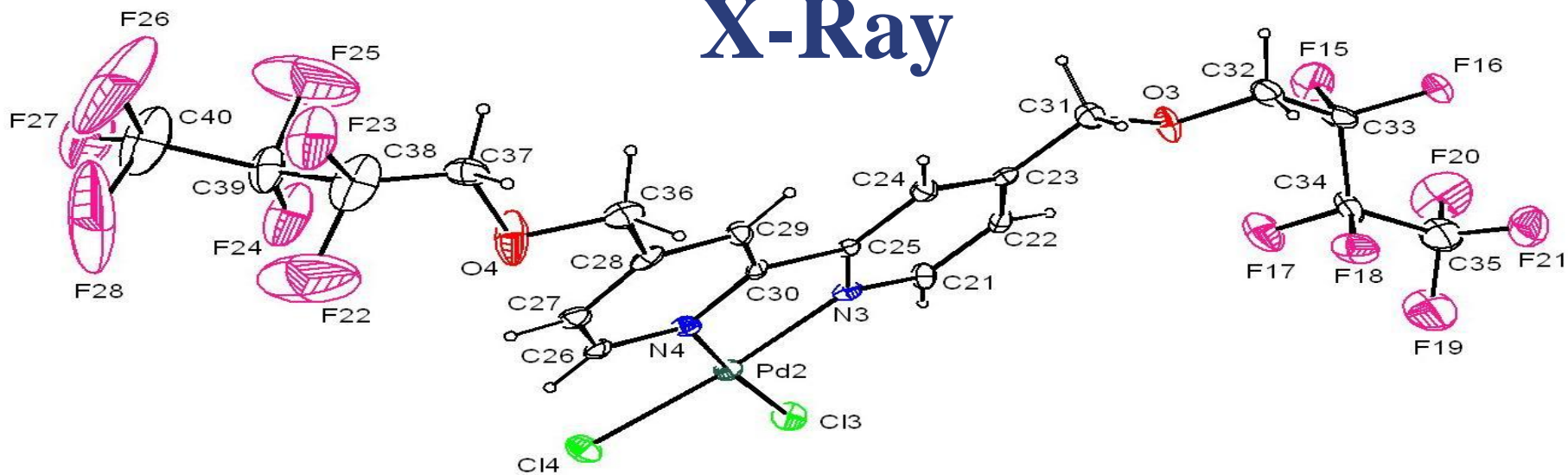
聚合反應  
進行

反應完成

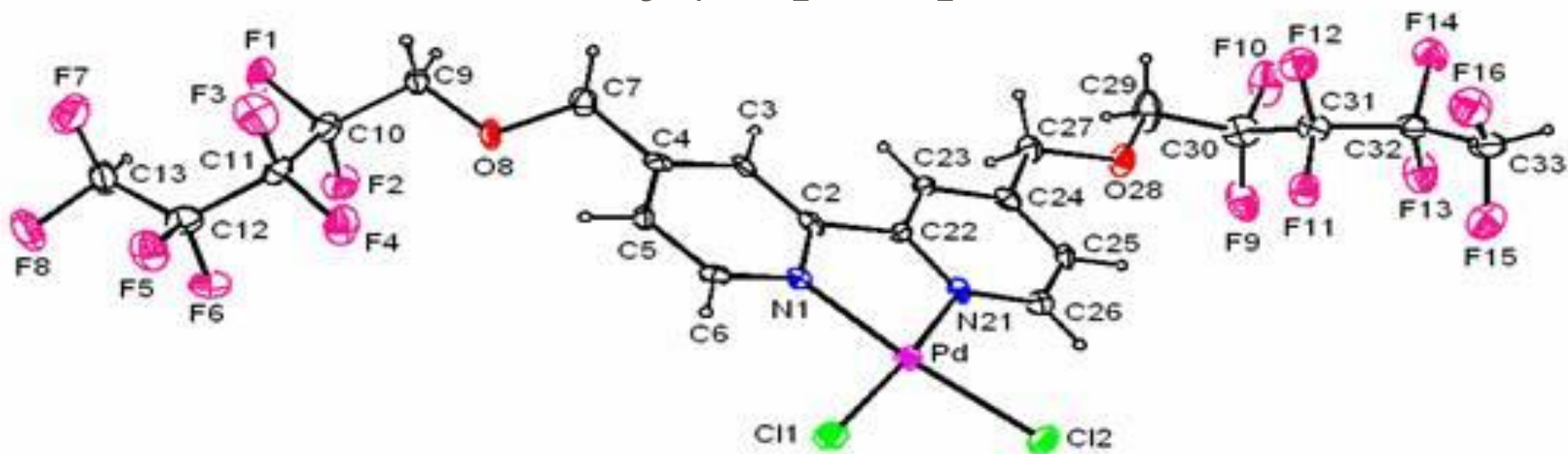




# X-Ray



[4,4'-bis(C<sub>3</sub>F<sub>7</sub>CH<sub>2</sub>OCH<sub>2</sub>)-2,2'-bpy]



[4,4'-bis(HC<sub>4</sub>F<sub>8</sub>CH<sub>2</sub>OCH<sub>2</sub>)-2,2'-bpy]



# Internship in the USA

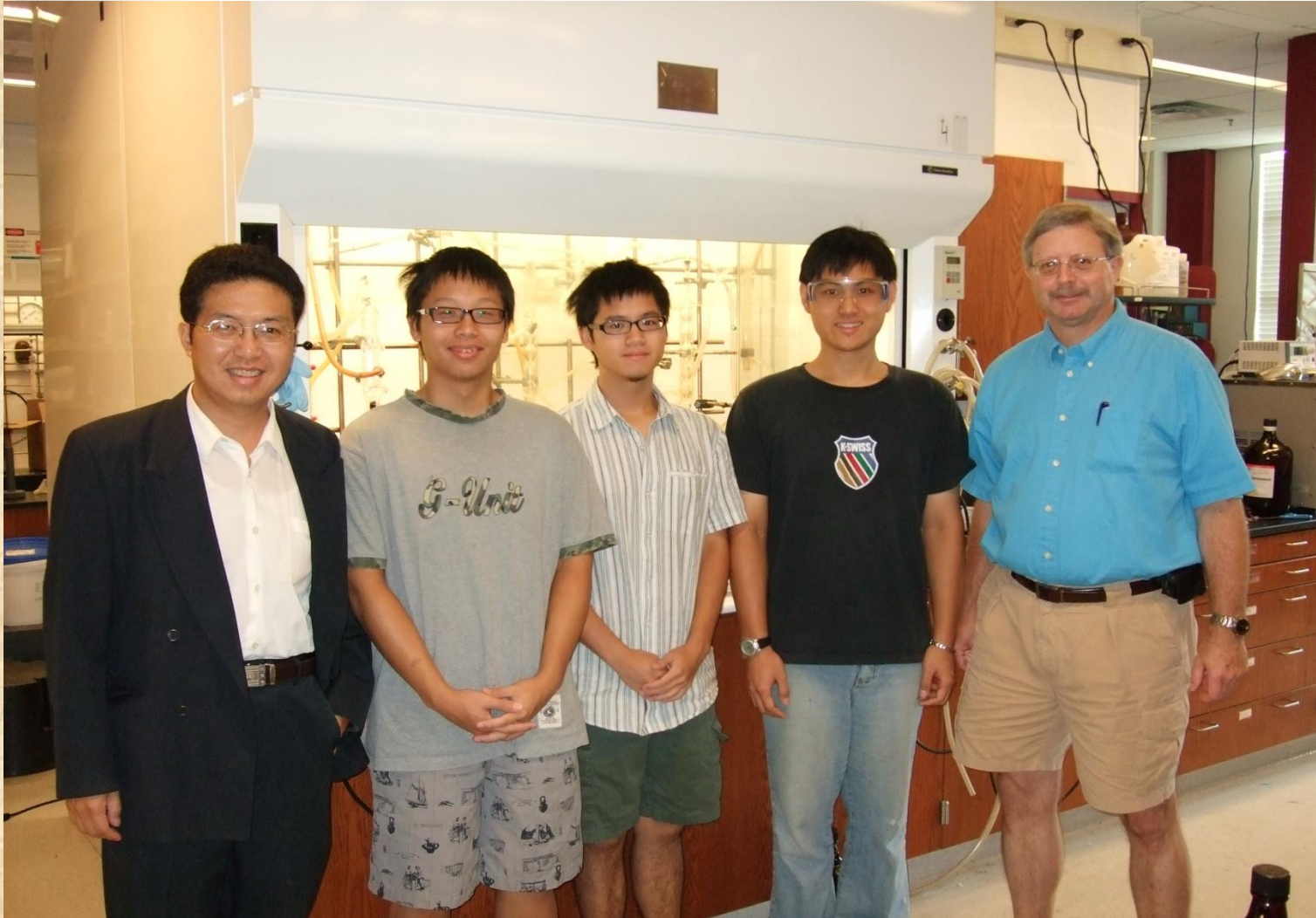
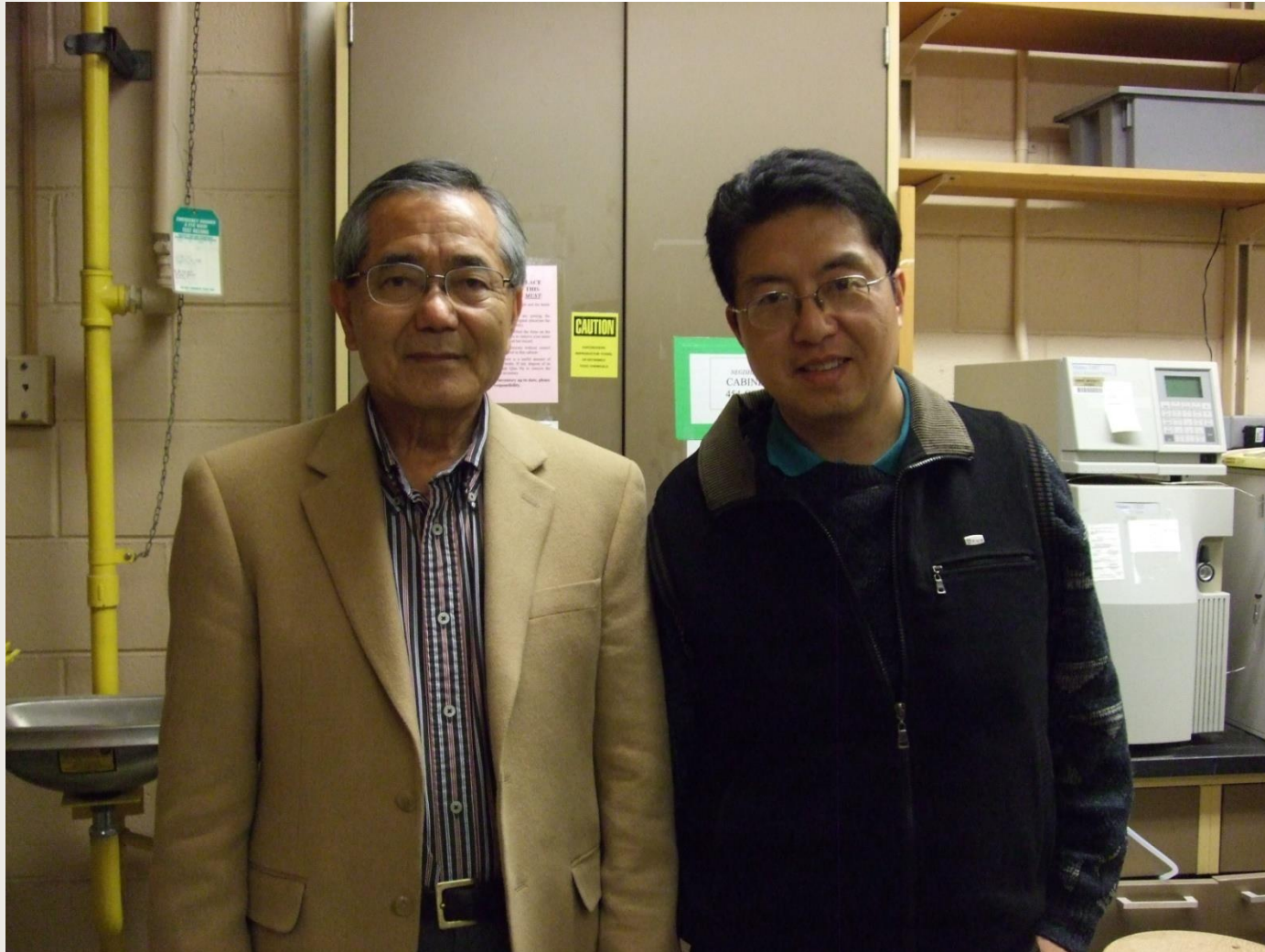


Photo with 2010 Nobel Laureate at Purdue Univ.





# Prof. Negishi's (Nobel Prize Winner) Symposium





# Prof. Negishi's Nobel Medal





# Departmental Seminar on May 18

## Host Speaker: Prof. Thrasher



# Attending International Meeting in Yokohama, Japan (2007)

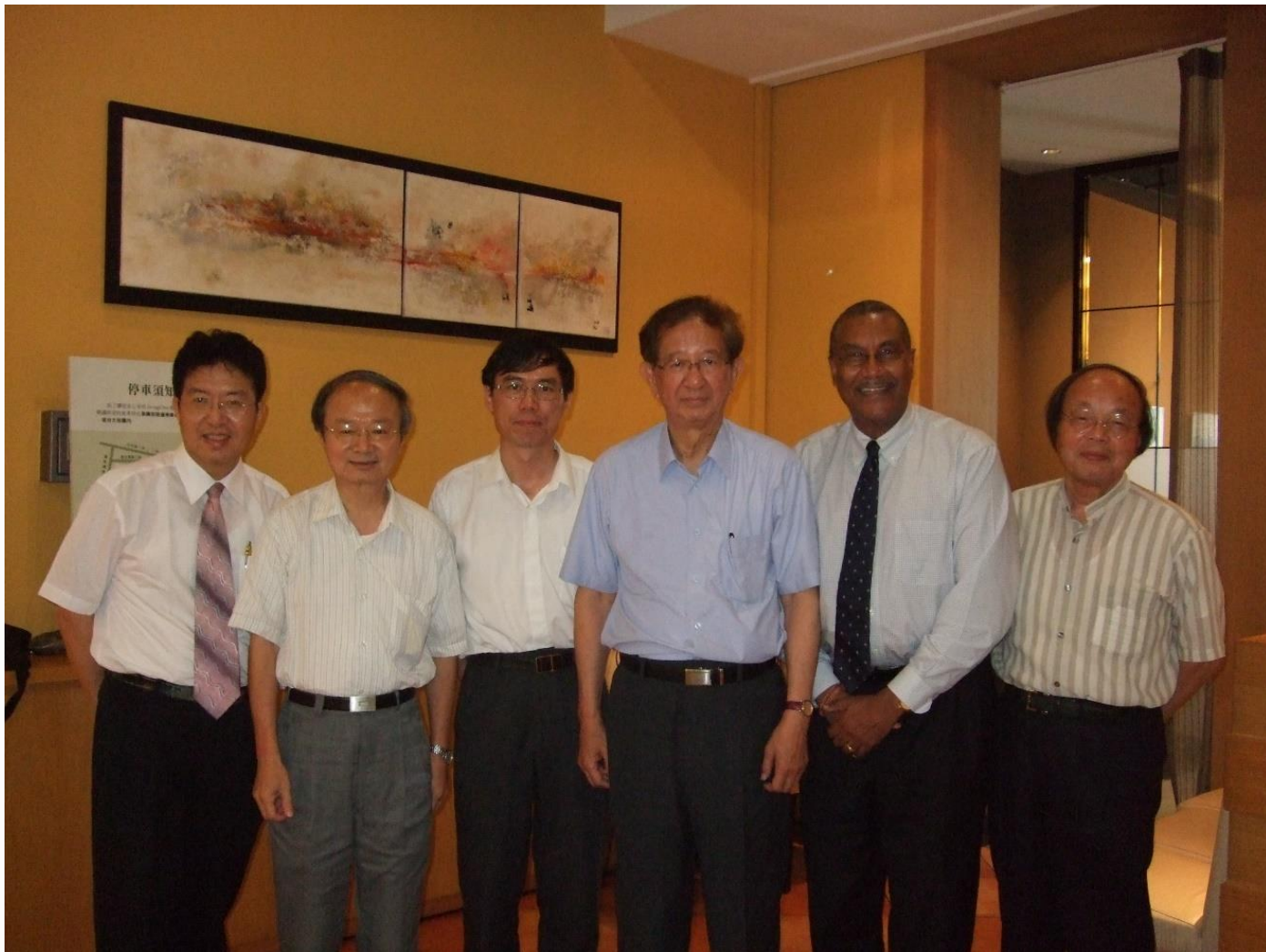




# Photo with Nobel Prize Winner, Prof. Grubbs



# 與李院士及Prof Francisco (美國院士)合影2016





# Farewell party to Prof. Francisco 2016



## Publications [期刊論文 (以北科大發表之英文期刊;自2005年起 >40 papers)]

1. **Norman Lu\***, Vijayanath Elakkat, Joseph S. Thrasher\*, Xiaoping Wang\*, Eskedar Tessema, Ka Long Chan, Rong-Jun Wei, Tarek Trabelsi, and Joseph S. Francisco\*, Neutron Diffraction Study of Significant sp<sup>3</sup> and sp<sup>2</sup> C–H Bond Shortening in a Fluorinated Pyridinium Saccharinate, *Journal of the American Chemical Society* 2021 143 (14), 5550-5557, DOI: 10.1021/jacs.1c02570
2. Eskedar Tessema, Vijayanath Elakkat, Chiao-Fan Chiu\*, Zong-Lin Tsai, Ka Long Chan, Chia-Rui Shen, **Norman Lu\***, Recoverable palladium-catalyzed carbon-carbon bond forming reactions under thermomorphic mode: Stille and Suzuki reactions, *Molecules* 2021, 26(5), 1414, DOI: 10.3390/molecules26051414
3. Eskedar Tessema, Vijayanath Elakkat, Chiao-Fan Chiu, Zong-Hung Cheng, Ka Long Chan, Chia-Rui Shen, Huan-cheng Chang, Peng Zhang\* and **Norman Lu\***, Recoverable phospho-Michael additions catalyzed by a DMAP.HSac adduct or a fluorous long-chained pyridine: Two types of reusable base catalysts, *Molecules* 2021, 26(4), 1159, DOI: 10.3390/molecules26041159
4. Chiao-Fan Chiu, Jinn-Hsuan Ho, Eskedar Tessema, Yijing Lu, Chia-Rui Shen, Chang-Wei Lin\* and **Norman Lu\***, Short-Chained Platinum Complex Catalyzed Hydrosilylation under Thermomorphic Conditions: Heterogeneous Phase Separation at Ice Temperature, *Molecules* 2021, 26(2), 378, DOI: 10.3390/molecules26020378
5. Dharmaraj Periyangounder, Tzu-Chiao Wei, Ting-You Li, Chun-Ho Lin, Théo Piechota Gonçalves, Hui-Chun Fu, Dung-Sheng Tsai, Jr-Jian Ke, Hung-Wei Kuo, Kuo-Wei Huang, **Norman Lu\***, Xiaosheng Fang\*, and Jr-Hau He\*, Fast-Response, Highly Air-Stable, and Water-Resistant Organic Photodetectors Based on a Single-Crystal Pt Complex”, *Advanced Materials*, 32(2), 1904634, DOI: 10.1002/adma.201904634
6. Nathaniel M. Barker, Yu-Xuan Li, Mandy M. Lee, Chia-Rui Shen, Jeanette A. Krause, Shih-Sheng Sun\*, **Norman Lu\***, William B. Connick\*, and David R. McMillin\*, Synthesis, Luminescence, and Structure of a Polymorphic Polyfluorinated Diiodoplatinum (II) Diimine Complex, *Inorganic chemistry*, 2019, 58(16), 10716–10724, DOI: 10.1021/acs.inorgchem.9b00669
7. Ling-Kang Liu\*, Tsao-Dong Wu, Yuh-Sheng Wen, Su-Ching Lin, Guei-Wei Lin, Yi-Chin Lin, Natashia Yang, and **Norman Lu\***, Novel (2,2'-Bipyridine)PtBr<sub>2</sub> Packing Polymorphic Form Produced in Chloroform–Ionic Liquid Dispersion, *Crystal Growth & Design* 2019 19 (2), 573-582, DOI: 10.1021/acs.cgd.8b00437
8. Vijayanath Elakkat, Chu-Chun Chang, Jun-Yu Chen, Yung-Cheng Fang, Chia-Rui Shen\*, Ling-Kung Liu and **Norman Lu\***, The first two examples of halogen bonding with a sigma hole-donating fluorine in the C<sub>sp</sub><sup>3</sup>-F···O<sub>sp</sub><sup>3</sup> interaction from polyfluorinated trans-dihalo-palladium(ii) di-substituted pyridine complexes, *Chemical communications*, 2019, 55, 15004-15004, DOI: 10.1039/C9CC90530H
9. **Norman Lu\***, Jing-Hung Zheng, Lei-Chin Lin, Ling-Kang Liu, Hsing-Fang Chiang, Ting-You Li, Yuh-Sheng Wen, Chung-Kuang Yang, Shih-Wen Chen, Joseph S. Thrasher, Studies of two different types of intramolecular C–H··· F–C interactions from polyfluorinated diiodometal (II) diimine complexes, *Journal of the Chinese Chemical Society*, Volume 66, Issue 1, Pages 31-40, DOI: 10.1002/jccs.201800161
10. **Norman Lu\***, Yi-Jing Lu, Jia-Yu Huang, Hsing-Fang Chiang, Chih-Chieh Kung, Yuh-Sheng Wen and Ling-Kang Liu, The Evolution Aspect in the Crystallization Process of [5,5'-(HCF<sub>2</sub>CF<sub>2</sub>CH<sub>2</sub>OCH<sub>2</sub>)<sub>2</sub>-2,2'-bpy]MX<sub>2</sub> (M = Pt, Pd; X = I, Br): Role of the Intramolecular CF<sub>2</sub>-H···X(-M) Hydrogen Bonds, *Journal of the Chinese Chemical Society*, Volume 65, Issue 5, Pages 613-627, DOI: 10.1002/jccs.201700365



## Publications [期刊論文 (以北科大發表之英文期刊;自2005年起 >40 papers)]

11. **Norman Lu\***, Chih-Chieh Kung, Jia-Yu Huang, Yu-Xuan Li, Chung-Kuang Yang, Yuh-Sheng Wen and Ling-Kang Liu\*, Hydrogen bonding and fluorine weak interactions in the non-isomorphous {4,4'-bis[(2,2,3,3-tetrafluoropropoxy)methyl]-2,2'-bipyridine- $\kappa$ 2N,N'}dibromidopalladium and platinum complexes, *Acta Cryst.* (2018). C74, 760-768, DOI: 10.1107/S2053229618005715
12. Kuo-Ting Wang, **Norman Lu\***, Chun-Wei Chu, Tsung-Yao Feng, Chih-Chieh Kung, Wen-Han Tu, Yun-Peng Yeh, Joseph S. Francisco\*, Robust sensitizer-assisted platinized titanium dioxide in photocatalytic removal of 4-chlorophenol in water: Light tunable sensitizer, *Journal of Photochemistry and Photobiology A: Chemistry*, 358 (2018) 100–110, DOI: 10.1016/j.jphotochem.2018.02.031
13. Ling-Kang Liu, Yi-Jing Lu, **Norman Lu\***, Ting-You Li, Jia-Yu Huang, Chia-Her Lin, Yuh-Sheng Wen, Colin D. McMillene, Joseph S. Thrasher\*\*, The (2,2'-bipyridine)PtII complex with 5,5'-modification of fluorine side chains: Orthogonal skeleton, *Journal of Fluorine Chemistry*, 206 (2018) 29–35, DOI: 10.1016/j.jfluchem.2017.12.002
14. **Norman Lu\***, Jing-Hung Zheng, Yi-Jing Lu, Hsing-Fang Chiang, Chun-Wei Chu, Joseph S. Thrasher\*, Yuh-Sheng Wen and Ling-Kang Liu\*, Side-chain conformations in the isomorphous polyfluorinated {4,4'-bis[(2,2-difluoroethoxy)methyl]-2,2'-bipyridine- $\kappa$ 2N,N'}dichloridopalladium and platinum complexes, *Acta Cryst.* (2017). C73, 930–936, DOI: 10.1107/S2053229617013857
15. **Norman Lu\***, Rong-Jyun Wei, Hsing-Fang Chiang, Joseph S. Thrasher, Yuh-Sheng Wen and Ling-Kang Liu, Weak hydrogen and halogen bonding in 4-[(2,2-difluoroethoxy)methyl] pyridinium iodide and 4-[(3-chloro-2,2,3,3-tetrafluoropropoxy)methyl] pyridinium iodide, *Acta Cryst.* (2017). C73, 682-687, DOI: 10.1107/S2053229617011172
16. **Norman Lu\***, Hsing-Fang Chiang, Rong-Jyun Wei, Yuh-Sheng Wen and Ling-Kang Liu\*, Molecular structures of 3-[(2,2,3,3-tetrafluoropropoxy)methyl]- and 3-[(2,2,3,3,3-pentafluoropropoxy)methyl] pyridinium saccharinates, *Acta Cryst.* (2017). C73, 593-599, DOI: 10.1107/S2053229617009512
17. **Norman Lu**,<sup>a</sup> Rong-Jyun Wei,<sup>a</sup> Kwan-Yu Lin,<sup>a</sup> Mani Alagesan,<sup>a</sup> Yuh-Sheng Wen,<sup>b</sup> Ling-Kang Liu<sup>a,b\*</sup>, Weak hydrogen bonding and fluorine interactions in the chloride and bromide salts of 4-[(2,2,3,3-tetrafluoropropoxy)methyl]pyridinium, *Cryst Acta section C* 2017, **C73**, 343–349.
18. **Norman Lu**,\* Wei-Cheng Chung, Hsing-Fang Chiang, Yung-Cheng Fang, and Ling-Kang Liu, “Dye Sensitized TiO<sub>2</sub>-Catalyzed Photodegradation of Sulfamethoxazole under Blue or Yellow Light” *Environmental Science and Pollution Research*, 2017, 24(1), pp. 489-499.
19. Shen-Ming Chen, Norman Lu\*, Jun-Yu Chen, Cheng-Yu Yang, Yun-Peng Yeh, Tsung-Yao Feng, Yang-hsin Shih, T. Kokulnathan, Dong Chen, “Enhanced photocatalytic degradation of atrazine by platinized titanium dioxide under 352 nm irradiation” *Water Science and Technology*, 2017, 75.5, 1128.-1137.
20. **Norman Lu\***, Shen-Ming Chen, Jun-Yu Chen, Cheng-Yu Yang, Yun-Peng Yeh, Tsung-Yao Feng, Yang-hsin Shih, T. Kokulnathan, Dong Chen, “Enhanced photocatalytic degradation of atrazine by platinized titanium dioxide under 352 nm irradiation” *Water Science and Technology* 2016. doi: 10.2166/wst.2016.593

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22. **Norman Lu**,\* Wei-Cheng Chung, Hsing-Fang Chiang, Yung-Cheng Fang, Ling-Kang Liu, “Recoverable platinum bis(fluoro-ponytailed) bipyridine complex as catalyst for hydrosilylation of alkynes under thermomorphic condition” *tetrahedron*, 72 (2016), 8508-8515.
23. **Norman Lu**\*, Yun-Peng Yeh, Guan-Bo Wang, Tsung-Yao Feng, Yang-hsin Shih\*, Dong Chen,\* “Dye Sensitized TiO<sub>2</sub>-Catalyzed Photodegradation of Sulfamethoxazole under Visible Light Environmental Science and Pollution Research” *Environmental Science and Pollution Research (ESPR)* Oct. 2016, accepted (on-line release; doi:10.1007/s11356-016-7815-6)
24. **Norman Lu**,\* Wei-Hsuan Chang, Rong-Jyun Wei, Yung-Cheng Fang, Tu-Wen Han, Guo-Quan Wang, Jia-Yaw Chang, Yuh-Sheng Wen, and Ling-Kang Liu; “Pyridinium Saccharinate Salts as Efficient Recyclable Acylation Catalyst: A New Bridge Between Heterogeneous and Homogeneous Catalysis” *Tetrahedron*, 72, 3468-3476, 2016.
25. **Norman Lu**,\* Wei-Cheng Chung, Rebecca M. Ley, Kwan-Yu Lin, Joseph S. Francisco (member of National Academy of Sciences), and Ei-ichi Negishi (2010 Nobel Prize Winner); “Molecularly Tuning the Radicaloid N-H...O=C Hydrogen Bond”, *J. Phys. Chem. A*, 2016, 120 (8), 1307-1315.
26. Qinglong Jiang, Yun-Peng Yeh, **Norman Lu**,\* Hung-Wei Kuo, Michael Lesslie, and Tao Xu, “The influence of fluoroalkyl chains in redox electrolytes for energy conversion” *Journal of Renewable and Sustainable Energy*, **2016**, 8, 013701
27. **Norman Lu**,\*†, ‡ Rebecca. M. Ley,† Charles E. Cotton,† Joseph S. Francisco\*†,§ and Ei-ichi Negishi\*† “Molecular Tuning of the C-H...F-C Hydrogen Bond”
28. **Norman Lu**,\* Yu-Meng Ou, Tsung-Yao Feng, Wei-Jen Cheng, Wen-Han Tu, Han-Chang Su, Xiao Wang, Liu Liu, Matthew D. Hennek, Todd S. Saylor, and Joseph S. Thrasher,\* “Synthesis and characterization of Polyfluorinated 2,2'-bipyridines and Their Palladium and Platinum Complexes, [MX<sub>2</sub>(bis(R<sub>f</sub>CH<sub>2</sub>OCH<sub>2</sub>)-2,2'-bpy)] (X=Cl, Br)” *J. Fluorine Chem* **2011** submitted (2012 on line release on March 6, 12'; 10.1016/j.jfluchem.2012.02.009)
29. Jen-Chieh Hsu, Chih-Ching Huang, Keng-Liang Ou, **Norman Lu**, Fu-Der Mai, Jem-Kun Chen and Jia-Yaw Chang,\* “Silica nanohybrids integrated with CuInS<sub>2</sub>/ZnS quantum dots and magnetite nanocrystals: multifunctional agents for dual-modality imaging and drug delivery” *J. Mater. Chem.*, 2011, **21**, 19257-19266
30. Chieh-Keng Li, Ajay Ghalwadkar, **Norman Lu**\*, “Cationic Palladium Complex-catalyzed Heck Reaction Under Thermomorphic Mode” *J. Organomet. Chem.***2011**, **696** (2011) 3637-3642



# Publications [期刊論文 (以北科大發表之英文期刊;自2005年起 >40 papers)]

31. Tzu Ting Chang, Shivaji V. More, **Norman Lu\***, Jyun-Wei Jhuo, Yi-Chuan Chen, Shu-Chuan Jao, Wen-Shan Li\*, “Polyfluorinated bipyridine cisplatin manipulate cytotoxicity through the induction of S-G<sub>2</sub>/M arrest and partial intercalation mechanism”, *Bioorganic & Medicinal Chemistry* 19 (2011) 4887–4894
32. **Norman Lu\***, Wei-Hsuan Chang, Wen-Han Tu, and Chieh-Keng Li, A Salt Made of 4-N,N-Dimethylaminopyridine (DMAP) and Saccharin as an Efficient Recyclable Acylation Catalyst: New Bridge Between Heterogeneous and Homogeneous Catalysis; *ChemComm* **2011**, 47 (25), 7227- 7229 (DOI: 10.1039/c1cc11556a) (NSC 98-2113-M-027-002-MY3)
33. **Norman Lu\***, Wen-Han Tu, Hsuan-Wei Chang, Zong-Wei Wu and Han-Chang Su, 5,5'-Bis(2,2,2-trifluoroethoxymethyl)-2,2'-bipyridine, *Acta Crystallographica Section E*, E67, o355–o356 **2011**. (NSC 98-2113-M-027-002-MY3)
34. **Norman Lu\***, Jia-Sheng Shing, Wen-Han Tu Ying-Chan Hsu and Jiann T. Lin,\* Amphiphilic Heteroleptical Ru-based Complexes for Dye-sensitized Solar Cell: The First Fluorous Bis-ponytailed Amphiphilic Ru Complexes” *Inorganic Chem* **2011**, 50(10), 4289-4294.(NSC 98-2113-M-027-002-MY3)
35. **Norman Lu\***, Wen-Han Tu, Jia-Sheng Shing,<sup>a</sup> Yuh-Sheng Wen and Ling-Kang Liu “New Type of Saccharinate Crystals: A Possible Supramolecular Synthone”, *Journal of Molecular Structure* 980 (**2010**) 101-107. (NSC 98-2113-M-027-002-MY3).
36. **Norman Lu\***, Wen-Han Tu, Zong-Wei Wu, Yuh-Sheng Wen and Ling-Kang Liu, “4,4'-Bis(2,2,2-trifluoroethoxymethyl)-2,2'-bipyridine”, *Acta Crystallographica Section C* **2010**, 66, o289-o291 (NSC 98-2113-M-027-002-MY3)
37. **Norman Lu\***, Ling-Kang Liu, Jia-Yu Huang, Hsing-Fang Chiang, Jun-Yu Chen, Ting-You Li, Yuh-Sheng Wen. “Structural Chemistry of Fluorinated Metal-bipyridine Complexes [5,5'-bis(HCF<sub>2</sub>CF<sub>2</sub>CF<sub>2</sub>CH<sub>2</sub>OCH<sub>2</sub>)-2,2'-bpy-k<sub>2</sub>N]MI<sub>2</sub>(M = Pd, Pt)” *J. Molecul. Structure* 2016. (submitted)
38. **Lu, Norman\***; Feng, Tsung-Yao ; Kung, Chih-Chieh; Tu, Wen-Han; Yeh, Yun-Peng; Francisco, Joseph S. "Durable Dye-Sensitized Photocatalytic Oxidation of 4- Chlorophenol Over Platinized Titanium Dioxide in Water Under Visible Light Irradiation: Tuning of Light Wavelength" *J. Phys. Chem. A*, 2016, (revised).
39. **Norman Lu\***, Chieh-Keng Li, Kwan-Yu Lin, Yun-Peng Yeh, and Chih-Chieh Kung, “Microwave-assisted, Recoverable Palladium-catalyzed Heck/Sonogashira Reaction in Thermomorphic Condition” *Journal of Chinese Chemical Society* 2015.
40. **Norman Lu\***, Kwan-Yu Lin, Chih-Chieh Kung, Jyun-Wei Jhuo, Yingjie Zhou and Luyi Sun,\* “Intercalated Polyfluorinated Pd Complexes in a-Zirconium Phosphate for Sonogashira Reactions”, *RSC Adv.*, 2014, 4 (52), 27329 – 27336.

# Publications [期刊論文 (以北科大發表之英文期刊;自2005年起 >40 papers)]

41. **Norman Lu,\*** Lauren M. Hight, David R. McMillin,\* Jyun-Wei Jhuo, Wei-Cheng Chung, Kwan-Yu Lin, Yuh-Sheng Wen and Ling-Kang Liu\* "Structure and Emission Studies of Dimorphic Crystals of [PtBr<sub>2</sub>(5,5'-bis(CF<sub>3</sub>CH<sub>2</sub>OCH<sub>2</sub>)-2,2'-bpy)](1): The First Linear-chain Structure of Dibromoplatinum(II) Diimine Complex" *Dalton* 2014, 43, 2112–2119.
42. "Molecular Tuning of the Closed Shell C-H...F-C Hydrogen Bond" **Lu, Norman\***; Ley, Rebecca M.; Cotton, E. Charles; Chung, Wei-Cheng; Francisco, Joseph S.; Negishi, Ei-ichi, *The Journal of Physical Chemistry A*, (2013), 117(34), 8256-8262.
43. "Selective photoreduction of CO<sub>2</sub> to CO in CO<sub>2</sub>-dissolved expanded liquid phase with heterogeneous CO<sub>2</sub>-philic Pd complex catalysts" R. Liu; H. Yoshida; S. Fujita; **Norman Lu\***; W.-H. Tu; Masahiko Arai; *Journal of Applied Catalysis A: General* 455 (2013) 32– 38.
44. "Targeting to overexpressed glucose-regulated protein 78 in gastric cancer discovered by 2D DIGE improves the diagnostic and therapeutic efficacy of micelles-mediated system" Cheng, Chun-Chia; **Lu, Norman (equally contributed)**; Peng, Cheng-Liang; Chang, Chun-Chao; Mai, Fu-Der; Chen, Ling-Yun; Liao, Mei-Hsiu; Wang, Wen-Ming; Chang, Jungshan; *Proteomics* (2012), 12(15-16), 2584-2597.
45. "Recyclable catalysts for esterification or acylation of alcohols" By **Lu, Norman**; Tu, Wen-Han; Li, Chieh-Keng From U.S. Pat. Appl. Publ. (2012), US 20120184748 A1 20120719.
46. **Norman Lu,\*** His Chun Hou, Chien-Ting Lin, Chien-Keng Li, and Ling-Kang Liu "Synthesis, Structure and Spectroelectrochemical Property of Novel Metal (M= Pt, Pd) dichloride-2,2'-bipyridine with 4,4'-Bis(fluorous-ponytail)", **2010**, 29(3), *Polyhedron* **2010**, 29,1123-1129. (NSC 98-2113-M-027-002-MY3)
47. Yao-Yi Cheng\*, Ynh-Yue Yen, Peng-Hsiang Kao, **Norman Lu** and Hsin-Ta Wang, "Preparation and Properties of Chloroprene Rubber (CR)/Clay Nanocomposites" *Polymers & Polymer Composites* **2010**, 18(1), 17-21.(NSC 98-2113-M-027-002-MY3)
48. **Norman Lu,\*** Wen-Han Tu, Yuh-Sheng Wen, Ling-Kang Liu, Chun-Yi Chou, Jyh-Chiang Jiang, "The Intramolecular C-H...F-C Hydrogen Bond: Crystal Structure of [4,4'-bis(HCF<sub>2</sub>CF<sub>2</sub>CF<sub>2</sub>CF<sub>2</sub>CH<sub>2</sub>OCH<sub>2</sub>)-2,2'-bpy]MCl<sub>2</sub> Where M= Pt, Pd", *CrystEngComm*, **2010**, 12, 538 - 542 (NSC 96-2113-M-027-004-MY2)
49. Y. Akiyama, S. Fujita, X. Meng, Y.-C. Chen, **N. Lu,\*** F. Zhao and M. Arai \*, "Carbon Dioxide Pressure Tunable Heterogeneous and Homogeneous Media for Heck and Sonogashira Coupling Reactions Using Fluorinated Palladium Complex Catalysts" *J. Supercrit. Fluids*. **2009**, 51(2), 209-216 (NSC 96-2113-M-027-004-MY2)
50. **Norman Lu,\*** Yi-Chuan Chen, Wei-Shung Chen, Ter-Lin Chen, Sy-Juen Wu "Copper-free Sonogashira Reaction under Thermomorphic Mode", **2009**, *J. Organomet. Chem.*, 694 (2), 278-284 (NSC 96-2113-M-027-004-MY2)

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42. "Molecular Tuning of the Closed Shell C-H...F-C Hydrogen Bond" **Lu, Norman\***; Ley, Rebecca M.; Cotton, E. Charles; Chung, Wei-Cheng; Francisco, Joseph S.; Negishi, Ei-ichi, *The Journal of Physical Chemistry A*, (2013), 117(34), 8256-8262.
43. "Selective photoreduction of CO<sub>2</sub> to CO in CO<sub>2</sub>-dissolved expanded liquid phase with heterogeneous CO<sub>2</sub>-philic Pd complex catalysts" R. Liu; H. Yoshida; S. Fujita; **Norman Lu\***; W.-H. Tu; Masahiko Arai; *Journal of Applied Catalysis A: General* 455 (2013) 32– 38.
44. "Targeting to overexpressed glucose-regulated protein 78 in gastric cancer discovered by 2D DIGE improves the diagnostic and therapeutic efficacy of micelles-mediated system" Cheng, Chun-Chia; **Lu, Norman (equally contributed)**; Peng, Cheng-Liang; Chang, Chun-Chao; Mai, Fu-Der; Chen, Ling-Yun; Liao, Mei-Hsiu; Wang, Wen-Ming; Chang, Jungshan; *Proteomics* (2012), 12(15-16), 2584-2597.
45. "Recyclable catalysts for esterification or acylation of alcohols" By **Lu, Norman**; Tu, Wen-Han; Li, Chieh-Keng From U.S. Pat. Appl. Publ. (2012), US 20120184748 A1 20120719.
46. **Norman Lu,\*** His Chun Hou, Chien-Ting Lin, Chien-Keng Li, and Ling-Kang Liu "Synthesis, Structure and Spectroelectrochemical Property of Novel Metal (M= Pt, Pd) dichloride-2,2'-bipyridine with 4,4'-Bis(fluorous-ponytail)", **2010**, 29(3), *Polyhedron* **2010**, 29,1123-1129. (NSC 98-2113-M-027-002-MY3)
47. Yao-Yi Cheng\*, Ynh-Yue Yen, Peng-Hsiang Kao, **Norman Lu** and Hsin-Ta Wang, "Preparation and Properties of Chloroprene Rubber (CR)/Clay Nanocomposites" *Polymers & Polymer Composites* **2010**, 18(1), 17-21.(NSC 98-2113-M-027-002-MY3)
48. **Norman Lu,\*** Wen-Han Tu, Yuh-Sheng Wen, Ling-Kang Liu, Chun-Yi Chou, Jyh-Chiang Jiang, "The Intramolecular C-H...F-C Hydrogen Bond: Crystal Structure of [4,4'-bis(HCF<sub>2</sub>CF<sub>2</sub>CF<sub>2</sub>CF<sub>2</sub>CH<sub>2</sub>OCH<sub>2</sub>)-2,2'-bpy]MCl<sub>2</sub> Where M= Pt, Pd", *CrystEngComm*, **2010**, 12, 538 - 542 (NSC 96-2113-M-027-004-MY2)
49. Y. Akiyama, S. Fujita, X. Meng, Y.-C. Chen, **N. Lu,\*** F. Zhao and M. Arai \*, "Carbon Dioxide Pressure Tunable Heterogeneous and Homogeneous Media for Heck and Sonogashira Coupling Reactions Using Fluorinated Palladium Complex Catalysts" *J. Supercrit. Fluids*. **2009**, 51(2), 209-216 (NSC 96-2113-M-027-004-MY2)
50. **Norman Lu,\*** Yi-Chuan Chen, Wei-Shung Chen, Ter-Lin Chen, Sy-Juen Wu "Copper-free Sonogashira Reaction under Thermomorphic Mode", **2009**, *J. Organomet. Chem.*, 694 (2), 278-284 (NSC 96-2113-M-027-004-MY2)




## Publications [期刊論文 (以北科大發表之英文期刊;自2005年起 >40 papers)]

51. **Norman Lu**,\* Ching-Lung Lin and Tsung-Chi Chen, “New Fluorous Bipyridine Ligands for Cu-catalyzed Atom Transfer Radical Polymerization of Methyl Methacrylate in the Thermomorphic Mode” *J. of Applied Polymer Science*, **2008**, 110 (5), 2531-3303; (NSC 96-2113-M-027-004-MY2)
52. **Norman Lu**,\* Shih-Chieh Chen, Tsung-Chi Chen and Ling-Kang Liu, “Pd-catalyzed Heck Reaction under Thermomorphic Mode” *Tetrahedron Letters* **2008**, 49, 371-375; (NSC 96-2113-M-027-004-MY2)
53. **Norman Lu**,\* Shih-Chieh Chen, Yan-Chou Lin, Y.Y. Cheng and Ling-Kang Liu\* "High Fluorine Content Bis(fluoro-ponytailed) Bipyridine Palladium Complexes as Catalyst for Mizoroki-Heck Reactions under Fluorous Biphasic Catalysis Conditions" *J. Chin. Chem. Soc.* **2008**, 55(1), 89-96; (NSC 95-2113-M-027-002)
54. **Norman Lu**,\* Yan-Chou Lin, “Efficient, Recoverable, Copper-catalyzed Aerobic Oxidation of Alcohols under FBS and Thermomorphic Mode” *Tetrahedron Lett* **2007**, 48, 8823-8828; (NSC 95-2113-M-027-002) (96-2113-M-027-004-MY2)
55. **Norman Lu**,\* Jeng-Yung Chen, Chi-Wen Fan, Yan-Chou Lin, Yuh-Sheng Wen, and Ling-Kang Liu\*; “Synthesis, Structure and Reactivity of Novel Palladiumdichloride-2,2'-bipyridine with 4,4'-Bis(fluorous-ponytail)” *Polyhedron* **2007**, 26, 3045-3053; (NSC 93-2113-M-027-005)
56. **Norman Lu**,\* Yu-Mei Ho, Chi-Wen Fan, Fu-Ming Wang and Jyh-Tsung Lee,\* “A Simple Method for Synthesizing Polymeric Lithium Salts Exhibiting Relatively High Cationic Transference Number for Solid Polymer Electrolytes” *Solid State Ionics* **2007**, 178, 347-353; (NSC 93-2113-M-027-005) & (NSC 94-2113-M-027-003)



# International Meeting

- 1. “Fluorous Catalysis of Pd-catalyzed Heck Reaction under Thermomorphic Condition without Fluorous Solvents: Facile Liquid/Solid Pd Catalyst Separation at RT” The 2nd International Symposium on Fluorous Technologies (ISoFT07), Yokohama, Japan, July 29-Aug.1, 2007. (oral); (NSC 95-2113-M-027-002)
- 2. “High Fluorine Content Bis(fluoro-ponytailed) Bipyridine Ligands for Pd-catalyzed Mizoroki-Heck Reactions under Fluorous Biphasic Catalysis Conditions” The 2nd International Symposium on Fluorous Technologies (ISoFT07), Yokohama, Japan, July 29-Aug.1, 2007. (poster); (NSC 95-2113-M-027-002)
- “The study of using novel Cu complexes with fluoro-ponytailed bipyridine for the ATRP under thermomorphic mode” The 2nd International Symposium on Fluorous Technologies (ISoFT07), Yokohama, Japan, July 29-Aug.1, 2007. (poster); (NSC 95-2113-M-027-002)
- 4. “New Bis(fluoro-ponytailed) Bipyridine Ligands for the Pd-catalyzed Heck-type Reactions under Fluorous Biphasic and Thermophoric Conditions” The 2nd International Symposium on Fluorous Technologies (ISoFT07), Yokohama, Japan, July 29-Aug.1, 2007 (poster); (NSC 95-2113-M-027-002)
- 5. “Copper-catalyzed aerobic oxidation of alcohol under FBS and thermomorphic system” The 2nd International Symposium on Fluorous Technologies (ISoFT07), Yokohama, Japan, July 29-Aug.1, 2007. (poster); (NSC 95-2113-M-027-002)

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- 6. “New Bis(fluoro-ponytailed) Bipyridine Ligands for the Pd-catalyzed Heck Reactions under Fluorous Biphasic Catalysis Condition” The 18th Winter Fluorine Conference (oral), St. Pete, FL, USA, Jan 14-20, 2007 (NSC 95-2113-M-027-002)
  - 7. “New Bis(fluoro-ponytailed) Bipyridine Ligands for the Cu-catalyzed Aerobic Oxidation of Alcohols under Homogeneous or Fluorous Biphasic System” The 18th Winter Fluorine Conference (poster), St. Pete, FL, USA, Jan 14-20, 2007 (NSC 95-2113-M-027-002)
  - 8. ‘Synthesis, Structure and Reactivity of PdCl<sub>2</sub>[4,4'-Bis-RfCH<sub>2</sub>OCH<sub>2</sub>-2,2'-bpy] (Rf= C<sub>3</sub>F<sub>7</sub>, HC<sub>4</sub>F<sub>8</sub>, HC<sub>8</sub>F<sub>16</sub> and C<sub>10</sub>F<sub>21</sub>)” The 18th ISFC- International Symposium on Fluorine Chemistry (Bremen, Germany, July 30- Aug.4, 2006) 國科會計畫編號 NSC 94-2113-M-027-003
  - 9. “Using  $\alpha,\omega$ -Perfluoroalkane Bis-sulfonyl Fluorides (FSO<sub>2</sub>C<sub>4</sub>F<sub>8</sub>SO<sub>2</sub>F, FSO<sub>2</sub>C<sub>6</sub>F<sub>12</sub>SO<sub>2</sub>F) as monomers And The Application of Their Condensation Polymers For Solid Lithium Battery Electrolyte” the 17th International Symposium on Fluorine Chemistry (July 24-29, 2005) 國科會計畫編號 NSC 93-2113-M-027-005
  - 10. Departmental Seminar “Two Industrial Applications of Fluoropolymers: Perfluoropolyalkylethers and Lithium Battery Electrolytes” Univ. of Alabama, USA, Feb. 1, 2005.



# 榮譽獎項及其他

- 榮獲國立台北科技大學工程學院98年度傑出研究獎，及四十萬元獎金。
- 2011.1升教授。
- 指導研究生學生林原週、陳宗琦及陳世傑投稿國際會議 (The 2nd International Symposium of Fluorous Technology; ISoFT )被接受；且每位學生獲得國科會3萬元之補助，去參與會議。
- 獲補助(海外)美國實習: 江幸芳, 方勇程及陳俊宇
- 郭鴻偉、黃佳愉、李廷佑、陳禹彤、龔智捷、林冠宇、卓均蔚、蘇郁麒、歐育孟、馮宗堯、鄭緯仁 等



# Invitation

- You are cordially invited to join this group for the cutting-edge research.