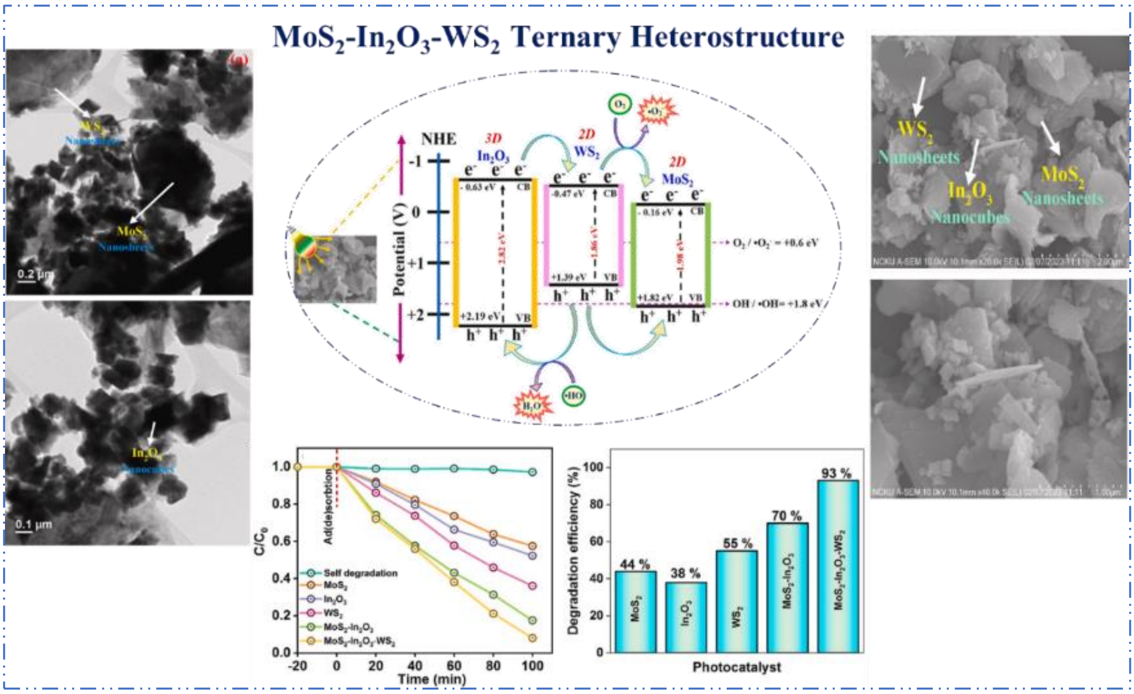
# 庫碼 教授

## 生命科學院/醫藥暨應用化學系

- 2024 年史丹佛大學全球前 2%頂尖科學家
- 中國工程師學會 112 年度「工程論文獎」
- 本校 2019-2023 年研究績優教師優秀論文獎
- 本校 2020-2023 年研究成果績優獎年輕教師組
- 2023 年高雄醫學大學與國立中山大學合作研究優秀獎
- 本校 2021、2023 年產學合作優良獎

製備具有強相互作用的三元複合光催化奈米材料對於在可見光下高效分離電荷，並實現有機污染物的光降解，對於廢水處理具有重要意義。本研究中，通過簡單的水熱法合成了新型三元 2D/3D/2D $MoS_2$-$In_2O_3$-$WS_2$ 多奈米結構。XRD、FTIR 和 XPS 分析結果證實了純 $MoS_2$、$MoS_2$-$In_2O_3$ 以及 $MoS_2$-$In_2O_3$-$WS_2$ 複合物的晶相、官能團及元素組成。$MoS_2$-$In_2O_3$-$WS_2$ 三元複合材料的 UV-DRS 光譜顯示，該材料在可見光範圍內具有最大吸收，帶隙能量為 2.4 eV。2D $WS_2$ 奈米片結構的表面與 2D $MoS_2$ 奈米片和 3D $In_2O_3$ 奈米立方體緊密結合並均勻分散，進一步證實了 $MoS_2$-$In_2O_3$-$WS_2$ 三元複合物以 2D/3D/2D 多奈米結構形式的成



功構建，這一點亦可從 SEM 與 HR-TEM 影像中得到支持。所合成的 $MoS_2$-$In_2O_3$-$WS_2$三元複合材料在可見光照射下顯示出對抗菌劑（如三氯生（TCS）與三氯卡班（TCC））的卓越光催化活性，其中 TCS 的光催化降解率在 90 分鐘後達到 95%，而 TCC 則在 100 分鐘後達到 93%。經過四次連續光催化循環後，使用 FTIR 與 SEM 分析所製備的 $MoS_2$-$In_2O_3$-$WS_2$三元複合材料的再使用性與穩定性，結果顯示該材料具有良好的穩定性與可重複使用性。綜合結果表明，所開發的 $MoS_2$-$In_2O_3$-$WS_2$（2D/3D/2D）多奈米結構作為光催化劑，具有低成本且環保的優勢，展現出在廢水中去除抗菌劑的潛力。

**擔任國內/國際知名學術期刊編輯或評審委員：**

1. 擔任 108 年~113 年食品藥物管理署(TFDA)研究檢驗組(醫療器材及化粧品科)之評審委員。
2. Associate Editor for Analytical Chemistry Section in Frontiers in Chemistry (IF-5.5, from 2020/02 to till now)
3. Review Editor for Water and Wastewater Management Section in Frontiers in Environmental Science (IF-4.6, from 2020/04 to till now)
4. Review Editor for Bioenergy and Biofuels in Frontiers in Energy Research (IF-3.4, from 2020/04 to till now)
5. Special Issue Editor - 3 Biotech (Springer) (IF-2.9, since 2020/02 to 2020/06)
6. Special Issue Editor- Bioresource Technology Journal (Science Direct, IF-11.5, since 2020/11 to 2020/12)
7. Editorial Panel Member in Ecronicon Chemistry Journal (open access, UK) from 2017/01 to till now)
8. Editorial Board Member in the journal - Maejo International Journal of Energy and Environmental Communication (MIJEEC) since 2017. ISSN (Print): 2673-0537 to till now.
9. Peer Reviewer in more than 40 SCI journals since 2010.
10. Master and PhD students' thesis examiner: (15 master thesis, 10 PhD thesis)
11. 擔任 107 年與 110 年高雄國際儀器暨化工展之研究論文壁報評審委員。

【研究團隊】

**團隊成員：**庫碼教授、蔡沛倩、Uday Shashikumar、Jeganathan Chinnadurai、黃正德、Pravallika Chittem Reddy、胡世韜、Gnanasundaram Sivalingam、李冠億、王兆恩、呂冠嫜等(https://kumarslab.wixsite.com/kumarslab)

**團隊簡介：**庫碼教授領導一支跨學科的國際研究團隊，專精於先進分析技術、奈米材料合成及其在環境監測、生物醫學診斷和能源儲存等領域的創新應用。該團隊結合了質譜學、色譜學、電化學和材料科學的深厚專業知識，致力於開發前沿且高效的方法來解決複雜的分析挑戰。團隊秉持綠色化學和可持續技術的核心理念，並與醫療專業人士、環境機構及業界夥伴緊密合作，將實驗室的創新成果轉化為具有實際價值的應用技術，致力於改善公共健康、保護環境和推動能源領域的可持續發展。

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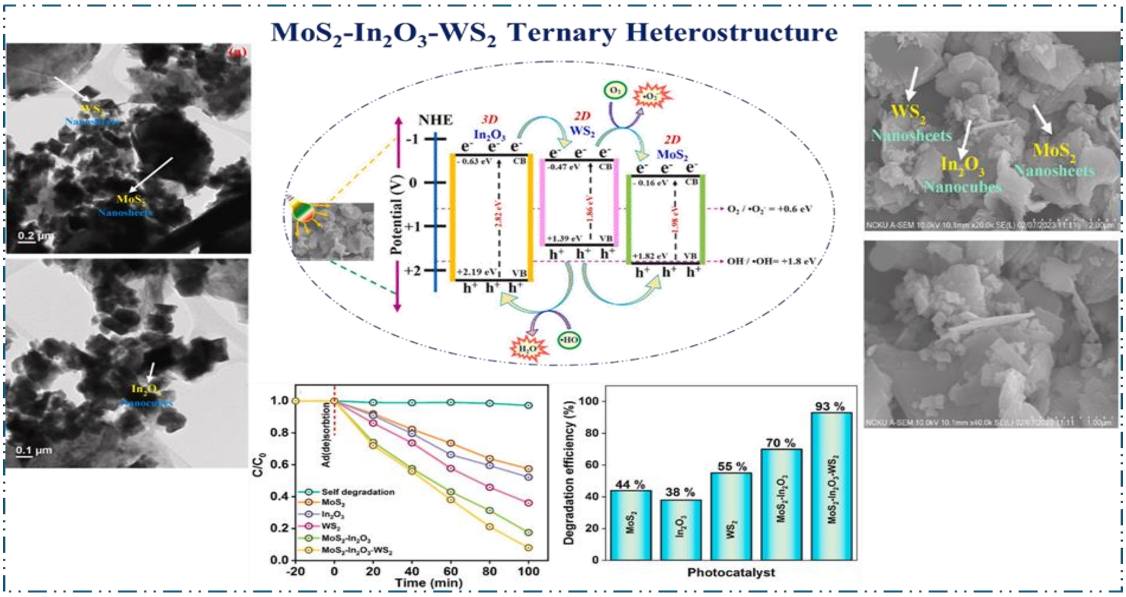
Fabrication of ternary composited photocatalytic nanomaterials with strong interaction is vital to deriving the fast charge separation for efficient photodegradation of organic contaminants in wastewater under visible light. In this work, novel ternary 2D/3D/2D MoS2-In2O3-WS2 multi-nanostructures were synthesized using facile hydrothermal processes. XRD, FTIR, and XPS results confirmed the phase, functional groups, and element composition of pure MoS2, MoS2-In2O3, and MoS2-In2O3-WS2 hybrids. UV-DRS spectra of the MoS2-In2O3-WS2 ternary hybrid indicate maximum absorption in the visible light range with a band-gap energy value of 2.4 eV. The surface of the 2D WS2 nanosheet structure tightly blends and densely disperses 2D MoS2 nanosheets and 3D In2O3 nanocubes. This confirmed the formation of the MoS2-In2O3-WS2 ternary hybrid in the form of 2D/3D/2D multi-nanostructures, which is also indicated from SEM and HR-TEM images. The synthesized MoS2-In2O3-WS2 ternary hybrid showed maximum photocatalytic activity under visible-light for antimicrobial agents such as triclosan (TCS) and trichlorocarban (TCC). The photocatalytic activity of TCS was revealed to be 95% at 90 min, while that of TCC was 93% at 100 min. The reusability and stability tests of the prepared MoS2-In2O3-WS2 ternary hybrid after four consecutive photocatalytic cycles were analyzed by FTIR and SEM, which indicated that the prepared ternary hybrid was very stable. Overall results suggested that the developed MoS2-In2O3-WS2 (2D/3D/2D) multi-nanostructures are environmentally friendly and low-cost nanocomposites as a potential photocatalyst for the removal of antimicrobial agents from wastewater.




## Concrete Results:

In a groundbreaking study, researchers from Kaohsiung Medical University (KMU) have engineered a revolutionary nanomaterial that promises to transform the field of environmental remediation. The team, led by Prof. Vinoth Kumar Ponnusamy, has successfully synthesized a novel ternary hybrid material capable of efficiently removing harmful antimicrobial agents from wastewater.

## Key Innovations:

1. Multi-Dimensional Nanostructure: The team developed a unique 2D/3D/2D multi-nanostructure combining $MoS_2$, $In_2O_3$, and $WS_2$. This innovative design maximizes surface area and enhances photocatalytic activity.

2. Superior Photocatalytic Performance: The new material demonstrated remarkable efficiency in degrading triclosan (TCS) and triclocarban (TCC), two prevalent and persistent water pollutants. It achieved a 95% removal rate for TCS in just 90 minutes and a 93% removal rate for TCC in 100 minutes under visible light.

3. Sustainable and Eco-Friendly:Utilizing visible light for catalysis, this material offers a green solution for water treatment, reducing the need for harsh chemicals or energy-intensive processes.

4. Reusability and Stability: The nanomaterial showed excellent stability, maintaining high efficiency even after multiple use cycles, promising cost-effective long-term applications.

**Implications and Future Prospects:**

This research opens new avenues for addressing the growing concern of pharmaceutical pollutants in water systems. The material's ability to efficiently remove antimicrobial agents under visible light conditions makes it a promising candidate for large-scale water treatment applications.

"Our team's work represents a significant step forward in developing sustainable solutions for water purification," says Prof. Ponnusamy. "This novel nanomaterial not only addresses current environmental challenges but also paves the way for future innovations in clean water technology."

The study, published in the prestigious journal Environmental Research, showcases KMU's commitment to cutting-edge research in environmental science and nanotechnology. This breakthrough aligns with global efforts to achieve clean water and sanitation goals, highlighting KMU's role in advancing sustainable development technologies.

**Additional Innovations:**

KMU's research prowess extends beyond environmental remediation. Recent works from Prof. Ponnusamy's lab include:

1. Development of advanced breath analysis techniques for early cancer detection, utilizing innovative thermal desorption methods.
2. Creation of highly sensitive electrochemical sensors for simultaneous detection of multiple drugs in human blood samples.
3. Pioneering work in green analytical methodologies for monitoring emerging pollutants in water and biological samples.

These diverse research streams underscore KMU's holistic approach to addressing pressing global health and environmental challenges through interdisciplinary scientific innovation.

## 【Research Team】

**Team Members:** Prof Vinoth Kumar Ponnusamy、Pei-Chien Tsai、Uday Shashikumar、Jeganathan Chinnadurai、Cheng-Te Huang、Pravallika Chittem Reddy、Shih-Tao Hu、Gnanasundaram Sivalingam、Kuan-Yi Li、Jhoen-En Wang、Kuan-Hua Lu (https://kumarslab.wixsite.com/kumarslab)

**Research Team Introduction:**

Prof. Vinoth Kumar leads a multidisciplinary research team specializing in advanced analytical techniques, nanomaterial synthesis, and their applications in environmental monitoring, biomedical diagnostics, and energy storage. The team combines expertise in mass spectrometry, chromatography, electrochemistry, and materials science to develop cutting-edge methodologies for complex analytical challenges. With a focus on green chemistry and sustainable technologies, the team collaborates closely with medical professionals, environmental agencies, and industry partners to translate laboratory innovations into practical applications.

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