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(A 組)應用科學系碩士班

Sodium alginate functionalized silver nanoparticles for colorimetric detection of dimethoate

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Keywords: colorimetric assay, dimethoate, silver nanoparticles, sodium alginate

Sodium alginate (SA) was used to functionalize the surface of silver nanoparticles (AgNPs) to form SA-AgNPs for sensing dimethoate with a rapid and sensitive visual readout. UV–Vis spectrophotometer, Fourier transform infrared spectroscopy and transmission electron microscopy, X-ray photoelectron spectroscopy, and zeta potential measurements were used to characterize SA-AgNPs that were synthesized under the ideal conditions. SA-AgNPs were spherical with an average size of 14.6 nm. The stability of SA-AgNPs was investigated towards changes in pH, salinity, and storage time. This colorimetric assay of dimethoate relied on the change in the absorption ratio (A_{475}/A_{400}) of SA-AgNPs, resulting in their aggregation caused by dimethoate, leading to a visual change of SA-AgNPs from yellow to pale yellow. As a result, the absorption ratio (A_{475}/A_{400}) of SA-AgNPs showed good linearity in the range of 0.05 to 2.0 ppm ($R^2 = 0.9986$) with a limit of detection (LOD) of 0.03 ppm. Adding other pesticides did not significantly change the absorption ratio of SA-AgNPs, indicating its high selectivity as a colorimetric assay. The sensor was successfully used to detect dimethoate in actual water samples.

References:

1. Su, Y.-C.; Lin, A.-Y.; Hu, C.-C.; Chiu, T.-C., Functionalized silver nanoparticles as colorimetric probes for sensing tricyclazole. *Food Chemistry* 2021, 347, 129044.
2. Dissanayake, N. M.; Arachchilage, J. S.; Samuels, T. A.; Obare, S. O., Highly sensitive plasmonic metal nanoparticle-based sensors for the detection of organophosphorus pesticides. *Talanta* 2019, 200, 218-227.

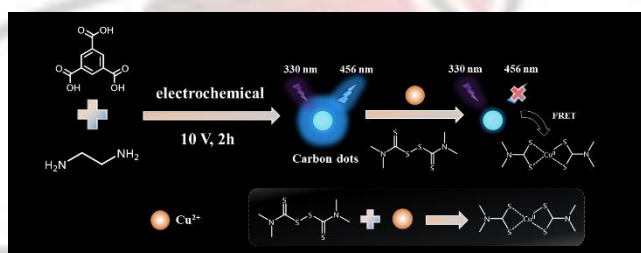
Electrochemical Synthesis of Carbon Dots for Highly Selective Detection of Thiram

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Keywords: Carbon dot; electrochemical; thiram; sensor

The carbon dots (CDs) were fabricated via electrochemical treatment using trimesic acid and ethylenediamine as precursors. The CDs exhibited blue fluorescence under ultraviolet irradiation and a maximum emission of 456 nm at an excitation wavelength of 330 nm; the calculated quantum yield was 22%. Thiram interacts with Cu^{2+} to form a complex with a characteristic absorption peak at 420 nm [1]. The fluorescence of the CDs can be quenched in the presence of the complex through fluorescence resonance energy transfer. Thus, the proposed method can be used to detect thiram with high selectivity and sensitivity. Under optimal conditions, the linear range was 0.3-3.75 ppm ($R^2 = 0.9992$) with limit of detection was 0.24 ppm.



Scheme 1 The proposed mechanism for sensing thiram based on fluorescent carbon dots via electrochemical synthetic process.

References

[1] Lewis, D.J.; Deshmukh, P.; Tedstone A. A.; Tuna, F.; O'Brien, P. "On the interaction of copper(II) with disulfiram", *Chemical Communications*. **2014**,50,13334-13337, DOI: 10.1039/C4CC04767B

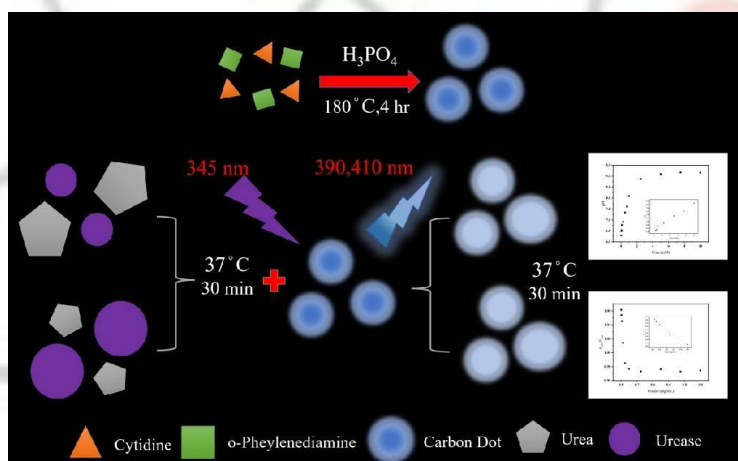
One-pot Synthesis Of P, N co-doped Carbon Dots For The Detection Of Urea And Urease

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Carbon dot, Urea, Urease

In this work, blue fluorescent carbon dots were synthesized by a one-pot facile synthesis using cytidine, o-Phenylenediamine, and phosphoric acid. Using urease to hydrolyze urea to produce NH_3 to change the pH value, it can be found that the carbon dots will increase in fluorescence as the pH value increases. The linear range of urea is 0.05-1 mM when urease is fixed at 0.5 mg/mL, $R^2 = 0.984$. The concentration of urease is detected under 1 mM urea^[1], the linear range of urease measured under the ratio fluorescence of F_{390}/F_{410} is 0.0025-0.05 mg/mL, $R^2 = 0.989$.



Scheme 1. Schematic illustration of P, N co-doped carbon dots synthetic process and used for the determination of urea and urease activity

References:

1. Liu, J.; Zhang, J.; Zhang, Y.; Wang, Y.; Wang, M.; Li, Z.; Wang, G.; Su, X., A pH-responsive fluorometric and colorimetric system based on silicon quantum dots and 4-nitrophenol for urease activity detection. *Talanta* **2022**, 237, 122956.

Established a medicine selected platform using planarians as model organisms

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Keywords: planarian ; double-headed

Planarians have an impressive ability to regenerate. Planarian neoblasts can differentiate into all the different tissue types found so far.^[1] The molecular mechanisms between neoblasts and their surrounding differentiated tissues are largely unknown. After trauma or surgery, planarians regenerate all missing tissue, returning to their form in about two weeks^[2]. From Morgan's experiments^[3], we found that simple surgery can cause many different regeneration patterns, and through simple chemical drug treatment, we can obtain various mutant patterns of planarians such as: double-headed, multi-eyed, and multi-headed. Finding the regularity of cell distribution information from these data will contribute to the development of planarian regeneration mechanism and regenerative medicine applications.



Figure 1. Double heads and synapses generated by addition of octanol

References:

1. R.C. Wong ,and M.F. Pera ,and A. “Pebay Role of gap junctions in embryonic and somatic stem cells”, Stem Cell Rev. ,4(2008),pp.283-292 DOI:10.1007/s12015-008-9038-9
2. Raymond ,C.,B.,Wong*; Martin , F.,Pera ; Alice Pébay :Role of Gap Junctions in Embryonic and Somatic Stem Cells. Stem Cell Reviews volume 4, pages283– 292 (2008) DOI: 10.1007/s12015-008-9038-9
3. T.H. Morgan:Regeneration in planarians Arch. Entw. Mech. Org., 10 (1900), pp.58-119, DOI:10.1007/BF02156347

(A 組)應用科學系化學組

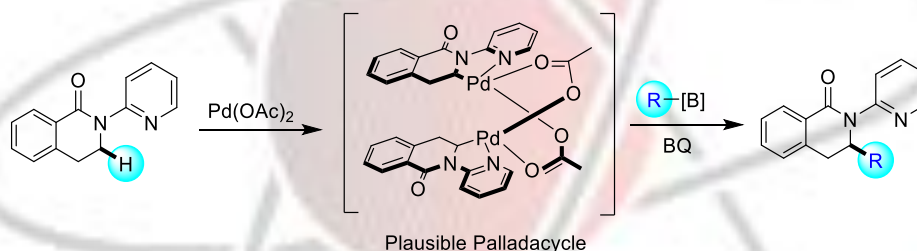
Palladium-Catalyzed C(sp³)-H Bond Activation and Arylation of 3,4-Dihydroisoquinolin-1(2H)-one Using Pyridine as a Removable Directing Group

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Keywords: Palladium, C(sp³)-H Bond Activation, 3,4-Dihydroisoquinolin-1(2H)-one

3,4-Dihydroisoquinolin-1(2H)-one 是一種重要天然生物鹼骨架分子，同時具有高度生物活性。本研究利用 3,4-Dihydroisoquinolin-1(2H)-one 作為起始物，結合吡啶 (pyridine) 導向基團，以鈀金屬催化對起始物進行碳(sp³)-氫鍵活化並進一步使用硼酸作為偶合試劑進行反應，我們可以成功合成出 3,4-Dihydroisoquinolin-1(2H)-one 之芳香基化衍生物，產物分子結構透過 ¹H NMR, ¹³C NMR 及 DEPT 光譜可確認。



References:

1. Chu, J.-H.; Su, Z.-H.; Yen, K.-W.; Chien, H.-I. *Organometallics* **2020**, 39, 3168–3179.
2. Ghosh, S.; Jana, C. K. *J. Org. Chem.* **2017**, 83, 260–266.
3. Forni, J. A.; Brzozowski, M.; Tsanaktsidis, J.; Savage, G. P.; Polyzos, A. *Aust. J. Chem.* **2015**, 68, 1890.

Electrochemical synthesis of B,N co-doped fluorescent carbon dots for sensing Hg(II) and cartap

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Keywords: 碳點、硼氮共摻雜、電化學、培丹、螢光

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摘要

本研究是以 3-胺基苯硼酸(3-Aminobenzenboronic acid ,ABBA)、蘋果酸(Malic acid ,MA)及 乙二胺 (ethylenediamine ,EDA) 為原料,以電化學法施加 10 V 電壓,2 小時合成硼氮共摻雜碳點 (BN-CDs)。此碳點發出藍色的螢光 ($\text{Ex} = 295 \text{ nm}$, $\text{Em} = 372 \text{ nm}$)的碳點,此碳點具有良好的水溶性及穩定性,透過 TEM、XPS、XRD、螢光光譜、UV-Vis 光譜及 FT-IR 光譜等研究其基本性質。以硫酸奎寧為參考物質,計算出碳點的螢光相對量子產率為 2.4 %。本研究提供了一種簡便且快速合成碳點的方法,用於檢測 Hg^{2+} 和培丹的高靈敏度螢光“開-關-開”感測器。且可應用於真實樣品中 Hg^{2+} 和培丹之檢測,檢測 Hg^{2+} 之線性範圍為 $0.1\text{-}80 \mu\text{M}$,LOD 為 8.9 nM,檢測培丹的線性範圍為 0.9-9 ppm,LOD 為 0.13ppm。在真實樣品中自來水的檢測 Hg^{2+} 和培丹的回收率分別為 95.3-104.5%、85.1-94.3 %。以上結果表示本方法可實際應用於真實水樣中 Hg^{2+} 及培丹之檢測。

References: (Times New Roman/標楷體, Single space, 10 point, ACS style, left-justified in numbered order)

1. -----Xu, X., et al., Electrophoretic Analysis and Purification of Fluorescent Single Walled Carbon Nanotube Fragments. Journal of the American Chemical Society, 2004. 126(40): p. 12736-12737.
2. -----Sun, Y.-P., et al., Quantum-Sized Carbon Dots for Bright and Colorful Photoluminescence. Journal of the American Chemical Society, 2006. 128(24): p. 7756-7757.

螢光素功能化的金奈米粒子以比色及螢光雙模式

選擇性檢測水中汞離子

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Keywords: 螢光素、金奈米粒子、汞離子、螢光共振能量轉移。

Text (Times New Roman/標楷體, Single space, 12 point, left-justified)

本研究開發一種簡單、方便且能以肉眼觀察的雙模式感測器用於檢測汞離子(mercury ion(II), Hg^{2+})，使用檸檬酸鈉(Sodium citrate dihydrate)作為保護劑及還原劑，以化學還原法將四氯金酸 (Sodium tetrachloroaurate(III) dihydrate)合成金奈米粒子(Gold nanoparticles, GNPs)，再加入螢光素(Fluorescein, FI)，完成金奈米粒子複合物(FI-GNPs)。在最佳化條件下，比例式螢光法檢測汞離子線性範圍介 $0.01\sim 10\ \mu\text{M}$ 之間， $R^2=0.9995$ ，偵測極限(LOD)為 3nM 。比色法檢測汞離子線性範圍介 $0.05\sim 5\ \mu\text{M}$ 之間， $R^2=0.9963$ ，偵測極限(LOD)為 14.6nM 。目前已成功運用於檢測飲用水中的汞離子，比例式螢光法與比色法的回收率分別為， $101.2\%\sim 104.4\%$ 與 $101.8\%\sim 104.5\%$ 之間。

References:

1. Guo, Y., et al., Hydrothermal synthesis of highly fluorescent carbon nanoparticles from sodium citrate and their use for the detection of mercury ions. Carbon, 2013. 52: p. 583-589.
2. Eksin, E., et al., Eco-friendly Sensors Developed by Herbal Based Silver Nanoparticles for Electrochemical Detection of Mercury (II) Ion. Electroanalysis, 2019. 31(6): p. 1075-1082.
3. Demirezen Yilmaz, D., D. Aksu Demirezen, and H. Mıhçıokur, Colorimetric detection of mercury ion using chlorophyll functionalized green silver nanoparticles in aqueous medium. Surf. Interfaces, 2021. 22: p. 100840.

Enhanced catalytic activity of tannic acid functionalized gold nanorods toward the reduction of 4-nitrophenol

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Keywords: 4-nitrophenol, catalytic reduction, gold nanorods, sodium borohydride, tannic acid

The conversion of 4-nitrophenol (4-NP) into 4-aminophenol (4-AP) with sodium borohydride (NaBH_4) is the most used chemical reaction for investigating the catalytic activity of various nanomaterials by ultraviolet–visible (UV–VIS) absorption spectroscopy. Herein, a simple approach is reported for the preparation of tannic acid-functionalized gold nanorods (TA-AuNRs), which functioned as catalysts for the reduction of 4-NP with NaBH_4 . Various processes including UV–VIS absorption spectroscopy, transmission electron microscopy, X-ray diffraction, Fourier transform infrared spectroscopy, zeta potential, and X-ray photoelectron spectroscopy were employed to characterize the TA-AuNRs. They exhibited good catalytic activity during the conversion of 4-NP. Under optimal conditions, the conversion efficiency was up to 79.04 % in 20 min. The reduction reaction followed the pseudo-first-order kinetics, and the rate constant was estimated to be 0.0827 min^{-1} . The active species responsible for the conversion efficiency were investigated through scavenger experiments using 1,4-benzoquinone, isopropyl alcohol (IPA), and ammonia oxalate as scavengers. The conversion efficiency decreased to 35.74 % in the presence of IPA, indicating that hydroxyl radicals were the main species that degraded 4-NP. Finally, five recycling steps confirmed the reusability and practical application potential of the TA-AuNRs for the catalytic reduction of water samples spiked with 4-NP.

References

1. M. Motamedi, L. Yerushalmi, F. Haghighat and Z. Chen, *Chemosphere*, 2022, **296**, 133688.
2. Z. Xiong, H. Zhang, W. Zhang, B. Lai and G. Yao, *Chem. Eng. J.*, 2019, **359**, 13–31.
3. A. Serrà, R. Artal, M. Pozo, J. Garcia-Amorós and E. Gómez, *Catalysts*, 2020, **10**, 458.

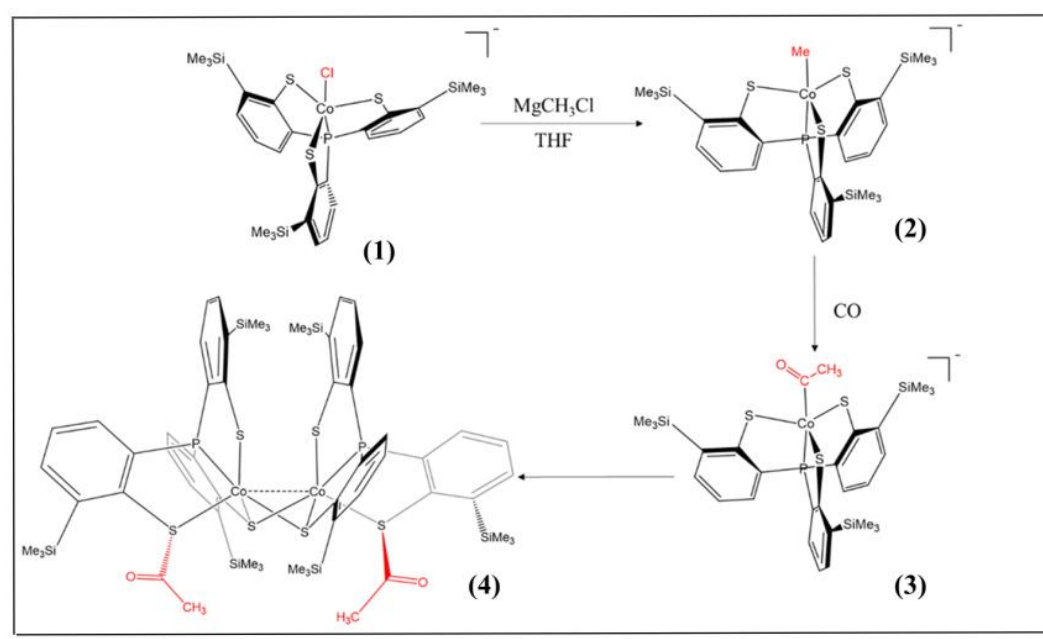
製備鈷-甲基硫磷錯合物之一氧化碳鍵入反應探討

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關鍵字: 一氧化碳鍵入、鈷、烴基

在氮氣環境下用 *n*-Butyllithium 與 $\text{P}(\text{C}_6\text{H}_3\text{-3-SiMe}_3\text{-2-SH})_3$ 進行反應，使其硫上的氫離去被鋰取代，並和 $\text{Co}(\text{acac})_3$ 、 $[\text{PPN}]\text{Cl}$ 反應產生錯合物 **1** $[\text{PPN}][\text{Co}^{\text{III}}(\text{Cl})\text{P}(\text{C}_6\text{H}_3\text{-3-SiMe}_3\text{-2-S})_3]$ ，再將 $[\text{PPN}][\text{Co}^{\text{III}}(\text{Cl})\text{P}(\text{C}_6\text{H}_3\text{-3-SiMe}_3\text{-2-S})_3]$ 與過量的格林試劑 MgCH_3Cl 反應，錯合物 **1** 上的氯離去並由甲基取代形成錯合物 **2** $[\text{PPN}][\text{Co}^{\text{III}}(\text{CH}_3)\text{P}(\text{C}_6\text{H}_3\text{-3-SiMe}_3\text{-2-S})_3]$ ，灌入 CO 與之反應，反應至紅棕色並抽乾，再加入 ether 過矽藻土純化出產物錯合物 **3** $[\text{PPN}][\text{Co}^{\text{II}}(\text{COCH}_3)\text{P}(\text{C}_6\text{H}_3\text{-3-SiMe}_3\text{-2-S})_3]$ ，揮發長晶完經由傅立葉轉換紅外線光譜儀中在 1741 cm^{-1} 有明顯訊號應為 CO Double bond，由 X-ray 晶體繞射發現了錯合物 **3** 上的乙醯基轉移至硫上形成雙核的結構的錯合物 **4** $[\text{Co}(\text{C}_6\text{H}_3\text{-3-SiMe}_3\text{-2-S-Ac})\text{P}(\text{C}_6\text{H}_3\text{-3-SiMe}_3\text{-2-S})_2]_2$ 。



References:

1. Can, M.; Armstrong, F. A.; Ragsdale, S. W., Structure, Function, and Mechanism of the Nickel Metalloenzymes, CO Dehydrogenase, and Acetyl-CoA Synthase. *Chem. Rev.* **2014**, *114* (8), 4149-4174.
2. Block, E.; Ofori-Okai, G.; Zubieta, J., 2-Phosphino- and 2-Phosphinylbenzenethiols: New Ligand Types. *J. Am. Chem. Soc.* **1989**, *111* (6), 2327-2329.

Electrochemical Activation Transition Metal

Dichalcogenides of Hydrogen Evolution Performance

電活化過渡金屬二硫屬化物之產氫效能

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Keywords:過渡金屬二硫屬化物, 產氫反應,液相剝離法

本研究以液相剝離法將 MoS_2 剝離為奈米片，再以一低電位不同活化時間測試其產氫效能明顯增加，其中最佳活化時間為 6 小時，在 10 電流密度（單位： mA/cm^2 ）的起始電位分別為 -0.323 V（相對於可逆氫電極, vs RHE），由塔佛方程式 (Tafel Equation, Tafel) 計算活化 6 小時 MoS_2 之 Tafel 斜率為 50 mV/dec， MoS_2 活化前的起始電位與 Tafel 斜率為 -0.679 V vs RHE 和 120 mV/dec。X 光電子能譜 (X-ray Photoelectron Spectroscopy, XPS) 鑑定材料活化後 Mo 3d 與 S 2p 軌域結合能呈現負位移，說明結構轉變為 1T 相，使低峰值的 1T 相分峰產生。以高解析穿透電子顯微鏡 (High-Resolution Transmission Electron Microscopy, HRTEM) 計算材料活化後之 MoS_2 (100) 晶面間距有部分為 1T 相，因此 TMDs 經活化後結構部分轉化為金屬相，以達到更好的產氫效率。

1. *Green Chem*, **2018**, 20 (2), 525-533
2. *Journal of Materials Science*, **2019**, 54 (13), 9656-9665

A colorimetric and ratiometric fluorescent dual-mode assay for the detection of Cartap based on carbon dots/golden nanoparticles nanocomposites

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碳點、金奈米粒子、雙模、農藥、快速

農藥主要用於抑制雜草和害蟲的生長以提高作物生產力，但其濫用和過度使用會造成環境污染並對人類健康產生不利的影響。其中培丹屬於胺基甲酸酯類化合物，也是在水稻種植中最常用的殺蟲劑，人體誤攝可能會造成頭痛、心悸、多器官截獲嚴重呼吸衰竭甚至死亡。因此本研究選擇以低成本開發的碳點及金奈米粒子複合物對其進行檢測。

1. Liu, G.; Jia, H.; Li, N.; Li, X.; Yu, Z.; Wang, J.; Song, Y., High-fluorescent carbon dots (CDs) originated from China grass carp scales (CGCS) for effective detection of Hg(II) ions. *Microchemical Journal* **2019**, 145, 718-728.
2. Li, J.; Li, M.; Tian, L.; Qiu, Y.; Yu, Q.; Wang, X.; Guo, R.; He, Q., Facile strategy by hyaluronic acid functional carbon dot-doxorubicin nanoparticles for CD44 targeted drug delivery and enhanced breast cancer therapy. *International Journal of Pharmaceutics* **2020**, 578, 119122.
3. Hoang, V. C.; Dave, K.; Gomes, V. G., Carbon quantum dot-based composites for energy storage and electrocatalysis: Mechanism, applications and future prospects. *Nano Energy* **2019**, 66, 104093.
4. Zhou, Q.; Yongli, L.; Wu, Y.; Li, Z.; Li, Y.; Liu, M.; Qu, T.; Chen, C., Measurement of mercury with highly selective fluorescent chemoprobe by carbon dots and silver nanoparticles. *Chemosphere* **2021**, 274, 129959.

A ratiometric fluorescent for the detection of penicillin G in water based on color tunability gold-silver nanoclusters	
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<i>CEW ; ATT ; AuAgNCs ; Penicillin G</i>	
Text (Times New Roman/標楷體, Single space, 12 point, left-justified) Abstract In this study, gold-silver nanoclusters (AuAgNCs) were synthesized using chicken egg white (CEW) and 6-aza-2-thiothymine (ATT) as dual ligands with strong yellow fluorescence at 509 and 689 nm for highly selective detection of Penicillin G. The method is based on the aggregation induced fluorescent quenching of AuAgNCs by Penicillin G. Under optimum conditions, the decrease of fluorescence intensity displayed a good linear correlation with the concentration of Penicillin G ranging from 0.2 μM to 6 μM, low detection limit of 18 nM. Furthermore, real sample analyses indicate that the as-presented sensor has potentials in Penicillin G determination in real sample analyses in 10 min. The recoveries of urine samples and water analyses are ranging from 99.66 % to 104 %. The results suggest the potential application of this approach for monitoring the level of Penicillin G in environmental samples. References: 1. Zhang, L. and E. Wang, <i>Metal nanoclusters: New fluorescent probes for sensors and bioimaging</i>. Nano Today, 2014. 9(1): p. 132-157. 2. Wang, J., et al., In vivo self-bio-imaging of tumors through in situ biosynthesized fluorescent gold nanoclusters. Sci. Rep., 2013. 3(1): p. 1157.	

鈀金屬催化 7-苯基吡唑并[1,5-a]吡啶之鄰位碳-氫鍵活化暨芳香基化反應 研究

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Keywords:

過度金屬催化/碳-氫鍵活化

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本次研究參考先前文獻製備吡唑[1,5-*a*]吡啶作為前驅物用以合成 7-苯基吡唑并[1,5-*a*]吡啶作為起始物，並進行 7-苯基吡唑并[1,5-*a*]吡啶的鄰位碳-氫活化的最佳化篩選，分別進行了氧化試劑種類、催化試劑種類、溶劑種類、是否需要鹼性環境、苯醌當量的篩選，為了更了解它的機制我們合成其中間體並確定結構，目前在嘗試在 7 號位上接上更多的芳香族取代基，希望可以拓展它未來可行性。

References: (Times New Roman/標楷體, Single space, 10 point, ACS style, left-justified in numbered order)

1. ----- Chu,J *; Hsiao,P; Chang,R; Sue,A; Liao,G; Lee,Y and Huang,J. Synthesis and Mechanistic Investigation of Bipyrazolo[1,5-*a*]pyridines via Palladium-Catalyzed Cross-Dehydrogenative Coupling of Pyrazolo[1,5-*a*]pyridines. J. Org. Chem. 2022, 87, 9851–9863.
2. ----- Chu,J * and Hsiao,P. Novel bipyrazolo[1,5-*a*]pyridine luminogens with aggregation-induced emission enhancement properties. Chem. Commun., 2021,57, 12281-12284

串聯式量子點發光二極體之研製與混光探究

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Tandem, Quantum dots, QLEDs, Ag NanoWire,

目前市面上的發光二極體(light -emitting diodes, LEDs)多數運用於顯示器或照明等發光工具，以紅(R)、綠(G)、藍(B)三原色的量子點(colloidal quantum dots, QDs)組成像素發出各種顏色乃至白光。運用R、G、B三原色的QDs串聯成一個LEDs的優勢^[1]在於可以讓顯示螢幕的畫質變得更加精緻。在此我們對串聯結構進行研究，透過表面處理、替換材料和溶劑等方式改善元件並對其所造成的色變進行探討，製作出以紅綠、藍綠、紅藍混光之元件亮度分別為14266cd/m²、13024 cd/m²、10695 cd/m²，實現以低成本、安全、簡單的方法製程出高效率之R、G、B三原色串聯QLEDs。在元件陰極部分我們嘗試用銀奈米線(ag nanowire, AgNW)代替鋁作為元件之透明電極，製程出綠光之發光元件。因為AgNW有良好的光學特性及可撓性^[2]，在近年來被廣泛地運用於發光二極體及太陽能電池上面^[3]。另外搭配軟性基板做成可撓式發光元件，此元件優點在於可彎折且不受物體形狀限制，可用於穿戴設備。

References:

- [1] Heng Zhang, Siting Wang, Xiaowei Sun, Shuming Chen. All solution-processed white quantum-dot light-emitting diodes with three-unit tandem structure. SID. 2017, 25(3), 143-150.
- [2] Liangbing Hu, Han Sun Kim, Jung-Yong Lee, Peter Peumans, Yi Cui. Scalable Coating and Properties of Transparent, Flexible, Silver Nanowire Electrodes. ACS Nano 2010, 4(5), 2955–2963
- [3] Yu, Z.; Li, L.; Zhang, Q.; Hu, W.; Pei, Q. Silver nanowire—Polymer composite electrodes for efficient polymer solar cells. Adv Mater. 2011, 23, 4453–4457.

探討 N-GQDs-CsPbIBr₂/TiO₂/Ti₃C₂ 氣凝膠對羅丹名 B 光催化降解之作用

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Keywords:(Times New Roman/標楷體, Single space, 12 point, Italics, Separated with semicolon, left-justified)

Text (Times New Roman/標楷體, Single space, 12 point, left-justified)

羅丹明 B (Rhodamine B, RhB)是一種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，並以多種的降解方式探詢有效率且環境友善的方法來進行汙水降解，並利用複合其材料以提升降解效率。

在本研究中利用一種新型二維材料 Ti₃C₂ MXenes。Ti₃C₂ 具有一些突出的特性，例如易於功能化、高表面積、親水性、生物相容性。目前發現，Ti₃C₂ 已顯示出作為有效降解各種污染物的助催化劑的潛力；即具有能形成 3D 結構的氣凝膠；最後 N-GQDs-CsPbIBr₂/TiO₂ 已經透過文獻得知具有良好的光催化效果，我們並與 Ti₃C₂ 氣凝膠複合。

本研究利用藉由 XRD 分析了複合材料的晶面，驗證材料結構正確，使用 SEM 拍攝及在實驗中的觀察，再透過 UV-vis 量測出 50mg TiO₂/Ti₃C₂ 20wt% Aerogel 及 60mgN-GQDs-CsPbIBr₂/TiO₂/Ti₃C₂30wt%Aerogel 皆有很好的降解效率，大約在兩小時就完全降解 RhB，但其穩定性不佳，所以最後得出 50mg N-GQDs-CsPbIBr₂/TiO₂/Ti₃C₂ 30wt% Aerogel 在約三小時完全降解完，這也遠比 N-GQDs-CsPbIBr₂/TiO₂ 所降解的時間來的快，且具有一定的穩定性。

1. Brown, M. A.; De Vito, S. C. Predicting Azo Dye Toxicity. Crit. Rev. Environ. Sci. Technol. 2009, 249–324.
2. Puvaneswari, N.; Muthukrishnan, J.; Gunasekaran, P. Toxicity Assessment and Microbial Degradation of azo dyes. Indian J. Exp. Biol. 2006, 44, 618–626.
3. Nakata, K.; Kagawa, T.; Sakai, M.; Liu, S.; Ochiai, T.; Sakai, H.; Murakami, T.; Abe, M.; Fujishima, A. Preparation and Photocatalytic Activity of Robust Titania Monoliths for Water Remediation. ACS Appl. Mater. Interfaces 2013, 5, 500–504

開發高穩定性之 ZnI_2 摻雜 CsPbI_3 鈣鈦礦量子點與 0D/2D 鈣鈦礦混合結構之應用

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Keywords: *quantum dots*、 CsPbI_3 、Zero-dimensional、perovskite

近年來鈣鈦礦材料在光電應用上具有強大的潛力，可以被加工用於光電元件的薄膜，包括太陽能電池，光電感測器和發光二極體，其中影響商業應用的最大挑戰是元件的穩定性，這主要是由於它們對周圍環境中的水分、氧氣和極性溶劑具有高敏感性。因此本研究使用高溫注入的方式來合成 CsPbI_3 鈣鈦礦量子點(Perovskite quantum dots, PQDs)，因為量子侷限效應，具有卓越的吸收能力和出色的光致發光 (PL) 特性，並透過 ZnI_2 的摻雜提高 CsPbI_3 QDs 的穩定性。 $\text{CsPb}_{(1-x)}\text{Zn}_x\text{I}_3$ QDs 可使鈣鈦礦太陽能電池在高濕度和高氧的環境下工作，還因為量子點的晶體結構在高極性溶劑及高溫環境下不會產生相變化，因此可在光催化領域做新興應用。

References:

- [1] Enzheng Shi, Yao Gao, Blake P. Finkenauer, Akriti, Aidan H. Coffey and Letian. Two-dimensional halide perovskite nanomaterials and heterostructures. Chemical Society Reviews, 2018,47, 6046-6072.
- [2] Protesescu, L.; Yakunin, S.; Bodnarchuk, M.I.; Krieg, F.; Caputo, R.; Hendon, C.H.; Yang, R.X.; Walsh, A.; Kovalenko, M.V. Nanocrystals of cesium lead halide perovskites (CsPbX_3 , X = Cl, Br, and I): Novel optoelectronic materials showing bright emission with wide color gamut. Nano Lett. 2015, 15, 3692– 3696.
- [3] Lin, H., Zhou, C., Tian, Y., Siegrist, T., & Ma, B. (2017). Low-dimensional organometal halide perovskites. ACS Energy Letters, 3(1), 54-62.

**Development of the ultra-high transparent conducting oxide multi-layer
thin film using the sputtering method**

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Keywords:Flexible transparent electrodes,Amorphous indium-gallium-zinc-oxide (a-IGZO),Oxide-metal-oxide (OMO),Thin film transistor (TFT)

Text

In recent years, the optoelectronic industry has developed rapidly along with cutting-edge technology, and modern people have higher and higher requirements for quality of life, so consumer electronics products have become the focus of attention. Among them, transparent conductive oxide films (Transparent Conductive Oxides, TCO) are widely used as transparent electrodes in solar cells, light emitting diodes, flat panel displays, touch panels, and the like. The oxide/metal/oxide (Oxide/metal/oxide, OMO) multilayer structure is a structure that scientists have been studying vigorously in recent years. This electrode material has excellent performance in electrical, optical and mechanical properties. Adding an ultra-thin metal layer in the middle of the oxide provides a current path through which electrons can also flow with low resistivity. In addition, the anti-reflection effect of the OMO multilayer structure makes them have high transmittance in the visible light range.

References:

1. Yun Cheol Kim, Su Jeong Lee, Il-Kwon Oh, Seunggi Seo, Hyungjun Kim, Jae-Min Myoung(2016). Bending stability of flexible amorphous IGZO thin film transistors with transparent IZO/Ag/IZO oxide-metal-oxide electrodes. *Journal of Alloys and Compounds*,688, 0925-8388.
2. V. Senthilkumar, P. Vickraman, M. Jayachandran, C. Sanjeeviraja, Struoptical properties of indium tin oxide (ITO) thin films with different compositions prepared by electron beam evaporation, *Vacuum*, 84, 6, (2010)864-869.
3. H.A. Wahab, A.A. Salama, A.A. El-Saeid, O. Nur, M. Willander, I.K. Battisha,Optical, structural and morphological studies of (ZnO) nano-rod thin films for biosensor applications using sol gel technique, *Results Phys.* 3, (2013)46 - 51.

常溫合成鋅離子摻雜溴化銫鉛(CsPbBr_3)鈣鈦礦奈米晶體之研究

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Keywords: CsPbBr_3 : Zn、常溫合成、鈣鈦礦奈米晶體

在鈣鈦礦奈米晶體的研究上，已經有不下少數的文章表明在大氣下的常溫合成(1)，能提高光致發光量子產率(PLQY)，而這次研究的鈣鈦礦奈米晶體(CsPbBr_3 : Zn NC) (2)其最大的好處是材料容易取得、合成過程迅速，但缺點是合成過後沒辦法迅速達到反應終點，因此我們將研究主軸放在材料合成的方式與添加物的比例，使其能在一般大氣下具有良好的保存效果與更佳的PLQY，並找到更能夠讓材料快速到達反應終點的方法與更好的純化方案使其分散性及其成膜的性質提升，最後再應用於元件製成。

References:

1. Jizhong Song,* Jinhang Li, Leimeng Xu, Jianhai Li, Fengjuan Zhang, Boning Han, Qingsong Shan, and Haibo Zeng*, Room-Temperature Triple-Ligand Surface Engineering Synergistically Boosts Ink Stability, Recombination Dynamics, and Charge Injection toward EQE-11.6% Perovskite QLEDs
2. Yong-Tang Zeng 1, Zhan-Rong Li 1, Sheng-Po Chang 2, Arjun Ansary 3, Zi-Hao Wang 2,4,* and Chun-Yuan Huang, Bright CsPbBr_3 Perovskite Nanocrystals with Improved Stability by In-Situ Zn-Doping
3. Jizhong Song, Tao Fang, Jianhai Li, Leimeng Xu, Fengjuan Zhang, Boning Han, Qingsong Shan, and Haibo Zeng, Organic-Inorganic Hybrid Passivation Enables Perovskite QLEDs with an EQE of 16.48%

CsPbBr₃ 鈣鈦礦元件製程及表面鈍化

劉享諺

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Keywords : 鈣鈦礦、發光二極體

發光二極體常用的電洞傳輸層為 PEDOT:PSS，因其為透明導電聚合物且具有良好的離子導電性，但此材料的缺點為弱酸性且具有些微的腐蝕性，因此我們將電洞傳輸層改為 PEDOT:PSS/PVK，使用 PVK 可讓鈣鈦礦前體溶液旋塗後具有更好的表面形貌以及提升電洞的躍遷能力，亮度從 1320cd/m² 提升到 3975cd/m²、效率從 0.22cd/A 提升至 1.06cd/A，元件 EL 波峰位置位於 513nm。在電子傳輸層方面，因為水相 ZnO 之溶劑 EtOH 塗佈於鈣鈦礦上後會使表面形成霧面導致元件效能大幅下降，因此我們將水相 ZnO 改質成油相，其塗佈後不會使表面霧化，反而使元件可以正常運行且亮度達到 441cd/m²，元件 EL 波峰位置位於 507nm。

References:

1. 林中冠、賴敏良、李君婷(民 107 年 08 月 06 日)。新世代鈣鈦礦材料:合成、光電特性及應用【物理雙月刊】
 2. A. Borenstein, Maher F. El-Kady, Christopher L. Turner, H. Wang, Adam Z. Stieg, and L. Pilon, Hybrid Transparent
 3. PEDOT:PSS Molybdenum Oxide Battery-like Supercapacitors. *ACS Appl. Energy Mater.* 2019, 2, 7, 4629–4639
- 液態製程白光 OLED 發展現況 【材料世界網】
4. Y.Liu, X. Wei, Z. Li, J. Liu, R. Wang, X. Hu, P. Wang, Yukiko Yamada-Takamura, T. Qi, and Y. Wang, Highly Efficient, Solution-Processed Organic Light-Emitting Diodes Based on Thermally Activated Delayed-Fluorescence Emitter with a Mixed Polymer Interlayer. *ACS Appl. Energy Mater.* 2018, 1, 2, 543–551

Ag leaf/Cu₂O tree/Ni foam 3D Nanocomposites as a Ultra High Efficiency Photocathode for Hydrogen Evolution Reaction

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electrocatalyst hybrid foam Cu₂O–Cu dendrite core–shell structure

氫是一種重要的可再生和清潔能源，因為其能量含量高，並且具有通過燃料電池和電池裝置提供可持續能源的巨大潛力。氫可以通過光催化或電催化(析氫反應，HER)分解水或通過氮硼烷的水解或太陽能製氫來獲得。

電化學制氫催化劑主要有過渡金屬氧化物、硫化物、碳化物和磷化物。然而，大部分電化學效率並不令人滿意，主要是由於光生電子空穴的分離效率低和催化劑穩定性差。提高光催化性能的常用策略引入二次半導體或電荷轉移介體和優化形態。與半導體一起，貴金屬顆粒，如 Au、Pt、Ag 等，通常用作電荷轉移介質，以加速電子-空穴分離，從而提高電催化性能製氫效率。

氧化亞銅(Cu₂O)是一種 p 型半導體，具有 1.9-2.2eV 的直接帶隙，在多個領域有廣泛的應用，由於成本較低而受到特別關注和廣泛的可用性，Cu₂O 作為電催化劑的廣泛應用受到其固有的低電導率和不穩定性的限制。目前，設計和製造具有高催化活性和耐久性的 Cu₂O 作為電催化劑仍然是面臨的巨大挑戰。

金屬/金屬氧化物核殼結構可以解決金屬氧化物導電性差的問題。鎳海綿三維多孔結構可以提供高活性點表面積，因此可以最大限度地提高催化劑的可用性並提供活性物質的快速傳輸。

在研究中利用五水硫酸銅溶液通過電沉積法合成 Cu/Cu₂O 樹狀結構，並且在樹狀結構上利用銀奈米粒子溶液，透過氧化還原置換法製備 Ag/Cu_xO/NF 樹狀結構。

研究的目的是了解(銅基氧化物和 Ag)對電催化的影響。我們合成了 Ag/Cu_xO/NF 樹枝狀奈米複合材料，利用電化學工作站(Electrochemical workstation)研究了製氫反應(HER)的電催化性能，並且成功達成塔佛斜率 54mV/dec⁻¹，對於綠色環境又前進大大的一步。

References: (Times New Roman/標楷體, Single space, 10 point, ACS style, left-justified in numbered order)

1. Lewis, N. S.; Nocera, D. G., Powering the planet: Chemical challenges in solar energy utilization. PNAS 2006, 103 (43), 15729-15735.
2. IEA In Global Hydrogen Review 2021, IEA Paris, France: 2021.
3. Medford, A. J.; Vojvodic, A.; Hummelshøj, J. S.; Voss, J.; Abild-Pedersen, F.; Studt, F.; Bligaard, T.; Nilsson, A.; Nørskov, J. K., From the Sabatier principle to a predictive theory of transition-metal heterogeneous catalysis. Journal of Catalysis 2015, 328, 36-42.

液態半圓鏡表面電漿波共振感測器之開發與模擬

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表面電漿波共振 液態半圓鏡 光學模擬

TEXT:

有別於傳統的菱鏡耦合式表面電漿波共振感測器，本研究提出以液態半圓鏡作為表面電漿波共振之耦合中介元件，而不使用固態菱鏡，因此我們可以很彈性地調控液態半圓鏡之折射率，進而改變產生表面電漿波共振之雷射光的入射角度，針對特定的待測樣品，利用液態半圓鏡的折射率調整可找出具有最佳靈敏度的共振角位置。

參考文獻:

Ref.1 Raether, H. Surface Plasmons on Smooth and Rough Surfaces and on Gratings. In Springer Tracts in Modern Physics, 1st ed.; Springer-Verlag: Berlin, Germany, 1988; Volume 111, pp. 4–39.



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