國立臺東大學理工學院
應用科學系
2021 學生學習成果競賽

大會手冊

贊助單位

三雄科技
SYSTEM LAB

實驗室周邊及無塵室整體規劃設計製作實驗桌:中央實驗桌、靠邊實驗桌、天平桌排煙櫃:PP 或 PVC 排煙櫃 PLC 程式門控系統藥品櫃:抽氣式藥品櫃 淨氣型藥品櫃、防爆型有機儲存櫃特殊氣體配管公安設備:安全器材箱、緊急淋浴洗眼器。

目錄

(A 組)應用科學系物理組學士班

無機鹵化物零維/三維複合鈣鈦礦量子點

吳沁霖、黃書瀚、蘇微雅

E-mail：gg0925409718@gmail.com

Keywords:perovskite;Zero-dimensional;Cs_4PbBr_6;quantum dots

近十年來鹵化鈣鈦礦在各大光電領域都得以有相當良好的表現，雖然鈣鈦礦在許多方面仍有著許多需要改善的地方，如:水氧穩定性不足、熱穩定性不好，以及壽命不長，但是仍有許多研究得以讓鈣鈦礦在這些地方得到一定的突破，而這次的研究內容就是從改善其壽命。

鈣鈦礦量子點是鈣鈦礦最廣為使用的一種材料，大多使用熱注入法進行合成，但是由於熱注入法需要相對嚴苛的合成環境，並且合成過程較為複雜，所以這次我們的研究提供了一個較為簡易的一鍋合成法，讓我們這個實驗得以獲得非常好的再現性，因為合成過程容易，又相對不易受到水氧影響，所以成功率跟再現性都相當良好，並且也可以有著非常好的光激量子產率，因此我們開始著手對這個材料的研究。

本研究對該材料進行了多種不同的分析，將其成果使用 3 毫安紫外光激發 Cs_4PbBr_6 零維鈣鈦礦量子點，可得最大強度為 32000，其 PL 峰值為 514nm，半高寬為 21nm，該材料吸收波長座落在 314nm；測得粒徑大小約為 10nm，並成功驗證了這個材料的主要發光波段是來自三維的鈣鈦礦，且該三維鈣鈦礦鑲嵌在零維的鈣鈦礦之中，所以該複合鈣鈦礦量子點不容易出現團聚的現象，也因為不容易出現團聚現象所以更延長了這個材料的壽命，延長了該材料壽命才可以使這個材料更應用於各種不同的光電領域，並且可以適應更多不同的環境。

$PbBr_2$+Cs_2CO_3+OA+OLA+ODE → 反應中 → 反應後 Cs_4PbBr_6 粉末 分散於己烷中 Cs_4PbBr_6

References:

1. Mondal, N.; Samanta, A. Complete Ultrafast Charge Carrier Dynamics in Photo-excited All-Inorganic Perovskite Nanocrystals (CsPbX3). Nanoscale 2017, 9, 1878−1885.
2. Zhang Y; Saidaminov, M. I; Dursun I; Yang H;Murali B; Alarousu E; Yengel E; Alshankiti B.A; Bakr O M and Mohammed O F Zero-Dimensional Cs4PbBr6 Perovskite Nanocrystals. The Journal of Physical Chemistry Letters,2017,8,5,961-965
3. Peng X; Chen J; Wang F; Zhang C; Yang B; One-pot synthesis of $CsPbBr_3/Cs_4PbBr_6$ perovskite composite. Optik,2020,4,164579

配合軟硬磁性材料之芬頓系統降解效率研究

曾睿為 譚光芯 吳家慶*

*E-mail:ccwu@cc.nttu.edu.tw

Keywords:軟硬磁性材料;羅丹明B;芬頓催化劑

1960 年代，人類發現工業革命對環境的污染、生態的破壞的問題。直到現在，環境保護之議題一直都是被世界關注的課題之一，人類對於資源追求著可重複利用與最大幅度的減量，讓資源永續發展與循環。而在工業中羅丹明 B (Rhodamine B, RhB)剛亮相時，因可以少量之劑量就能配置出非常亮眼之粉紅色，讓染色的成本降低非常多，常溶解在水中，作為示蹤染料來確定水流動的速率和方向，且能發出螢光，因此可以被螢光計輕易且便宜地偵測到。但是這種有機染料的化學活性相當的低且結構複雜，屬於處理成本較高的一項產品。本研究將使用紫外線/可見光分光光譜儀觀察濃度變化，並以 $CoFe_2O_4$/CoFe 作為催化劑形成芬頓系統，探尋有效率且環境友善的方法來進行汙水降解。

References:

1. Fangying,J., Peng,Y.,Qingkong,C.,Tingyi,L.,Wei,G.,&Xuan,X.(2013). Synergistic effect of bifunctional Co–TiO_2 catalyst on degradation of Rhodamine B: Fenton-photo hybrid process.*Chemical Engineering Journal 229*,57-65, 1385-8947.

2. H.Sun, J.Lian, L.Zhao, T.Xu& X.Yang.(2016). One-pot hydrothermal synthesis of octahedral CoFe/$CoFe_2O_4$ submicron composite as heterogeneous catalysts with enhanced peroxymonosulfate activity. *Journal of Materials Chemistry A 24*(4),9455-9465,10.1039/C6TA02126C.

3. Amadine,O., Dânoun,K., Essamlali,Y., Rhihil,A., Tabit,R.& Zahouily,M.(2018). Magnetic $CoFe_2O_4$ nanoparticles supported on graphene oxide ($CoFe_2O_4$/GO) with high catalytic activity for peroxymonosulfate activation and degradation of rhodamine B. *RSC Advances 3*(8),1351-1360, 10.1039/C7RA09949E.

彩色鈣鈦礦太陽能電池

Colored perovskite solar cell

Zih-Syuan Huang[1], Cheng-Siou Wu[1] and Chia-Ching Wu[1*]

[1]*Department of Applied Science, National Taitung University, Taiwan.*

e-mail:ccwu@nttu.edu.tw

Keywords: Nanoporous NiO; optical cavity; perovskite solar cell;, building integrated photovoltaic

本研究製作具色彩的倒置型鈣鈦礦太陽能電池，我們成功利用沉積法製做摻雜鋰的多孔氧化鎳(Li:NiOx)，由高解析掃描式電子顯微鏡(High Resolution Scanning Electron Microscope, HR-SEM)分析得知，Li:NiOx 具有奈米多孔網狀連結特性，孔徑約為 200-250nm，壁厚約為 20-30nm。由紫外線/可見光光譜儀分析，可以看到未摻雜鋰的多孔氧化鎳，在八分鐘的沉積時間，穿透率高達約80%，至於，摻雜鋰的多孔氧化鎳，摻雜量 40wt%時，依舊接近於 80%的穿透率，並且隨著摻雜量增加，穿透率下降。接著，透過吸收圖譜計算能隙(band gap) 大小、四點探針量測電阻率以及 X 射線光電子能譜儀(X-ray photoelectron spectrometer, XPS)等的分析儀，鑑定薄膜特性。

本研究以二次連續沉積法製作的鈣鈦礦，成功透過添加 4-叔丁基吡啶(4-tert- butylpyridine, TBP)於鈣鈦礦層，使 PbI_2 能完全轉換成鈣鈦礦，由高解析掃描式電子顯微鏡，發現鈣鈦礦與氧化鎳層達到良好的接觸，並探討添加與未添加TBP，不同溫度下鈣鈦礦的結晶狀況，並且利用 X 光繞射儀(X-ray diffraction, XRD)鑑定、紫外線/可見光光譜儀分析材料，證實成功利用二次沉積法製作鈣鈦礦。

除此之外，本研究利用 RF 射頻磁控濺鍍法沉積氧化銦錫(ITO)薄膜和 DC 直流磁控濺鍍法沉積銀(Ag)薄膜並且沉積在玻璃基板上，製作成彩色濾光片，並作為太陽能元件上電極。我們個別探討出 ITO 與 Ag 最佳濺鍍參數，利用Ag/ITO/Ag 結構製作出光學微共振腔並且在各顏色波長下有透射峰值之彩色濾光片，透過改變 ITO 厚度，分別在 500nm、559nm 以及 614nm 獲得可見光透射峰值，對應顏色為藍色、綠色以及紅色。另外，也利用 ITO/Ag/ITO 結構製作透明電極於太陽能電池上，並且利用模擬數據與實驗相互對應。最後製作出glass-ITO/Li:NiO/$CH_3NH_3PbI_3$/TTIP/Ag/ITO/Ag， 以及 glass- ITO/Li:NiO/ $CH_3NH_3PbI_3$/TTIP/ITO/Ag/ITO 的倒置型鈣鈦礦太陽能電池作元件並探討其轉換效率。

References:

1. Park, M. A.; Park, I. J.; Park, S.; Kim, J.; Jo, W.; Son, H. J.; Kim, J. Y., Enhanced electrical properties of Li–doped NiOx hole extraction layer in p–i–n type perovskite solar cells. *Curr Appl Phys* **2018**, *18*, S55-S59.

2. Xiao, Z.; Bi, C.; Shao, Y.; Dong, Q.; Wang, Q.; Yuan, Y.; Huang, J., Efficient, high yield perovskite photovoltaic devices grown by interdiffusion of solution-processed precursor stacking layers. *Energy Environ. Sci.* **2014**, *7*(8), 2619-2623.

3. Lu, J. H.; Yu, Y. L.; Chuang, S. R.; Yeh, C. H.; Chen, C. P., High-performance, semitransparent, easily tunable vivid colorful perovskite photovoltaics featuring Ag/ITO/Ag microcavity structures. *J. Phys. Chem. C* **2016**, *120*(8), 4233-4239.

開發具介電及磁特性之生物可降解複合材料

並應用於 3D 列印

黃崧瑋

Corresponding Information

吳家慶

Keywords:印刷電路板、CCTO、Fe_3O_4、生物可降解塑膠、

印刷電路板是現今最常利用的電路基板之一，但其無法回收以及製成材料易汙染環境，且開發過程繁雜，需要先進行開模，增添了複雜的設計要素，因此 3D 列印是解決此此兩種問題的方法。

本研究使用可當作 3D 列印線材的生物可降解高分子材料聚乳酸(Poly Lactic Acid,PLA)以及高介電陶瓷材料鈦酸銅鈣(CaCu3Ti4O12, CCTO)，磁性材料四氧化三鐵(Ferroferric Oxid，Fe3O4)製備複合材料基板，使用不同的添加比例，探討介電常數及損失的影響。藉由 XRD 分析了複合材料的晶面，驗證材料結構正確，使用 SEM 拍攝複合材料截面，發現添加比例分別再 CCTO-PLA 20 wt%以及 Fe3O4-PLA 30 wt%產生明顯變化，推測這是讓介電損失增加之原因，利用安捷倫 4294A 精密阻抗分析儀分析界電常數及損失之特性，測得高添加比時會在 10000Hz 後產生較大的浮動。

製作 3D 列印線材中使用了單螺桿的線材製造機，重複製備線材至無空氣產生，選定 30 wt%的添加比做為 3D 列印線材之基材，利用製備線材進行電路基板列印，測定其介電常數，分析作為基板之複合材料特性。

References:

1. *Bin Yu, Mingjun Wang, Hui Sun,ab Feichao Zhu, Jian Han, Gajanan Bhatc(2017),Preparation and properties of poly (lactic acid)/magnetic Fe3O4 composites and nonwovens, Royal Society Of Chemistry*
2. *Mirae Kim, Jae Hwan Jeong, Jong-Young Lee, Andrea Capasso,,FrancescoBonaccorso, Seok-Hyeon Kang, Young-Kook Lee, Gwan-Hyoung Lee(2019),Electrically Conducting and Mechanically Strong Graphene− Polylactic Acid Composites for 3D Printing, ACS Applied Materials & Interfaces*
3. *Mohsen Ahmadipour, Mohd Fadzil Ain, Zainal Arifin Ahmad(2016), A Short Review on Copper Calcium Titanate (CCTO) Electroceramic: Synthesis, Dielectric Properties, Film Deposition, and Sensing Application, Nano-Micro Letters*

模擬地熱能結合史特林引擎進行溫差發電之研究

劉涵文、朱力民

姓名:朱力民教授 學校單位名稱:國立臺東大學應用科學系

聯絡地址: 95092 臺東市大學路二段 369 號 連絡電話:0912740900

Keywords:再生能源;地熱;史特林引擎

因大量的化石能源使用因而產生了二氧化碳的排放並造成了現在的溫室效應，其結果導致了嚴重的氣候變遷問題，因此開發綠色能源是目前的當務之急。因臺東具有豐富的地熱資源，而絕大部分都是被溫泉業者所使用，在使用溫泉時從溫泉井到溫泉池需要進行降溫的過程才可被使用，而本研究的發想是利用溫泉水在降溫過程所產生的廢熱來推動史特林引擎運轉並進行溫差發電。

本專題將實際運用臺東在地的地熱資源，結合低溫差β構型史特林引擎以及線性直流發電機並使其運轉並進行發電。

一般史特林引擎是外燃機，且主要靠的是溫差發電。因是外燃機的緣故只要溫差夠大即可以使其運轉，不必使用特定的燃料，像是柴油引擎需要柴油、汽油引擎需要汽油，這樣需要特定燃料才可以運作且有振爆問題的發動機，史特林引擎運作不會產生震爆且不產生溫室氣體又零汙染，是個安全、環保、又安靜的發電機。

References:

1.Hung-Di Huang、Wen-Lih Chen(2020)，Development of a compact simple unpressurized Watt-level low-temperature-differential Stirling engine，International Journal of Energy Research)

2.劉晉榮(2017)，史特林引擎運用於絕氣推進之研究，碩士學位論文，國防大學理工學院機械及航太工程學系 航空太空工程碩士班

3.Shahed Md. Abu Sufian, Kawsar Ahmed Sagar, Muhammad Ahsan Ullah .Harvesting Electrical Power from Waste Heat Using Stirling Engine .IEEE.The 9th International Forum on Strategic Technology (IFOST), October 21-23, 2014.

4.Shahed Md. Abu Sufian, Muhammad Ahsan Ullah,Prasenjit Mazumder .Design of a Stirling Engine to Generate Green Energyin Rural Areas of Bangladesh .IEEE.2nd International Conference on Green Energy and Technology,.September 2014.

5.張浚弦(2013)，史特靈引擎軌道車教材的改進研究，碩士論文，大同大學機械工程學系研究所

6.童立瑋(2013)，應用田口法於 Beta 型史特靈引擎之最佳化設計，碩士論 文，逢甲大學航太與系統工程學系

(B 組)應用科學系化學組學士班(B1 組 有機、無機、材料、生化)

Palladium Mediated Site-Selective C-H Bond Arylation and Alkylation of 9(10*H*)-Acridinone and Mechanistic Investigation

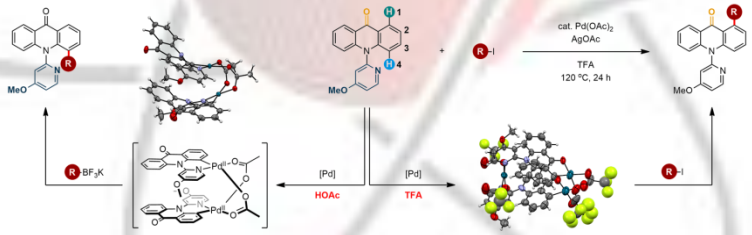
Chien-Wen Lin (林虔芟), Lin-En Zeng (曾琳恩), Jin Lee (李晉), Guan-Wei Liao (廖冠維) and Jean-Ho Chu (朱見和)*

Department of Applied Science, National Taitung University

j_hchu@nttu.edu.tw

Keywords: Palladium-catalyzed; C-H activation; 9(10H)-Acridinone, Site-Selective

A site-selective functionalization of 9(10*H*)-acridinone via palladium-mediated C(sp^2)-H bond activation was presented. In the study, the direct C(1)-H and C(4)-H arylation/alkylation of 9(10*H*)-acridinone could be conducted while acetic acid and trifluoroacetic acid were used as the reaction solvent, respectively. A series of arylated and alkylated *N*-(4-methoxypyridin-2-yl)-9(10*H*)-acridinones were afforded by these reactions. Finally, the structures of key palladacycles were confirmed by X-ray crystallography.



References:

1.Chu, J.-H.; Su, Z.-H.; Yen, K.-W.; Chien, H.-I. *Organometallics* **2020**, *39*, 3168–3179.

2.Mehra, M. K.; Sharma, S.; Rangan, K.; Kumar, D. *Eur. J. Org. Chem.* **2020**, *2020*, 2409–2413.

3.Gandeepan, P.; Parthasarathy, K.; Cheng, C.-H. *J. Am. Chem. Soc.* **2010**, *132*, 8569–8571.

Palladium/Copper-Catalyzed C-H Bond Arylation and Transformation of Iminostilbene

鈀/銅金屬催化亞氨基芪分子之碳-氫鍵芳香基化暨結構轉化研究

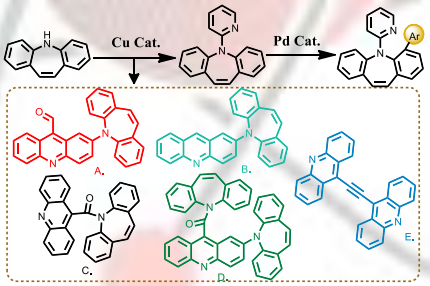
Wei-Ching Jeng (鄭蔚晴) , Chen-Ling Chang (張禎玲) , Chao-Chun Ke (柯兆群) and Jean-Ho Chu (朱見和)*

Department of Applied Science, National Taitung University

j_hchu@nttu.edu.tw

Keywords:Iminostilbene;Palladium;Copper;C-H Bond;Arylation/Transformation

The first study concerns that palladium-catalyzed ortho-C−H bond arylation/alkylation of iminostilbene. By the stoichiometric reaction of substrate and palladium catalyst, we were able to afford the palladacycle intermediate. Next, potassium aryl/alkyltrifluoroborate and p-benzoquinone were added into the reaction as a coupling reagent and promoter, respectively. The desired ortho-arylated iminostilbenes could be produced by the above reaction. The second used copper metal to catalyze the carbon-hydrogen bond transformation of iminostilbene which eventually resulted in the formation of theses novel molecules. Finally, these molecules were found to own strong fluorescence properties. Regarding the synthetic conditions for these compounds are studying in the laboratory.



References:

1.Chu, J.-H.; Su, Z.-H.; Yen, K.-W.; Chien, H.-I. *Organometallics* **2020**, *39*, 3168–3179.

2.Huang, W.; Buchwald, S. L. *Chem.-Eur. J.* **2016**, *40,* 14186-14189.

3.Chu, J.-H.; Chen, C.-C.; Wu, M.-J. *Organometallics* **2008**, *130*, 2900-2901.

4.Khan, M. A.; Saleem, A.; Ghouri, N.; Hameed, A.; Choudhary, M. I.; Basha, F. Z. *lett drug des discov.* **2015**, *12*, 597-606.

含硫、磷配位基之單亞硝基鐵化合物的合成、鑑定與反應性探討

李建明, 張福生, 陳暐喆

Department of Applied Science, National Taitung University

Keywords :mononitroso;iron compounds; DNIC;sulfur;phosphorus

本次實驗繼續嘗試將雙亞硝基鐵錯合物與不同的配位基反應，看是否能轉 化成單亞硝基鐵錯合物。

我們使用雙亞硝基鐵錯合物 $Fe_2((NO)P(C_6H_4\text{-}2\text{-}SH)_2(C_6H_5))_2$ 分別與 $P(C_6H_5)_3$、Imidazole 和 3-Methylpyrazole 反應，在藉由傅立葉轉換紅外線光譜儀、紫外光-可見光光譜儀以及 X-ray 單晶繞射做一個初步的鑑定和探討其基本性質。

References:

1. Tsai-Te Lu, Yu-Ting Tseng, Wei-Min Ching, and Wen-Feng Liaw. Dinitrosyl Iron Complex [K-18- crown-6-ether][$(NO)_2Fe(MePyrCO_2)$]: Intermediate for Capture and Reduction of Carbon Dioxide. Angewandte,2020,59.29: 11819-11823

TiO_2-PDMS 海綿在紫外光下催化降解羅丹明 B 染料

CHEN,PO-YEN(陳柏諺), WU,CHIA-EN(吳嘉恩),

LIAO,WEI-TSEN(廖尉岑)*

Department of Applied Science, National Taitung University

Email:liaowc@nttu.edu.tw

Keywords:二氧化鈦;吸附油汙;降解染料;PDMS 海綿

本專題是利用乳化作用下的油水混和物來做為軟模板來製成 PDMS 疏水性海綿來達到吸附油性染劑，相比較於傳統的糖模板避免了需要長時間抽真空的問題。利用海綿多孔結構的大表面積上摻雜用於光催化的二氧化鈦，達到吸附汙染物的同時進行光催化降解，並且海綿還能回收重複使用。在海綿吸附和 TiO_2 光催化降解的作用下，可以有效的從水中去除有機污染物。

References:

1. Yong, J.; Yang, Q.; Chen, F.; Zhang, D.; Du, G.; Bian, H.; Si, J.; Yun, F.; Hou, X. *Appl. Surf. Sci.* **2014**, *288*, 579– 583.
2. Choi, S.-J.; Kwon, T.-H.; Im, H.; Moon, D.-I.; Baek, D.-J.; Seol, M.-L.; Duarte, J.-P.; Choi, Y.-K. *ACS Appl. Mater. Interfaces* **2011**, *3*, 4552– 4556.
3. Qiu, S.; Bi, H.; Hu, X.; Wu, M.; Li, Y.; Sun, L. *RSC Adv.* **2017**, 7, 10479– 10486.
4. Zhang, L.; Zhang, Y.; Chen, P.; Du, W.; Feng, X.; Liu, B.-F. *Langmuir* **2019**, *35*, 11123– 11131.

Synthesis of (a) *ortho*-Arylated/Alkylated Dibenzosuberenones and (b) Novel Phenanthridines via Palladium(II)-Catalyzed C-H Bond Activation Strategy

Ying-Hui Chen (陳英惠), Hsuan-I Chien (簡瑄逸),

Xing-Wei Chen (陳星維), and Jean-Ho Chu (朱見和)*

Department of Applied Science, National Taitung University, Taitung

Email: j_hchu@nttu.edu.tw

Keywords:Dibenzosuberenone;Phenanthridine;Palladium

A palladium-catalyzed the synthesis of *ortho*-arylated/alkylated dibenzosuberenones and phenanthridines directed from dibenzosuberenone employing a methoxyimine as the directing group was presented. Potassium trifluoroborates was used as the coupling reagent, whereas *p*-benzoquinone and *tert*-butanol were screened as the optimal reaction promoter and solvent, respectively. The methodology was shown good functional group tolerance. All products were fully characterized by NMR spectroscopy and some of them, including an additional palladacycle intermediate, were further elucidated by X-ray crystallography. Finally, a possible reaction mechanism was proposed based on the mechanistic investigation.

References:

1. Chu, J.-H.; Chiang, M.-F.; Li, C.-W.; Su, Z.-H.; Lo, S.-C.; Wu, M.-J. *Organometallics* **2019**, *38*, 2105.
2. Chu, J.-H.; Su, Z.-H.; Yen, K.-W.; Chien, H.-I. *Organometallics* **2020**, 39, 17, 3168.
3. Dastan, A.; Kilic, H.; Saracoglu, N. *Synthesis* **2018**, *50*, 391–439.
4. Merkaš, S.; Litvić, M.，Cepanec, I.; Vinković, V. *Molecules* **2005**, *10*, 1429-1437.

Electrochemical Activating Tungsten Disulfide for Hydrogen Evolution Catalysis

(電活化二硫化鎢於催化析氫反應)

Yi-Lun Zeng (曾怡綸)

Department of Applied Science, National Taitung University, 369, Sec. 2, University Rd., Taitung City, Taiwan 95092

Keywords: liquid phase exfoliation; tungsten disulfide; hydrogen evolution reaction; 1T metallic phase

In this study, liquid phase exfoliation (LPE) method was used to exfoliated tungsten disulfide (WS_2) from transition metal into nanosheets by chlorophyll. Then, the material was activated by electrochemical activation. Through the hydrogen evolution reaction (HER) test, it can be seen that at the same current density, with the increase of activation time for 3hr to 6hr, the potential became close to zero. However, when the activation time increased to 9 hr, the potential became even more negative than 6 hr, showing that the activation limit was 6 hr. The potential of WS_2 suspension was -600 mV and the Tafel slope was 125 mV/dec. If the activation time is increased to 6 hr, the potential can reach -370 mV and the Tafel slope can be reduced to 36 mV/dec.

The results of XPS, Raman and UV spectra showed that the phase change of 1T metallic occurs in WS_2, and the size of WS_2 becomes smaller after activation in DLS, SEM and TEM spectra. It shows that the possible reason of activation is that the occurrence of 1T metallic phase change and the smaller size help to improve the efficiency of hydrogen evolution reaction.

After that, though the electrochemical impedance test, the result showed that the resistance of WS_2 suspension was 70 Ω, which could be reduced to 15 Ω after 6 hours of activation. The capacitance value of WS_2 suspension was 0.2 mF/cm^2, and the capacitance of 4 mF/cm^2 after 6 hours of activation. The following, though caculate electrochemical active surface areas (ECSA), obtain the value of WS_2 suspension was 5 cm^2, and the value of 6 hours activation was 100 cm^2, which showed that the two-dimensional material is exfoliated by chlorophyll was a good catalyst for hydrogen evolution reaction, and the size of 1T metallic phase change produced by electrochemical activation was smaller than that of electrochemical hydrogen evolution reaction.

References:

1. Nguyen, V.-T.; Yang, T.-Y.; Le, P. A.; Yen, P.-J.; Chueh, Y.-L.; Wei, K.-H., New Simultaneous Exfoliation and Doping Process for Generating MX_2 Nanosheets for Electrocatalytic Hydrogen Evolution Reaction. *ACS Appl. Mater. Interfaces* **2019,** *11* (16), 14786-14795.

One Pot Synthesis of Chlorophyll-Assisted Exfoliated MoS_2/WS_2 Heterostructures via Liquid Phase Exfoliation Method for Photocatalytic Hydrogen Evolution Reaction

Lai,Yan-Ming (賴彥銘) Liao,Wei-Sheng (廖偉盛)

Corresponding Information

Department of Applied Science, National Taitung University, Taitung, Taiwan

Keywords: liquid-phase exfoliation; cocatalyst; photocatalytic hydrogen evolution

Text:

本實驗利用自萃取葉綠素當作塊材二維材料的助分散劑，並且使用超音波細胞粉碎機進行液相剝離法，將塊材二維材料剝離為少數層奈米片，藉由穿透式電子顯微鏡及拉曼光譜儀獲得奈米片層數之證據。利用 250 瓦氙燈冷光源作為模擬太陽光的燈源，並且透過照光與否來觀察材料的光電流密度的上升幅度，從數據中我們可以得到 MoS_2 及 WS_2 克數比為 1:1 的複合材料在單一材料或不同比例中具有最高的照光響應程度。另外，從電子阻抗實驗中，也發現 1:1 的複合材料在照光下具有最低的電阻值，以至於增強產氫效果。接著使用電化學系統以及紫外光/可見光光譜儀測量材料的導帶與能隙，利用導帶位置以及能隙的結果，推算價帶位置。經換算後得到能階圖，了解電子傳輸產氫過程。

References:

1. Bhimanapati, G. R.; Lin, Z.; Meunier, V.; Jung, Y.; Cha, J.; Das, S.; Xiao, D.; Son, Y.; Strano, M. S.; Cooper, V. R.; Liang, L., Recent Advances in Two-Dimensional Materials beyond Graphene. *ACS Nano* **2015,** *9*, 12, 11509–11539.

2. Xu, D.; Xu, P.; Zhu, Y.; Peng, W.; Li, Y.; Zhang, G.; Zhang, F.; Mallouk, T. E.; Fan, X., High Yield Exfoliation of WS_2 Crystals into 1-2 Layer Semiconducting Nanosheets and Efficient Photocatalytic Hydrogen Evolution from WS_2/CdS Nanorod Composites. *ACS Appl. Mater. Interfaces* **2018,** *10* (3), 2810-2818.

Preparation of Iron-Nitrosyl-Thiolate Complexes Relevant to Nitric Oxide(NO) and Nitroxyl (HNO/NO^-) Transfer Upon Photoinduced Reaction

探討鐵硫磷錯合物之合成並在光照反應下觀察一氧化氮與次硝酸分子轉移

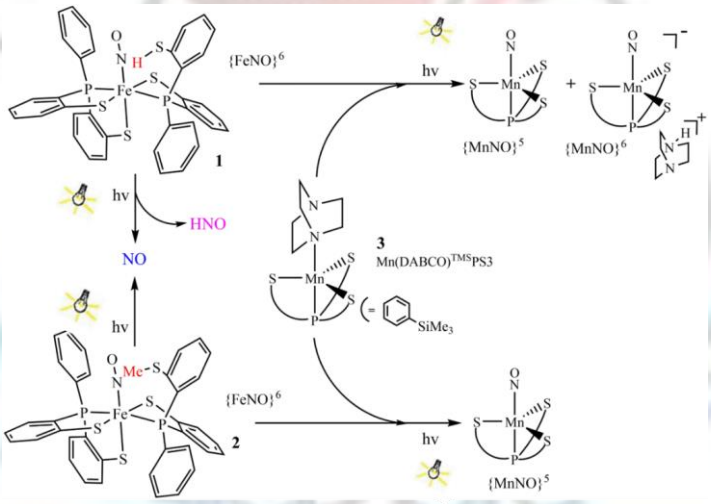
Yu-Tsan Hsiao[a], Pei-I Yen [a], Cheng-Po Kao [a],

Yu-Hsuan Chen [a], Chien-Ming Lee[a*]

[a] *Department of Applied Science, National Taitung University, Taitung 950, Taiwan*

Keywords:Thiol;Nitroxyl;Photodissociation;Transition metals

In this experiment, we synthesize two $\{FeNO\}^6$ species (the Enemark–Felthan notation) FeNO(PhPS2)(PhPSSH)(**1**) and FeNO(PhPS2)(PhPSSMe)(**2**) iron-nitroxyl species. Under continuous light reaction conditions, the complex **1** can release nitroxyl(HNO) and nitric oxide(NO), while the complex **2** only releases nitric oxide(NO) and both are identified by FT-IR and NMR spectroscopy. We add the NO-trapping agent $Mn^{III}(DABCO)^{TMS}PS3$(**3**) which can capture nitric oxide and nitroxyl molecules. We obtained the spectrum when **3** react with HNO or NO by the FT-IR.



References:

1. Ming-Li Tsai, Ming-Hsi Chiang, and Chien-Ming Lee *Journal of the American Chemical Society* **2020** ,142 (19), 8649-8661.

Exfoliation of Two Dimensional Materials Thin Sheets by Amino Acid in Water for Hydrogen Evolution Reaction

Chia-Hui Yi, I-Wen Peter Chen*

Department of Applied Science, National Taitung University, 369, Sec. 2, University Rd., Taitung City, Taiwan 95092

Keywords: Exfolation; Nanosheets; Two Dimensional Materials; Hydrogen Evolution Reaction

This study using six amino acids: Histidine (His), Tryptophan (Trp), Phenylalanine (Phe), Citrulline (Cit), Glycine (Gly), and Glutamic acid (Glu) to be an exfoliant, and a large number of water-soluble transition metal dichalcogenides (TMDs) nanosheet were successfully prepared by liquid-phase exfoliation. Using sonicator to destroy the van der Waal forces between the layer by layer of TMDs nanosheet, and then a few layers of TMDs nanosheet were prepared by the Nitrogen (N) of the amino acid and the Mo or W of TMDs bonding. The TMDs nanosheets were subjected to material identification to determine the stability of the dispersion and the number of layers, which proved to have Mo-N or W-N bonding. From the stability of the dispersion, it can be seen that His exfoliate TMDs have good dispersibility and stability. The literature indicates that amino acids with aromatic ring structures have strong adsorption capacity on TMDs and have relatively good stability. Because His structure has aromatic ring imidazole has been reported as a good exfoliant. However, Cit, Gly, and Glu are not able to be embedded in the layers of TMDs because of the structure without aromatic rings, so their dispersibility is poor.

The TMDs nanosheets were subjected to the electrochemical hydrogen evolution reaction. The electrochemical evaluation demonstrates that His-$MoSe_2$ shows extraordinary HER electrocatalytic performances, possessing an extremely low overpotential of 230 mV at 10 mA/cm^2 and an extraordinary small Tafel slope of 33 mV/dec at high current density. After adding platinum nanoparticles (PtNPs), the Tafel slope can be reduced to 24 mV/dec and the overpotential can be reduced to 180 mV. Compared with the literature has good hydrogen evolution efficiency.

Electrochemically active surface area (ECSA) proved that the addition PtNPs can increase the active site from 48 cm^2 to 54 cm^2, and the resistance value from 48 to 32 Ω, indicating that the addition PtNPs can increase its catalytic activity. The results show that using amino acids as exfoliant can obtain a large number of environmentally friendly TMDs nanosheets with good hydrogen evolution performance, which has great potential in replacing precious metal catalysts.

References:

1. Satheeshkumar, E.; Bandyopadhyay, A.; Sreedhara, M.; Pati, S. K.; Rao, C.; Yoshimura, M., One-Step Simultaneous Exfoliation and Covalent Functionalization of MoS_2 by Amino Acid Induced Solution Processes. *ChemNanoMat* 2017, *3* (3), 172-177.

2. Zhang, P.; Wang, Z.; Liu, L.; Klausen, L. H.; Wang, Y.; Mi, J.; Dong, M., Modulation the Electronic Property of 2D Monolayer MoS_2 by Amino Acid. *Appl. Mater. Today* 2019, *14*, 151-158.

3. Chen, Y.-X.; Wu, C.-W.; Kuo, T.-Y.; Chang, Y.-L.; Jen, M.-H.; Chen, I.-W. P., Large-Scale Production of Large-Size Atomically thin

(B 組)應用科學系化學組學士班 (B2 組 分析)

以硫胺修飾金奈米粒子用於比色檢測得恩地

李岱竹、胡焯淳、邱泰嘉*

國立臺東大學應用科學系

keywords：硫胺;金奈米粒子;得恩地;比色法

本篇開發一種簡單的比色探針檢測得恩地(Thiram)，利用檸檬酸鈉(sodium citrate) 作為還原劑和保護劑將四氯金酸(Gold(III) chloride trihydrate)還原成金奈米粒子，再將硫胺(Thiamine, Th)修飾到金奈米粒子上合成硫胺-金奈米粒子(Th-AuNPs)，此時溶液顏色從酒紅色轉變為深紅色，是由於硫胺上的硫與金有很強的作用力，造成金奈米粒子上部分的羧酸基被硫胺取代；當加入得恩地後溶液顏色由深紅色轉變成藍色，可由紫外光-可見光光譜可發現金奈米的吸收峰 520 nm 下降，650 nm 之吸收峰上升，是由於加入得恩地後，得恩地上也含有硫會與金奈米粒子有強作用力，使金奈米粒子產生聚集。在最佳化條件下，檢測得恩地的線性範圍為 0.001-0.25 ppm (R^2=0.9916)，偵測極限為 0.0008 ppm。此檢測方法具簡單合成、快速檢測、選擇性優良及優秀的靈敏度等優點，提供了一種具有潛力的替代方法檢測得恩地。已成功運用於水樣品中檢測得恩地的濃度，且具有良好的回收率。

References:

1. Khan, U.; Niaz, A.; Shah, A.; Zaman, M. I.; Zia, M. A.; Iftikhar, F. J.; Nisar, J.; Ahmed, M. N.; Akhter, M. S.; Shah, A. H., Thiamine-functionalized silver nanoparticles for the highly selective and sensitive colorimetric detection of Hg^{2+} ions. *New Journal of Chemistry* **2018,** *42* (1), 528-534.
2. Singla, S.; Achanta, V. G.; Pandey, O. P.; Sharma, G., Influence of the size of gold nanoparticles dispersed in glass matrix on optical properties. *Ceramics International* **2020,** *46* (7), 9907-9912.

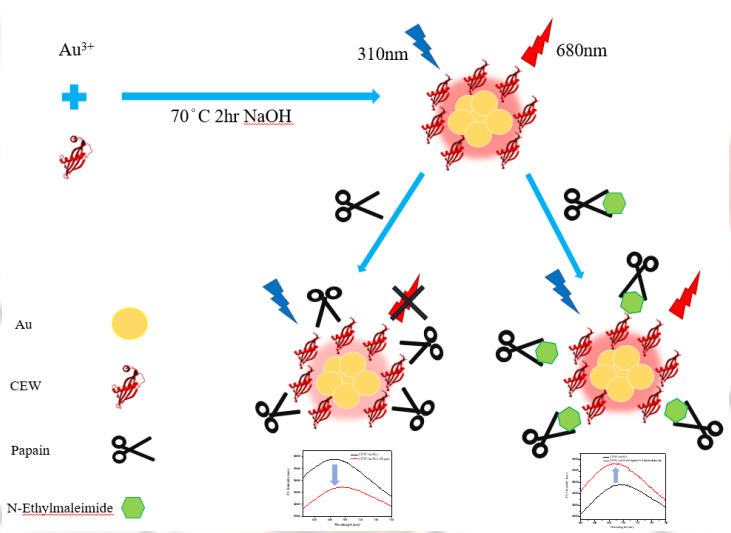
金奈米團簇螢光檢測木瓜蛋白酶和 N-乙基馬來酰亞胺

李晉維 胡焯淳*

國立台東大學應用科學系

Keyword: 金奈米團簇;雞蛋白;木瓜蛋白酶;抑制劑;螢光檢測

雞蛋做為常用食品取得方便具生物相容性，本實驗使用雞蛋白作為配體合成出的雞蛋白金奈米團簇，激發在 310 nm，放射 680 nm 呈現紅色螢光，在加入木瓜蛋白酶時水解 CEW 使 CEW-AuNCs 螢光焠滅，之後 N-乙基馬來酰亞胺做為抑制劑抑制木瓜蛋白酶的活性 CEW-AuNCs 螢光回升。CEW-AuNCs 在加入木瓜蛋白酶時螢光淬滅線性為 40 – 240 ppm， R^2 = 0.992。N-乙基馬來酰亞胺對木瓜蛋白酶的抑制使得 CEW-AuNCs 的螢光回升線性為 50 – 350 ppm ，R^2 = 0.999，LOD = 9.347 ppm，提供一種簡單綠色合成的團簇用於檢測木瓜蛋白酶並加入 N-乙基馬來酰亞胺達到抑制效果在未來病毒上的蛋白酶檢測具有潛力。



Scheme 1. The schematic illustration of the synthesis method and the mechanism of AuNCs.

References:

1. Joseph, D.; Geckeler, K. E., Synthesis of highly fluorescent gold nanoclusters using egg white proteins. *Colloids and Surfaces B: Biointerfaces* **2014,** *115*, 46-50.

2. Wang, S.; Wang, Y.; Yang, X., Identifying three routes of the sensing mechanism for casein-directed gold nanoclusters. *Colloids and Surfaces B: Biointerfaces* **2018,** *169*, 348-355.

3. Chen, Y.; Qiao, J.; Liu, Q.; Zhang, M.; Qi, L., Fluorescence turn-on assay for detection of serum D-penicillamine based on papain@ AuNCs-Cu2+ complex. *Analytica chimica acta* **2018,** *1026*, 133-139.

One-pot hydrothermal synthesis of carbon dots as fluorescent probes for the determination of mercuric and hypochlorite ions

Hsin Lee, Yen-Chang Su, Hsiang-Hao Tang, Jan-Yee Lee, Cho-Chun Hu, Tai-Chia Chiu*

Department of Applied Science, National Taitung University, Taitung, Taiwan

Keywords: Carbon dot;Mercury ion ;hyperchlorite ion

Nitrogen and sulfur co-doped carbon dots (NSCDs) with were synthesized via a one-pot hydrothermal method using citric acid, ethylenediamine and methyl blue as precursors. The obtained NSCDs were spherical with an average size of XX nm. The fluorescence spectra of the NSCDs were excitation-independent and they emitted bright blue fluorescence at 440 nm by excitation at 350 nm. The calculated fluorescence quantum yield was as high as 68.0%. The NSCDs could be constructed as fluorescent probes for the detection of mercuric (Hg^{2+}) and hypochlorite (ClO^{-}) ions with good selectivity and sensitivity. The fluorescence of the NSCDs is quenched by Hg^{2+} and ClO^{-} owing to the static quenching. Under the optimal conditions, the linear response of the NSCDs was in the range 0.7–15 μM with a detection limit of 0.55 μM and was 0.3–5 μM with a limit of detection of 0.29 μM for Hg^{2+} and ClO^{-}, respectively. The fluorescent probes were successfully used to quantify Hg^{2+} and ClO^{-} in spiked tap water samples with satisfactory results.

Facile synthesis composite of TiO_2 /metal efficient for photocatalytic degradation of ciprofloxacin

Lin,I-Chun Hu,Jhuo-Chun Ciou,Tai-Jia

國立臺東大學應用科學系

Keyword:ciprofloxacin, photocatalyst, titanium dioxide, gold nanoparticle, copper nanocluster

Gold nanoparticles and copper nanoclusters were adsorbed on commercially available titanium dioxide (P25, Degussa), and ciprofloxacin (CIP) dissolved in hydrochloric acid (HCl) were used as precursors. The optimal conditions were found through experiments and compared with different light sources (254nm, 365nm, 405nm) in the environment of P25 to catalytic ciprofloxacin.

References:

1. Henze, M., van Loosdrecht, M. C., Ekama, G. A., & Brdjanovic, D. (Eds.). (2008). Biological wastewater treatment. IWA publishing.Fries, E., Crouzet, C., Michel, C., & Togola, A. (2016). Interactions of ciprofloxacin (CIP), titanium dioxide (TiO_2) nanoparticles and natural organic matter (NOM) in aqueous suspensions. Science of The Total Environment, 563, 971-976.
2. León, D. E., Zúñiga-Benítez, H., Peñuela, G. A., & Mansilla, H. D. (2017). Photocatalytic removal of the antibiotic cefotaxime on TiO 2 and ZnO suspensions under simulated sunlight radiation. Water, Air, & Soil Pollution, 228(9), 361.
3. Karaolia, P., Michael-Kordatou, I., Hapeshi, E., Drosou, C., Bertakis, Y., Christofilos, D., ... & Fatta-Kassinos, D. (2018). Removal of antibiotics, antibiotic-resistant bacteria and their associated genes by graphene-based TiO2 composite photocatalysts under solar radiation in urban wastewaters. Applied Catalysis B: Environmental, 224, 810-824.

One-step hydrothermal synthesis of N,S co-doped carbon dots for detection of Fe^{3+}

唐向豪、邱泰嘉*

Department of Applied Science, National Taitung University, 369, Sec. 2, University Rd., Taitung City, Taiwan 95092

Keywords: carbon dot; *Iron ion*; *Nitrogen doped*; *sulfur doped*

Fluorescent nitrogen and sulfer codoped carbon dots (NSCDs) were synthesized by a facile one-step hydrothermal strategy using Thiamine(VB1) and m-Phenylenediamine (mPD) as the precursors. The obtained NSCDs exhibited blue fluorescence with maximum excitation/emission wavelengths at 355/398 nm and a high fluorescence quantum yield of 31.2%. The blue emission of the NSCDs was independent of the excitation wavelength, while they possessed well monodispersed and spherical morphology. The NSCDs were also very stable in a wide pH range and in solutions with high ionic strength. More specifically, the fluorescence of the NSCDs was effectively quenched by Iron ion (Fe^{3+}) suggesting that the NSCDs can be utilized as a fluorescent probe for the detection of Fe^{3+} with high sensitivity and selectivity. The linear ranges and limits of detection were 5 to 200 μM and 2.27 μM for Fe^{3+},respectively. Moreover, the fluorescent probe was applied for the detection of Fe^{3+} in water samples with satisfactory results, indicating its promising application potential in environmental monitoring.

References:

1. Zhu, X.; Wang, J.; Zhu, Y.; Jiang, H.; Tan, D.; Xu, Z.; Mei, T.; Li, J.; Xue, L.;Wang, X., Green emitting N,S-co-doped carbon dots for sensitive fluorometric determination of Fe(III) and Ag(I) ions, and as a solvatochromic probe. Microchimica Acta 2018, 185 (11), 510.

2. Ran, Y.; Wang, S.; Yin, Q.; Wen, A.; Peng, X.; Long, Y.; Chen, S., Green synthesis of fluorescent carbon dots using chloroplast dispersions as precursors and application for Fe^{3+} ion sensing. Luminescence 2020, 35 (6), 870-876.

Modified TiO_2 with carbon dots for photocatalytic degradation of amoxicillin

以碳點修飾 TiO_2 用於光催化降解阿莫西林

徐玉姍Yu-Shan Syu、胡焯淳Cho-Chun Hu *

邱泰嘉 Tai-Chia Chiu*

國立臺東大學應用科學系

Keywords: TiO2;Carbon dots;Photocatalytic;Amoxicillin;PLC

本研究使用水熱法合成含氮（N）、硫（S）摻雜的藍色螢光碳點，結合市售二氧化鈦TiO_2（P25，Degussa）作為光催化劑，在UV-A（365nm）針對溶解在氫氧化鈉（NaOH, 10^{-4} M）中的阿莫西林（$C_{16}H_{19}N_3O_5S$）來作光降解反應，透過實驗找到最佳化條件，並與市售二氧化鈦來做效率的比較。經過實驗得到最佳條件之參數為：200 mL 50 ppm AMX 氫氧化鈉水溶液（10^{-4} M）＋TiO_2 0.04g＋0.05 mL CDs、pH＝10.8，光催化系統為：轉速130 rpm、照光6 小時、紫外光365 nm、功率為3 W 下對阿莫西林（AMX）具有最佳的光催化效果。以高效液相層析串聯紫外光偵測器，測位於波長226 nm 處之波鋒面積。

實驗結果表明，本研究製備的含氮（N）、硫（S）摻雜的藍色螢光碳點，和市售二氧化鈦TiO_2 的組合搭配具有良好光催化能力，與市售二氧化鈦照光相同時間的效率相比，本研究製備的光催化劑組合在初期降解速率快，可以達成短時間大幅催化的目的，單純P25照光3 小時為60.3 %降解率，本實驗為78.3 %。隨著照光時間拉長，照光6 小時的最終降解率從90.8% 提升至95.4 %。

References:

1. D. Klauson, *Catalysis Today*, **2010**, *151*, 39-45

2. Dorian A. H. Hanaor, *Journal of Materials Science*, **2011**, *46*, 855–874

3. Dror Avisar, *Chemosphere*, **2013**, *91*, 985-992

4. Sylwia Mozia, *Separation and Purification Technology*, **2010,** *73*, 71-91

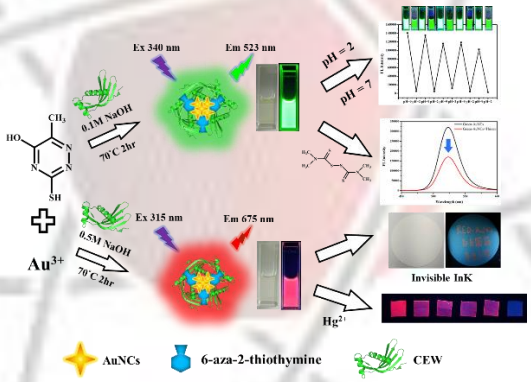
Multifunctional biligand gold nanocluster for detection of pollutants in water and pH sensor

Jla-Ming Jhang, Tai-Chia Chiu, Cho-Chun Hu*

Department of Applied Science, National Taitung University, Taitung,

Keywords:gold nanocluster;Bi-ligand;CEW;pH sensing;metal ions

This article uses ATT and CEW to synthesize nanoclusters with green fluorescence and red fluorescence. The red nanoclusters have high affinity for mercury ions, with a linear range of 10-250 μM, R^2 = 0.9954, and LOD of 1.02 μM. The Red nanoclusters filter paper is soaked in 10^{-7} M mercury ions for an hour, the fluorescence of Red-AuNCs on the filter paper can be quenched. Illustrate the test paper also has the characteristic of adsorbing mercury ions. The green nanoclusters are sensitive to pH and Thiram. The pH linear range of pH is pH 2 – pH 9, R^2 = 0.9972, good recovery rate for real samples urea in human, recovery rate is between 90.3% - 110.7%, RSD is less than 4.9%, it can be dedicated to the detection of urea in human and the Thiram linear range is 5-50 ppm, R^2 = 0.9945, LOD of 1.72 ppm. The real water sample recovery rate is between 87.7% -112.0%, RSD is less than 3.7%.



Scheme 1. Schematic diagram of the application of green nanoclusters and red nanoclusters.

References:

[1]. Deng, H.-H.; Shi, X.-Q.; Wang, F.-F.; Peng, H.-P.; Liu, A.-L.; Xia, X.-H.; Chen, W., Fabrication of water-soluble, green-emitting gold nanoclusters with a 65% photoluminescence quantum yield via host–guest recognition. *Chemistry of Materials* **2017,** *29* (3), 1362-1369.

[2]. Deng, H.-H.; Shi, X.-Q.; Balasubramanian, P.; Huang, K.-Y.; Xu, Y.-Y.; Huang, Z.-N.; Peng, H.-P.; Chen, W., 6-Aza-2-Thio-Thymine Stabilized Gold Nanoclusters as Photoluminescent Probe for Protein Detection. *Nanomaterials* **2020,** *10* (2), 281.

魚鱗製備螢光碳點用於檢測次氯酸根離子

陳威亨、胡焯淳、邱泰嘉*

國立台東大學應用科學系

keywords：碳點;魚鱗;螢光;水熱法;次氯酸根離子

本篇利用的生物廢棄物魚鱗，以水熱法 240˚C，12 小時，合成藍色螢光碳點 (carbon dots, CDs)。此碳點的激發波長為 320 nm，放射波長為 410 m，其螢光量子產率為 11.4%。透過螢光光譜、UV-Vis 光譜、FTIR 光譜、XPS 和 TEM 等鑑定其基本性質，由TEM 的圖譜計算得到碳點的大小約為 5.1 nm。由FTIR 和XPS 光譜證明碳點具有 NH_2、OH 和COOH 等官能基，因此此碳點具有良好的水溶性。本研究提供一個簡單、快速具有選擇性的方法，將合成的碳點用於檢測次氯酸根的濃度，次氯酸根的線性範圍為 3-70 μM，$R^2 = 0.9908$，LOD ($3\sigma/k$) 為0.23 μM。最後，將此螢光碳點應用於檢測礦泉水和自來水中的次氯酸根濃度，所得到的回收率分別為 99.77 % - 119.03% 和101.66% – 109.03%， RSD 值(n = 3) 皆小於 1.9 % 和6.9 %。

References:

1. Athinarayanan J., Periasamy, V.-S., & Alshatwi, A.-A. (**2020**). Simultaneous fabrication of carbon nanodots and hydroxyapatite nanoparticles from fish scale for biomedical applications. *Materials Science & Engineering: C*, 117, 111313.
2. Chen, C.-Y., Tsai, Y.-H., & Chang, C.-W. (**2019**). Evaluating the dialysis time required for carbon dots by HPLC and the properties of the carbon dots after HPLC fractionation. *New Journal of Chemistry*, 43(16), 6153–6159.

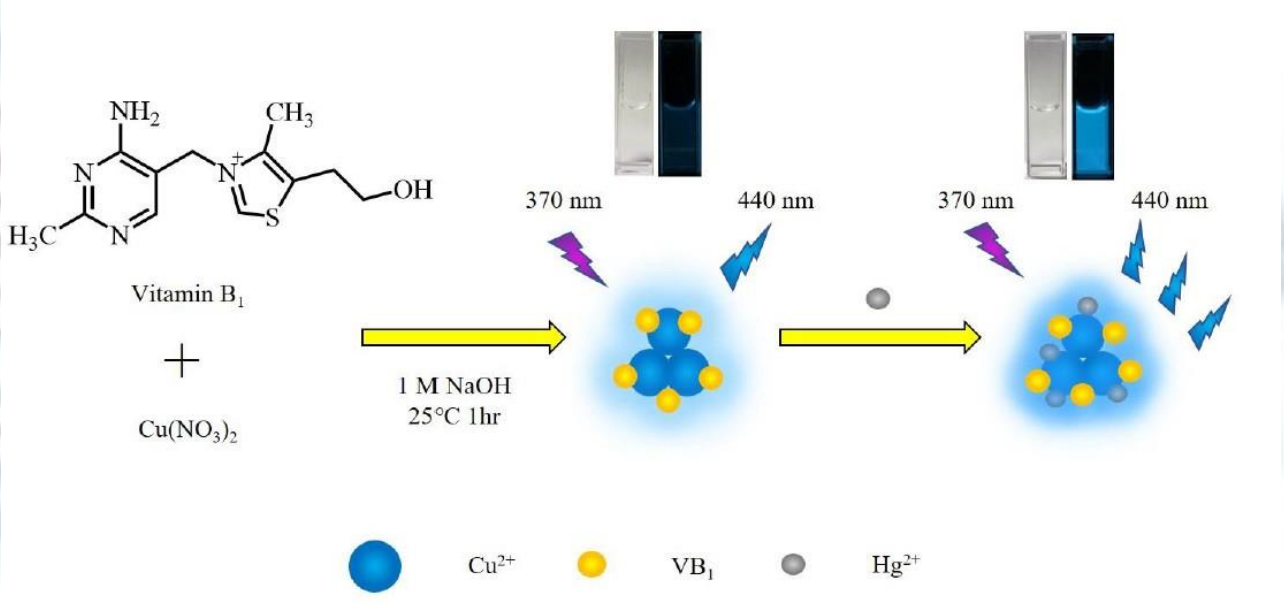
維他命 B1 修飾銅奈米團簇用於靈敏檢測汞離子

楊宗逸、邱泰嘉*

國立臺東大學應用科學系

Keywords:銅奈米團簇;硫胺;維他命B1;汞離子;螢光檢測。

我們開發了一種快速一步合成銅奈米團簇（CuNCs）的方法用作靈敏檢測Hg^{2+}的螢光探針。$Cu(NO_3)_2$水溶液在室溫下1小時內透過維他命B1(Thiamine)還原合成CuNCs。合成過程快速，簡單，輕鬆。含維他命B1的CuNCs的特徵在於紫外光可見吸收，有螢光放射且顯現出藍色螢光。本篇研究一種同時以維他命B1(硫胺)為保護劑及還原劑合成CuNCs，在pH為6下通過維他命B1將Cu^{2+}還原。透過調控銅離子與維他命B1之間的莫爾比例，所得到VB1-CuNCs在370nm激發下在440nm有放射峰。此材料在緩衝溶液pH 7下與汞離子產生靜電吸引力使團簇不穩定聚集誘導螢光上升，藉此檢測汞離子。於最佳化條件下，對汞離子的線性範圍為1 - 75 μM，R^2 = 0.994，LOD = 0.405 μM。



Scheme 1. The schematic illustration of the synthetic method of VB1-CuNCs and the mechanism of VB1-CuNCs for the detection of Hg^{2+}.

References:

1. Edwards, K. A.; Tu-Maung, N.; Cheng, K.; Wang, B.; Baeumner, A. J.; Kraft, C. E., Thiamine Assays—Advances, challenges, and caveats. *ChemistryOpen* **2017,** *6* (2), 178-191.

TiO_2 nanocomposite toward photocatalytic degradation of Rhodamine B

TiO_2 奈米複合材料對羅丹明 B 的光催化降解

蔡佳容、胡焯淳、邱泰嘉

國立臺東大學應用科學系

Keywords: *碳點;銀奈米粒子;二氧化鈦;光觸媒;羅丹明 B;負載片*

本研究使用銀奈米粒子（silver nanoparticle）和碳點加入羅丹明B 使濃度為10^{-5} M後加入0.01 g TiO_2，市售二氧化鈦TiO_2（P25，Degussa）作為前驅物，透過實驗找到最佳化條件；本研究製作P25 負載片，使用醋酸與SDS ，讓TiO_2 形成核殼結構與能均勻分散，後加入碳點進行光催化，透過實驗找到最佳化條件。

經過實驗得到最佳降解條件為羅丹明B 10^{-5} M，使用純P25 粉末，P25添加量為0.01g，反應時間為5小時。使用P25 負載片，反應時間為7小時。在紫外光下對羅丹明B 具有光催化效果，光催化系統的光源為365 nm 功率為3 瓦的LED 紫外光燈，以紫外－可見光光譜儀測其位於波長553 nm 處之吸收值。

實驗結果表明，本研究的光催化粉末與負載片具有光催化能力，製備的光催化劑粉末第二個小時的降解率皆低於純P25 粉末; 製備的負載片以純P25 負載片的效果最佳，7 小時降解36 %。

References:

1. Wang, Y.; Zhang, M.; Lv, S.; Li, X.; Wang, D.; Song, C., Photogenerated Oxygen Vacancies in Hierarchical Ag/TiO2 Nanoflowers for Enhanced Photocatalytic Reactions. ACS Omega 2020, 5 (23), 13994-14005.

2. Najafidoust, A.; Allahyari, S.; Rahemi, N.; Tasbihi, M., Uniform coating of TiO2 nanoparticles using biotemplates for photocatalytic wastewater treatment. Ceram. Int. 2020, 46 (4), 4707-4719.

Functionalized silver nanoparticles as colorimetric probes for sensing tricyclazole

Yen-Chang Su, Ai-Yu Lin, Cho-Chun Hu, Tai-Chia Chiu*

Department ofApplied Science, National Taitung University, Taitung, Taiwan

Keywords：Colorimetric detection; Fluorescein Rice Silver nanoparticles Tricyclazole

A colorimetric assay for highly selective and sensitive detection of tricyclazole using fluorescein funct ionalized silver nanoparticles (F AgNPs) as sensing probes was investigated. As the addition of tricyclazole to F AgNPs, a drastic decrease in the absorbance at 394 nm was detected, which was accompanied with a noticeable color change from yellow to gray. The sensing mechanism involved an interaction between tricyclazole and F AgNPs, which led to aggregation of the latter, inducing a color change from yellow to gray. An excellent linear calibration curve ($R^2 = 0.9994$) was achieved between absorbance at 394 nm and the tricyclazole concentration in the range between 0.06 and 1.0 ppm. Moreover, the detection limit was estimated at 0.051 ppm. The developed colorimetric assay also showed good selectivity and was successfully utilized to quantify tricyclazole in r ice samples with satisfactory recoveries. The proposed assay has been successfully applied for monitoring tricyclazole in rice samples.

References:

1. Huang, C.-C.; Chang, H.-T.*, Selective gold-nanoparticle-based “turn-on” fluorescent sensors for detection of mercury (II) in aqueous solution. Anal. Chem., 2006, 78, 8332–8338.

2. Su, Y.-C.; Lin, A.-Y.; Hu, C.-C.; Chiu, T.-C.*, Functionalized silver nanoparticles as colorimetric probes for sensing tricyclazole. Food Chem., 2021,347, 129044.

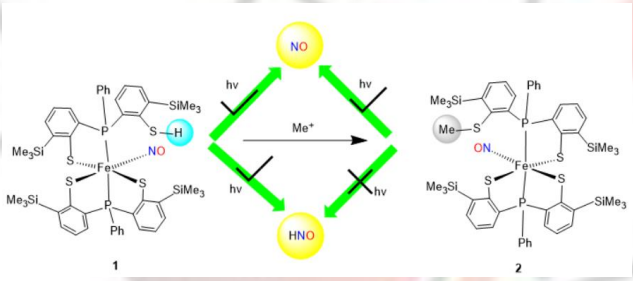
(C 組)應用科學系碩士班

Photoinduced NO and HNO Production from Mononuclear {FeNO}^{6} Complex Bearing a Pendant Thiol

Chien-Ming Lee,*a Ming-Hsi Chiang,*b Ming-Li Tsai,*c Chuan-Kuei Chiang,a Kai-Ti Chu,band Chia-Chin Lin,c

National Taitung University Department of Applied Sciene
a Department of Applied Science, National Taitung University, Taitung 950, Taiwan
b Institute of Chemistry, Academia Sinica, Taipei 115,Taiwan
c Department of Chemistry, National Sun Yat-sen University, Kaohsiung 804, Taiwan

Keywords: nitrosyl iron;complexe;nitric oxide;Nitroxyl



Two {FeNO}^{6} complexes (Enemark-Felthan notation), with pendant thiol [Fe(NO)(^{TMS}PS$_2$)(^{TMS}PS$_2$H)] (**1**), and pendant thioether [Fe(NO)(^{TMS}PS$_2$)(^{TMS}PS$_2$CH$_3$)] (**2**) has detailed analysis on the spectrum and structure. Both complexes are highly sensitive to visible light. After photolysis, the complex **2** cracked to produce NO, and the mononuclear Fe^{III} complex [Fe(^{TMS}PS$_2$)(^{TMS}PS$_2$CH$_3$)] (**3**) was generated. On the contrary,the Pendant group SH of **1** can act as a trap for NO radicals that leave when exposed to light, leading to the formation of intermediate **A** with intramolecular [SH---ON-Fe] interaction.

According to the calculation result (DFT), the NO bond vibration frequency (υ_{NO}) is sensitive to the intramolecular interaction between the pendant ligand SH and iron-bound NO. The subsequent photolysis of intermediate **A** leads to the formation of HNO and a sulfhydryl group, which then coordinates with the Fe

center to form [Fe(^{TMS}PS$_2$)$_2$](**4**). Photogenerated HNO can further react with [Mn^{III}(^{TMS}PS$_3$)(DABCO)] in an organic medium to generate anions [Mn(NO)(^{TMS}PS$_3$)]$^-$(**5**$^-$) with {MnNO}^{6} electronic configuration, while [Mn^{III}(^{TMS}PS$_3$) (DABCO)] reacts with NO gas to generate {MnNO}^{5} species [Mn(NO)(^{TMS}PS$_3$)] (**6**). By using [Mn^{III}(^{TMS}PS$_3$)(DABCO)], it is possible to effectively distinguish HNO formed from the complex **1** with side chain , SH from the formation of NO from complex **2** with side chain SMe

CFD 模擬日式玻璃溫室系統流場分析

國立臺東大學研究生：李惇皓

指導教授：朱力民博士

研究生：李惇皓學校單位名稱:國立臺東大學應用科學系

聯絡地址: 95092 臺東市大學路二段369 號連絡電話:089- 517820

指導教授:朱力民學校單位名稱:國立臺東大學應用科學系

聯絡地址: 95092 臺東市大學路二段369 號連絡電話:089-517976

Keywords:溫室(greenhouse);流體力學計算*(CFD)*;離散相模型*(DPM)*;噴霧;濕度;物聯網

過去台灣引進溫室目的為栽培蘭花等高經濟價值作物，由於台灣地理氣候因素與其他發展溫室的大陸型國家不同，國外溫室難以適應台灣全年性氣候特殊性，因而促使台灣溫室技術的發展。溫室種類可分為三種，結構型溫室、簡易型溫室與網室型，結構型以玻璃、玻璃浪板或塑膠布溫室為主。主要應用於研究、蘭花及種苗之生產。簡易型均以塑膠布為覆蓋，有些則以帆布為遮蔭，平時採開放天空之方式，主要以種植蔬菜、瓜類為主。網室型採用之紗網顏色則有綠、黑、白及藍等，可以調整不同之波長，以適應不同蔬菜之生長。

目前大多溫室實驗，皆須以實際建造溫室進行實驗，且經常無法得到理想之狀況，耗費大量資金與人力，研發成本過高。過去有相關溫室CFD模擬計算，但只能得到溫室內部溫度分布，對於溫室設計上的參考有限[12]。

本研究欲提出利用計算流體力學方法模擬日式玻璃溫室，使用(Species transfer)多物種模型與(Discrete Phase Model)離散相模型，在空氣中加入水蒸氣，考慮相對溼度，模擬溫室噴霧的粒子運動狀態，並以國立臺東專科學校-園藝暨景觀科日式玻璃溫室的實際狀況為考量，結合現代物聯網技術取得即時溫濕度變化，特過水牆、灑水和風扇控制，與模擬情況進行比較，使未來在溫室改良時，提供更多的參考依據。

References:

[1]方煒（1994）。水墻設計與使用。農業機械學刊，3（4），頁57-70。

[2]方煒（1995）。溫室蒸發冷卻系統降溫效果量化指標之建立。農業機械學刊，4（2），頁15-25。

[3]Arbel, A., Yekutieli, O., & Barak, M. (1999). Performance of a fog system for cooling greenhouses. Journal of Agricultural Engineering Research, 72(2), 129-136.

[4]黃裕益（1999）。噴霧冷卻法應用於臺灣地區塑膠布溫室內降溫之研究。農業機械學刊，8（4），頁17-27。

[5]尤建琳. (2002). 噴霧冷卻法配合擾流風扇於開放式溫室降溫之研究. (碩士), 國立中興大學, 台中市. Retrieved from https://hdl.handle.net/11296/tsvvc9

[6]秦銘志（2006）。CFD於溫室系統模擬之應用。國立屏東科技大學機械工程系，屏東縣。

[7]賴柏勳（2007）。溫室內低容量噴霧器與風扇配置關係之研究。國立中興大學生物產業機電工程學系所，台中市。

[8]Bournet, P.-E., & Boulard, T. (2010). Effect of ventilator configuration on the distributed climate of greenhouses: A review of experimental and CFD studies. Computers Electronics in Agriculture, 74(2), 195-217.

基於影像處理作為識別尖晶石型催化劑應用在有機染料降解效率之可行性研究

李雅華(Ya-Hua, Li)[1]，林志銘(Chih-Ming, Lin)[1]

國立台東大學應用科學系(Department of Applied Science, National Taitung University, Taitung, Taiwan)

Keywords:Rhodamine B; Peroxymonosulfate; Advanced oxidation processes; Degradation efficiency; Colorimetric

本論文透過OpenCV結合HSV彩色空間的影像辨識技術，研究以幀為單位之光譜圖量測的可行性，藉以分析有色汙染物其降解效率。實驗選定羅丹明B(Rhodamine B,RhB)螢光試劑作為目標汙染物，經由粉末催化劑以催化過一硫酸氫鉀(Peroxymonosulfate, PMS)所生成高度氧化能力的自由基，對於有機汙染物RhB進行降解，粉末催化劑為溶膠-凝膠燃燒合成法所製備而成的尖晶石型鈷鐵氧體，藉由改變溶膠-凝膠系統之熱處理溫度，探討在不同的合成條件之下，尖晶石型鈷鐵氧體對於催化PMS以致降解RhB汙染物的影響，為解決嘗試以影像辨識替代紫外光/可見光光譜儀的問題，使用Google Spreadsheet以及Microsoft Visual Basic for Application (VBA)來得到多維度像素值的微型資料庫；實驗結果顯示，由改變催化劑添加量、汙染物濃度、氧化劑添加量、反應液體容積的實驗中，成功建構一種基於影像辨識作為吸收光譜圖的測量方法，提出一個可快速於可見光之下分析RhB水溶液其降解效率的架構，由於吸收光譜圖存在有不可避免的脈衝雜訊，於一定光亮度之下的降解實驗，更能得到準確的吸收光譜圖。

References:

1. Pham, H.-H.;You, S.-J.;Wang, Y.-F.;Cao, M. T.; Pham, V.-V., Activation of potassium peroxymonosulfate for rhodamine B photocatalytic degradation over visible-light-driven conjugated polyvinyl chloride/Bi2O3 hybrid structure. *Sustainable Chemistry andPharmacy* **2021,***19*, 100367.

2. Kuntzleman, T. S.; Jacobson, E. C., Teaching Beer's Law and Absorption Spectrophotometry with a Smart Phone: A Substantially Simplified Protocol. *Journal of Chemical Education* **2016,***93*(7), 1249-1252

4-甲氧基吡啶作為可移除式導向基團輔助鈀金屬催化 9(10H)-吖啶酮之鄰位碳-氫鍵活化暨芳香基化反應研究

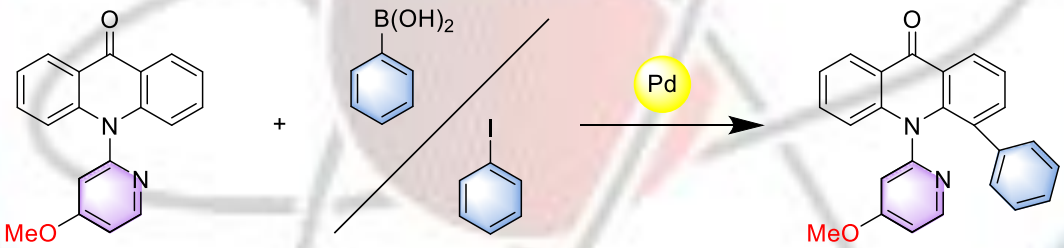
Palladium-Catalyzed ortho-C-H Bond Activation and Arylation of 9(10H)-Acridinone Using 4-Methoxypyridine as a Removable Directing Group

Wen-Chieh Lin (林妏潔), Jean-Ho Chu (朱見和)*

EMAIL:j_hchu@nttu.eddu.tw

Keywords: Palladium; C−H Bond Activation; Acridinone

本實驗主要是利用 2-溴-4-甲氧基吡啶作為鄰位可移除式導向基團協助鈀金屬催化 9(10*H*)-吖啶酮之鄰位碳-氫鍵芳香基化。10-(4 甲基氧吡啶-2-基)-9(10*H*)-吖啶酮反應用起始物可透過 2-溴-4-甲氧基吡啶與 9(10*H*)-吖啶酮進行烏爾曼反應後製備，進一步藉由苯硼酸以及碘苯作為偶合試劑利用催化量鈀金屬進行一系列有系統性的反應條件篩選，並測試反應官能基耐受性，最後提出可能的催化反應機制。



Optimization of reaction conditions

References:

2. Chu, J.-H.; Su, Z.-H.; Yen, K-W.; Chien, H.-I. *Organometallics* **2020**, *39*, 3168.

3. Chu, J.-H.; Wu, C.-C.; Chang, D.-H.; Lee, Y.-M.; Wu, M.-J. *Organometallics* **2013**, *32*, 272.

Synthesis of dibenzosuberones via palladium-mediated intramolecular C-H/C-H bond cross-coupling of *ortho*-aroylated 3,5-diarylisoxazoles and mechanistic investigation

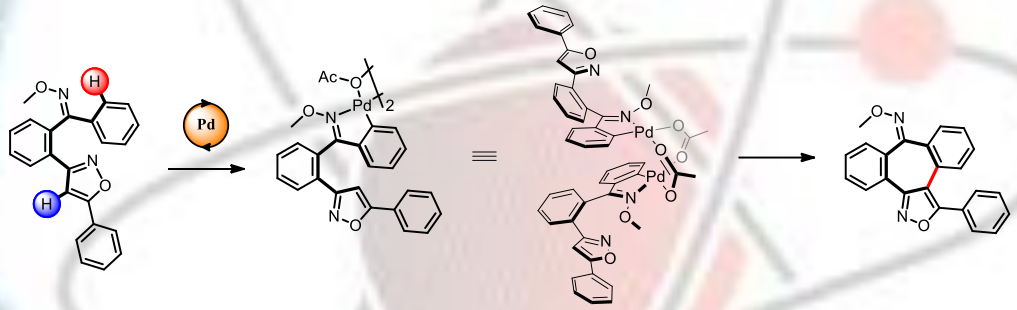
Ke-Liang Chen (陳科諒) and Jean-Ho Chu (朱見和)*

Department of Applied Science, National Taitung University

j_hchu@nttu.edu.tw

Keywords: dibenzosuberones;soxazole;palladium;C-H bond activation

A simple and efficient methodology for the synthesis of dibenzosuberones bearing an isoxazole group was presented. In the study, *ortho*-aroylated 3,5-diarylisoxazoles were employed as starting materials, in which the *O*-methyl oxime was utilized as a removable directing group. The reaction shows good functional group tolerance with modest-to-good yields. Finally, the structure of the key palladacycle was synthesized and confirmed by X-ray crystallography.



References:

1. Dastan, A.; Saracoglu, N.; Kilic, H. *Synthesis* **2018**, *50*, 391-439.
2. .Chao, T.; Su, Z. H.; Yen, K. W.; Wu, M. J.; Chu, J. H. *J. Org. Chem.* **2021**, *85*, 5559-5569.
3. Sahoo, S.; Pal, S. *J. Org. Chem.* **2021**, *86*, 4081-4097.

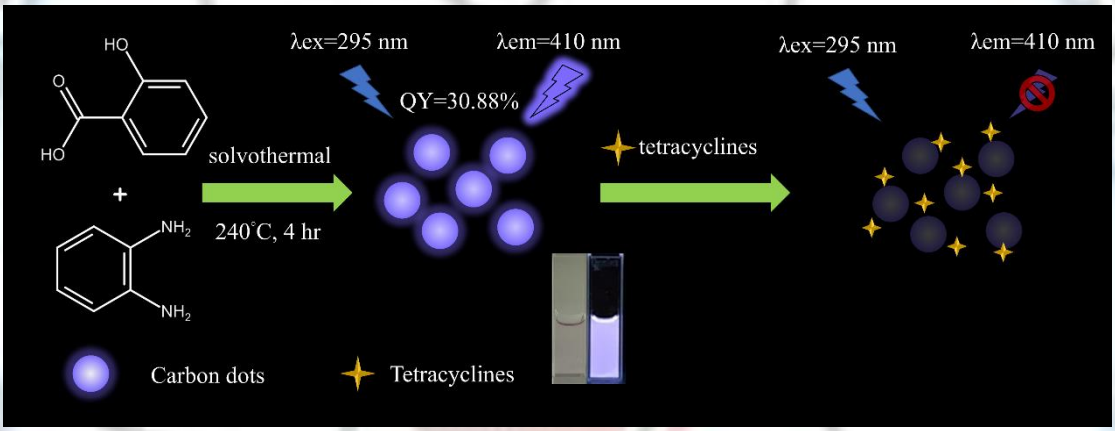
One-pot synthesis of a carbon dot-based fluorescent probe for selective detection of tetracyclines

Che-Hsie Chen, Tai-Chia Chiu* and Cho-Chun Hu*

Department of Applied Science, National Taitung University, Taitung, Taitung, Taiwan 95092

Keywords: Fluorescence; Carbon dots; Tetracycline; o-phenylenediamine

Bright-blue fluorescent carbon dots (CDs) with a quantum yield (QY) of 30.88% were synthesized using salicylic acid and *o*-phenylenediamine through one-pot solvothermal method[1,2]. The CDs were further employed as a fluorescent sensor for the detection of tetracycline (TC), oxytetracycline (OTC) and chlortetracycline (CTC) with high selectivity and sensitivity. The detection limits of TC, OTC and CTC were 4.02 μM, 1.121 μM and 0.69 μM, repsectively.



Scheme 1.

References

[1]. Jiang, K., Sun, S., Zhang, L., Lu, Y., Wu, A., Cai, C., & Lin, H*. *Angewandte chemie*, **2015**,127(18), 5450-5453.

[2]. Vedamalai, M., Periasamy, A. P., Wang, C. W., Tseng, Y. T., Ho, L. C., Shih, C. C., & Chang, H. T*.*Nanoscale*, **2014**, 6(21), 13119-13125.

Synthesis of Highly Fluorescent Bipyrazolo[1,5-*a*]pyridines Directed from Pyrazolo[1,5-*a*]pyridines *via* Palladium-Catalyzed Cross-Dehydrogenative Coupling Strategy

透過鈀金屬催化交叉脫氫偶聯策略進行高螢光性雙吡唑并[1,5-*a*]吡啶之合成研究

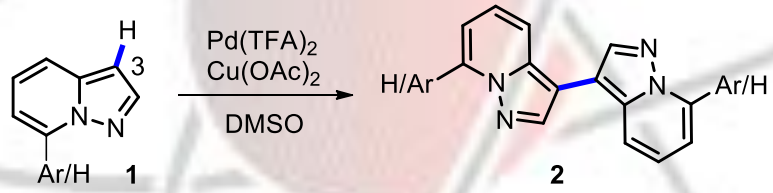
蕭普晏、黃睿洋、李侃昕、朱見和*

國立臺東大學應用科學系

j_hchu@nttu. edu.tw.

Keywords: Palladium; Pyrazolo[1,5-a]pyridines; Cross-Dehydrogenative Coupling

本研究藉由鈀金屬催化吡唑并[1,5-*a*]吡啶 (**1**) 於 3 號碳位進行自身偶聯反應生成吡唑并[1,5-*a*]吡啶雙聚物 (**2**) 伴隨中等至良好產率；再者我們亦對反應進行動力學同位素效應與控制實驗來深入探討機制過程。最後，藉由紫外-可見光與螢光光譜技術進行雙聚物分子之光物理性質量測。



References:

1. Bathel, P. A.; Campbell, A. D.; Goldberg, F, W.; Kemmit, P. D.; Lamont, G. M.; Sulemam, A. *Tetrahedron* **2012**, *68*, 5434-5444.
2. Wu, H.-C.; Chu, J.-H.; Li, C.-W.; Hwang, L. C.; Wu, M. J. *Organometallics* **2016**, *35*, 288-300.
3. Balkenhohl, M.; Salgues, B.; Hirai, T.; Karaghiosoff, K.; Knochel, P. *Org. Lett.* **2018**, *20*, 3114−3118.

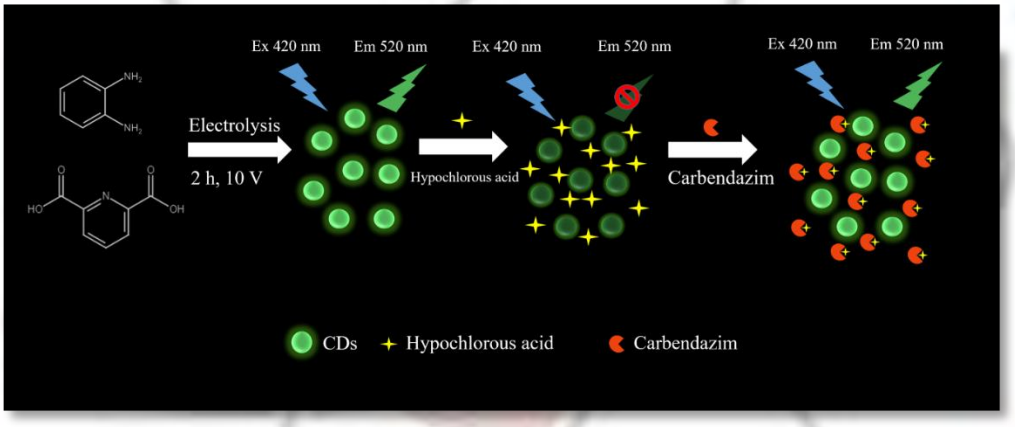
Facile synthesis of green emission fluorescent carbon dots as an “on-off-on” probe for detection hypochlorite acid and carbendazim

Kuan-Min Lo, Tai-Chia Chiu* and Cho-Chun Hu*

Department of Applied Science, National Taitung University, Taitung, Taiwan 95092

Keywords: Electrochemical generation; Carbon nanodots; Hypochlorous acid, Carbendazim

We developed a novel method for synthesizing green emission carbon dots (CDs) from pyridinedicarboxylic acid and o-phenylenediamine1 through electrolysis2 for 2 h. After synthesis, we developed a convenient and simple CD-based “on-off” fluorescent probe for detection of hypochlorite acid and carbendazim. Hypochlorite acid leads to the fluorescence quenching of CDs. The fluorescent quenching linearly correlates with the concentration of hypochlorite acid in the two range of 1-10 μM and 10-50 μM，R2=0.9962 and 0.9983. When carbendazim is added into the CDs + hypochlorite acid solution, causing the fluorescence recovery of CDs.



Scheme

References

[1]. (a) Vedamalai, M., Periasamy, A. P., Wang, C. W., Tseng, Y. T., Ho, L. C., Shih, C. C., & Chang, H. T. Nanoscale, 2014, 6.21: 13119-13125.

[2]. Roy, P., Chen, P. C., Periasamy, A. P., Chen, Y. N., & Chang, H. T. Materials Today, 2015, 18.8: 447-458.

三雄科技
SAN-HSIUNG TECHNOLOGY

國立臺東大學 應用科學系
地址: 臺東市大學路二段 369 號
e-mail: se@nttu.edu.tw
tel: 089-51797
校內分機: 6401
fax: 089-518108