

2025 國立屏東大學理學院 中長程計畫暨各系特色成果展示會

應用物理系-材料開發實驗室
主持老師:李建興教授

期刊與會議論文發表

- Jun-Ting Chen and **Jiann-Shing Lee**, "Synthesis and Magnetic Characterization of Sm₂Fe₁₇N₃ Powder" 2025台灣磁性技術協會年會暨第37屆磁學與磁性技術研討會，新竹。
- Jhih-Hao Ke, Ching-Wen Pan and **Jiann-Shing Lee**, "Synthesis and Characterization of Magnetic Manganese Ferrites", Annual Meeting of the Physical Society of Taiwan, 2025, Kaohsiung.
- Yu-Hui Xue and **Jiann-Shing Lee**, "The Synthesis and Luminescence Properties of ZnO-doped Y₂O₃ Ceramics", 2025 AMN conference, New Zealand.

學生的學習與表現



▲ 2025-03-03由陳奕維同學為泰國孔敬大學教師參訪團介紹實驗室的儀器設備。



▲ 2025-03-10由蘇翔億同學為捷克的大學教師參訪團介紹實驗室的儀器設備。



▲ 2025-04-08由蘇翔億同學為來自捷克的天文研究參訪團介紹實驗室的儀器設備。

應用物理系

陳均庭同學

獲補助114年度國科會
大專學生研究計畫！

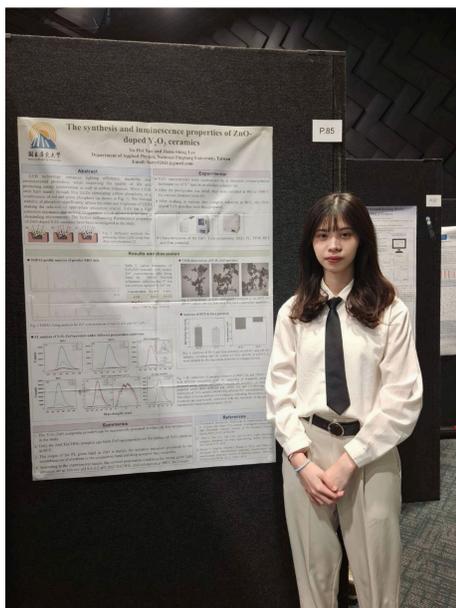
計畫名稱：鈔鐵氮永磁粉體製備之
研究
指導教授：李建興老師

應用物理系

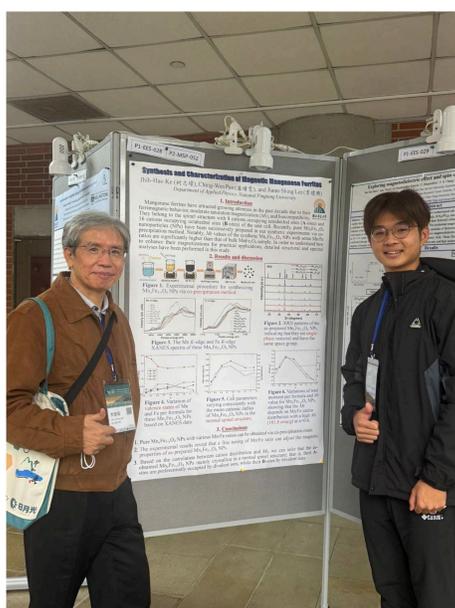
陳奕維同學

獲補助114年度國科會
大專學生研究計畫！

計畫名稱：以玻璃纖維作為奈米金
表面增強拉曼散射基底之研究
指導教授：李建興老師



▲ 2025-02-12薛郁卉同學赴紐西蘭參加11屆AMN conference的壁報論文發表。



▲ 柯志壕同學赴高雄中山大學參加2025年台灣物理年會壁報論文發表。



▲ 2025-07-16陳均庭同學赴陽明交通大學參加2025年磁學與磁性技術研討會壁報論文發表。

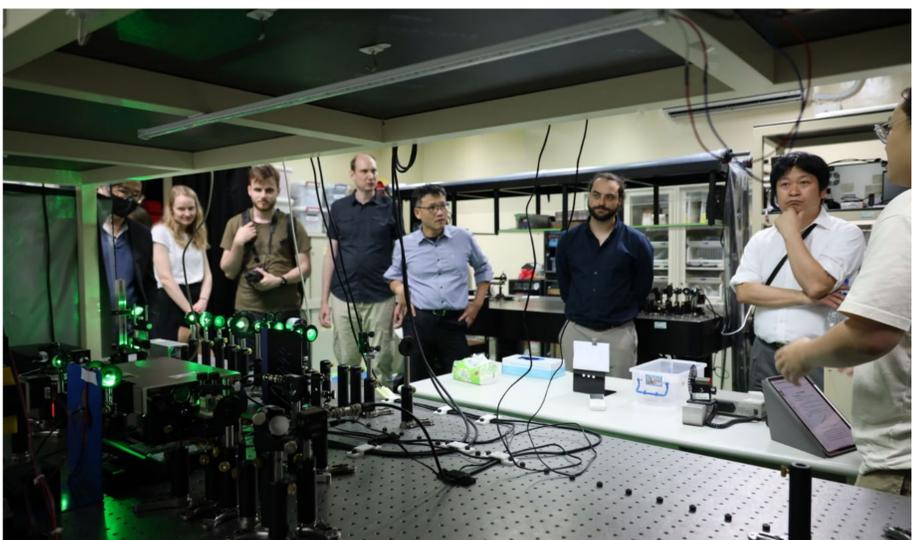
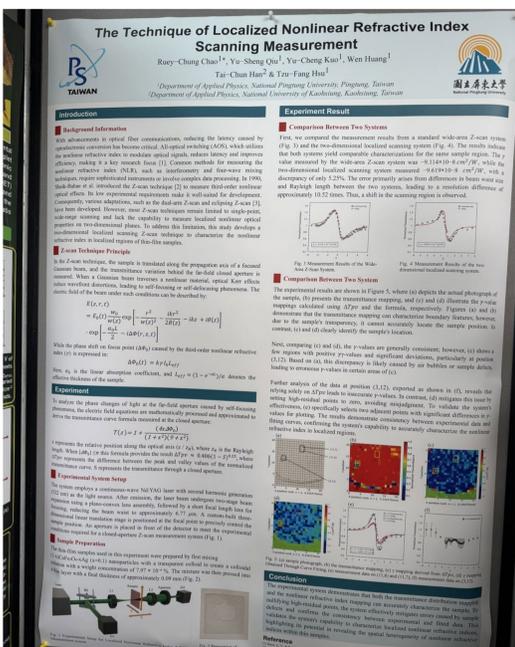
2025 國立屏東大學理學院 中長程計畫暨各系特色成果展示會

應用物理系-非線性光學實驗室
主持老師:許慈方副教授

期刊與會議論文發表

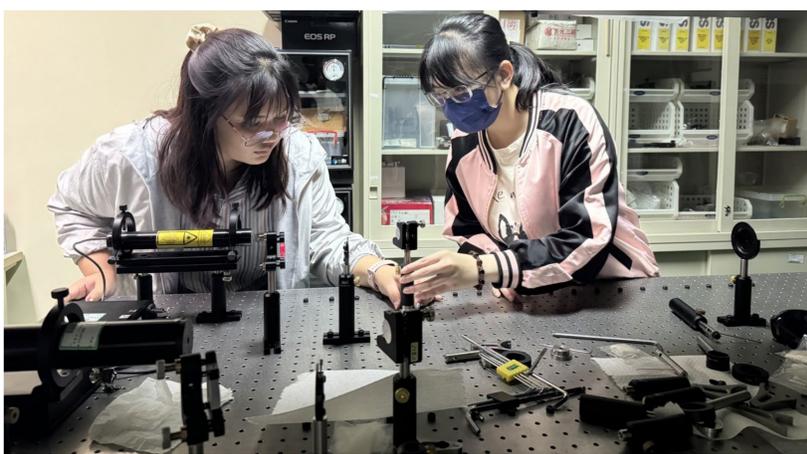
- Yu-Ying Chang, Yun-Kai Hsu, Yi-Sheng Hsu, Yan-Lin Zhong, Jun-Xiao Lin, **Tzu-Fang Hsu**, Hua-Shu Hsu (2025) "Erratum: "Long-range structural anisotropy governs macroscopic chiroptical response in twisted anodic aluminum oxide membranes."” *Appl. Phys. Lett.* 127, 261701 (2025)
- **Ruey-Chung Chao**, Yu-Sheng Qiu, Yu-Cheng Kuo, Wen Huang, **Tzu-Fang Hsu** & Tai-Chun Han (2025) "The technique of localized nonlinear refractive index scanning measurement." 2025年台灣物理年會壁報論文發表
- **Shi-Xuan Xu**, Hsiu-An Liu, Hua-Shu Hsu, **Tzu-Fang Hsu** (2025) "Polarization-Dependent Nonlinear Optical Behavior in TmIG/Pt Thin Films." *Materials Research Meeting 2025*

學生的學習與表現



➢ 2025.04.08 黃文同學為來自捷克與日本衛星計畫學者介紹實驗室的儀器設備。

➢ 趙睿中同學赴高雄中山大學參加2025年台灣物理年會壁報論文發表。



➢ 2025.04.22~25 泰國孔敬大學(KKU)學生來本實驗室進行參訪、實習



➢ 2025.11.11~21 泰國孔敬大學(KKU)學生來本實驗室進行參訪、實習

科普教具活動



➢ 2025.11.8~9 2025台灣科學節科普市集



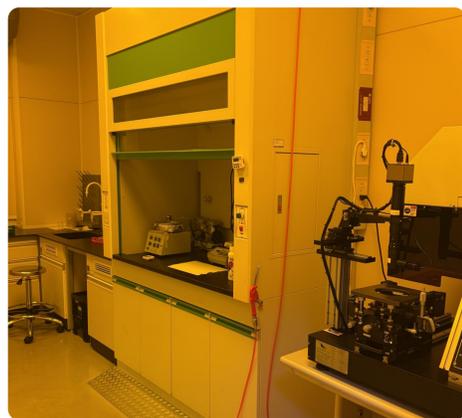
➢ 2025.11.23 國科會-國境之南量子科普推廣活動計畫(平野科學季)



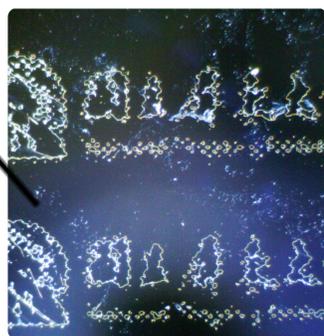
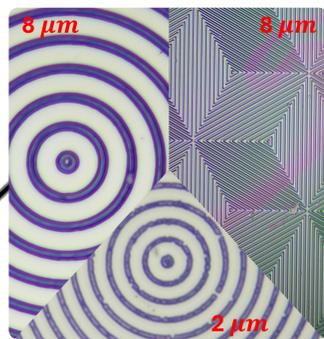
2025 國立屏東大學理學院 中長程計畫暨各系特色成果展示會

應用物理系-量子傳輸實驗室
主持老師:劉岱泯教授

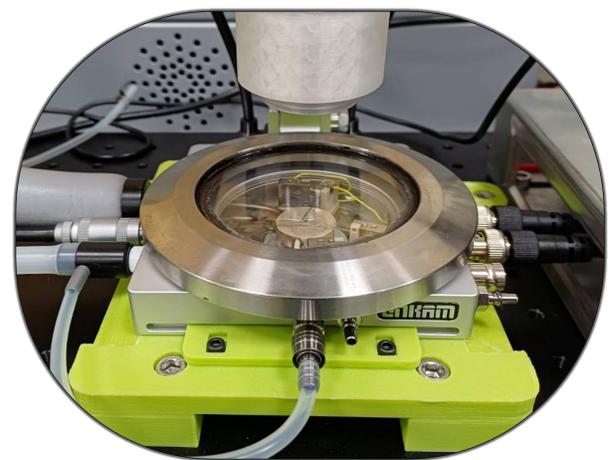
微影製程



於黃光微影製程中藉由在樣品塗佈光阻與曝光，後續再進行鍍膜或蝕刻使樣品上能夠形成特定的圖案。



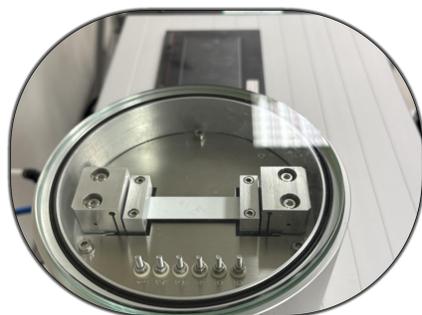
變溫量測系統



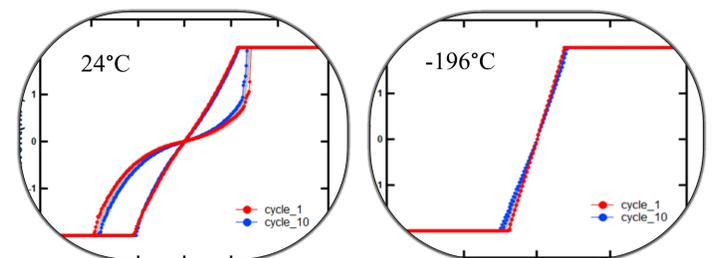
變溫系統能可將透過樣品置於具溫控功能的平台上，藉由液態氮冷卻或加熱模組進行溫域控制。在氣密環境下，可穩定且精確地調控溫度，以進行樣品的電性量測。

快速熱退火處理

快速熱退火能夠透過快速升溫及冷卻的方式此材料中的原子獲得能量並重新排列。透過對氧化鋅薄膜進行熱退火處理以改善薄膜的結晶品質與表面形貌。

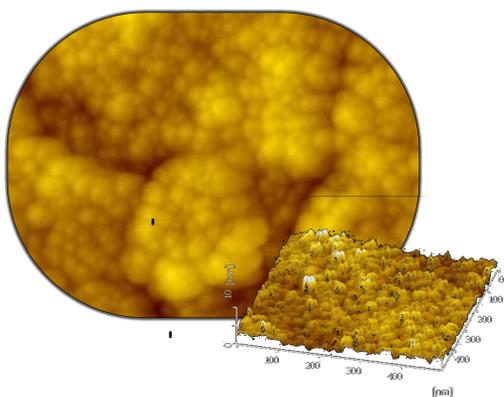


電壓電流特性量測



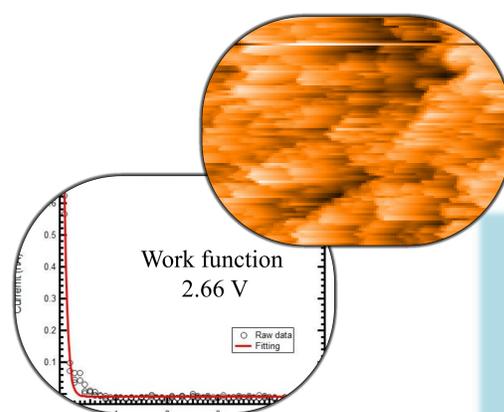
透過對銅/氧化鋅/氧化銻錫施加電壓進行電壓-電流特性曲線量測，可觀察元件在不同溫度下的電性響應變化。

材料表面形貌分析



利用原子力顯微鏡(AFM)能夠量測材料經過不同情況下的熱退火處理後，表面形貌以及粗糙度的變化情形。

材料表面形貌及功函數量測



透過掃描穿隧顯微鏡(STM)能夠了解材料的表面形貌外，也能夠STS的技術進一步得到材料的功函數，藉此探討不同表面形貌對材料功函數的影響。



Work Function Characterization of Sputtered Au Films by Scanning Tunneling Spectroscopy for RRAM Applications

Yong-Zhi Zhang^{1*}, Tai-Min Liu¹

¹Applied Physics, National Pingtung University, Pingtung, Taiwan

* Presenter: Yong-Zhi Zhang, email:yongzhiz0416@gmail.com

Abstract

Resistive random-access memory (RRAM) has emerged as a promising candidate for next-generation nonvolatile memory owing to its high performance and low power consumption. The electrical characteristics of RRAM devices are strongly influenced by the choice of electrode materials. In this study, the work function of a sputtered gold (Au) film, commonly employed as a contact electrode in RRAM structures, was investigated using scanning tunneling spectroscopy (STS). For calibration, highly oriented pyrolytic graphite (HOPG) was examined, yielding work function values of 0.64 eV for atomically smooth regions and 0.78 eV for rougher surfaces. The as-sputtered Au film exhibited a work function of 2.65 eV. These findings demonstrate that STS provides a reliable and quantitative approach for characterizing the work function of metallic films relevant to RRAM applications.

Theory

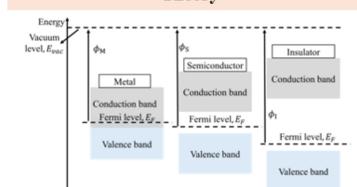


Fig. 1: The work function is defined as the minimum energy required to remove an electron from the surface of a solid to a point just outside the material in vacuum. Its magnitude is determined by the difference between the vacuum energy level and the Fermi energy level of the material, and it can be expressed mathematically as $\phi = E_{vac} - E_F$. Where ϕ denotes the work function, E_{vac} is the vacuum energy level, and E_F is the Fermi energy level.

Schematic

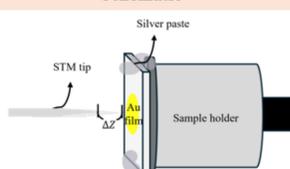


Fig. 2: The scanning tunneling microscope (STM) operates based on the quantum tunneling effect that occurs when the distance between the tip and the sample is extremely small. The tunneling current is highly sensitive to this distance, enabling the characterization of the surface morphology of materials through variations in the measured current. Furthermore, by varying the tip-sample distance and analyzing the dependence of the tunneling current on distance, the work function of the material can be determined through curve fitting.



Temperature-Dependent Switching and Retention Characteristics of ZnO-Based RRAM

Po-Ming Chen¹, Ting-An Chien², Chien-Chen Lee¹, Fang-Yuh Lo², *Tai-Min Liu¹

¹Applied Physics, National Pingtung University, Pingtung, Taiwan

²Department of Physics, National Taiwan Normal University, Taipei 116, Taiwan

* Email: tmliu@mail.nptu.edu.tw

Abstract

This study examines the temperature-dependent resistive switching (RS) behavior of ZnO-based nonvolatile resistive random-access memory (RRAM) devices. The Cu/ZnO/ITO devices, featuring a 60 nm ZnO active layer in a metal-insulator-metal structure, were characterized by current-voltage ($I-V$) measurements under identical compliance current at different temperatures.

At room temperature, the devices exhibit stable bipolar resistive switching (BRS) over multiple cycles. However, as the temperature decreases, the switching stability degrades. Irregular switching occurs between 0 °C and -40 °C, and at lower temperatures, the BRS behavior disappears, yielding a linear $I-V$ response. Notably, the BRS characteristics do not recover upon reheating, implying that low temperatures cause irreversible changes within the device. These results confirm that while Cu/ZnO/ITO devices show stable BRS at room temperature, their performance deteriorates irreversibly at low temperatures, highlighting temperature's key role in memory stability.

Theory

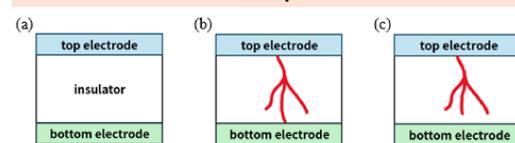


Fig 1 : (a) Structure of the RRAM device, (b) schematic illustration of filament formation, and (c) filament rupture.

The basic structure of an RRAM device consists of a top electrode, an insulating layer, and a bottom electrode. Its operating principle is based on applying an appropriate bias to form or rupture conductive filaments within the insulating layer that connect the top and bottom electrodes, causing the device to switch between a high-resistance state and a low-resistance state.

Devices

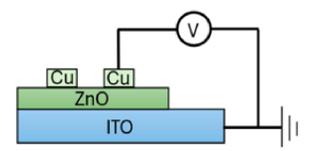


Fig 2 : 60nm ZnO films were deposited on ITO(bottom electrode) substrates followed by 40nm Cu top electrodes .

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應用物理系-磁性材料實驗室
主持老師:林春榮教授

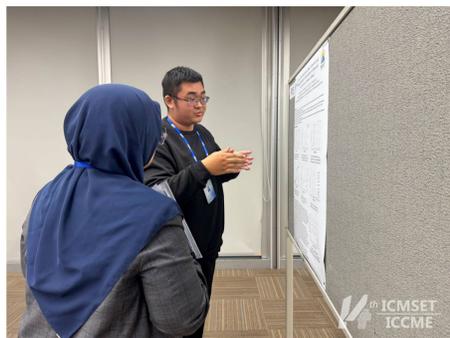
期刊與會議論文發表

- Yu-Chen Wu, Zi-Peng Hong, Chien-Chih Chen and **Chun-Rong Lin**, “Structural and Magnetic Properties of Gd-Substituted M-type Ca-La-Co Hexaferrites Synthesized by Sol-Gel Auto-Combustion Method” **2025 the 14th International Conference on Material Science and Engineering Technology (ICMSET 2025)**, Japan。
- Zi-Peng Hong, Yu-Chen Wu, Chien-Chih Chen and **Chun-Rong Lin**, “Sodium-Induced Structural and Magnetic Modifications in Thulium Iron Garnet” **2025 the 14th International Conference on Material Science and Engineering Technology (ICMSET 2025)**, Japan。
- Chien-Chih Chen, Yu-Chen Wu, Zi-Peng Hong and **Chun-Rong Lin**, “Effect of Fe/Ba Molar Ratio on Phase Composition and Magnetic Properties of M-type $\text{BaFe}_{12}\text{O}_{19}$ Synthesized by Gel-Sol Auto-Combustion Method” **2025 the 14th International Conference on Material Science and Engineering Technology (ICMSET 2025)**, Japan。
- Wen-Ching Chen, Yu-Chen Wu, Zi-Peng Hong and **Chun-Rong Lin**, “Ca-La摻雜Co六方鐵氧體奈米顆粒的製程與結構分析” **2025 Annual Meeting of the Taiwan Association for Magnetic Technology**, Hsinchu。
- Yi-Chi Feng, Wen-Ching Chen, Yu-Chen Wu, Zi-Peng Hong and **Chun-Rong Lin**, “鋰摻雜 CoFe_2O_4 磁性奈米粒子之合成、結構與功能性質探討” **2025 Annual Meeting of the Taiwan Association for Magnetic Technology**, Hsinchu。
- Zi-Peng Hong, Yu-Chen Wu, Chien-Chih Chen and **Chun-Rong Lin**, “Magnetic Characterization and Analysis of Sodium-Doped Thulium Iron Garnet” **2025 Annual Meeting of the Taiwan Association for Magnetic Technology**, Hsinchu。
- Yu-Chen Wu, Zi-Peng Hong, Chien-Chih Chen, Wen-Ching Chen, Yi-Chi Feng and **Chun-Rong Lin**, “Gd取代M型Ca-La-Co六方鐵氧體之合成與磁性分析” **2025 Annual Meeting of the Taiwan Association for Magnetic Technology**, Hsinchu。
- Pei-Han Lin and **Chun-Rong Lin**, “Li摻雜 CuFe_2O_4 的製程與磁性分析” **2025 Annual Meeting of the Taiwan Association for Magnetic Technology**, Hsinchu。
- Tin-Yu Chang and **Chun-Rong Lin**, “鐵硫化合物的製程與磁性分析” **2025 Annual Meeting of the Taiwan Association for Magnetic Technology**, Hsinchu。

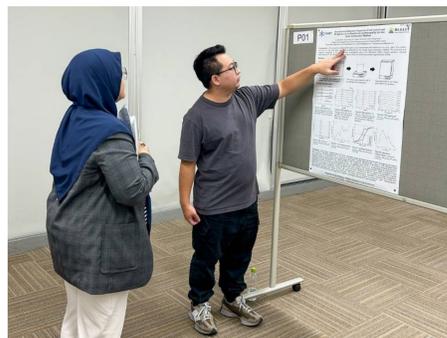
學生的學習與表現



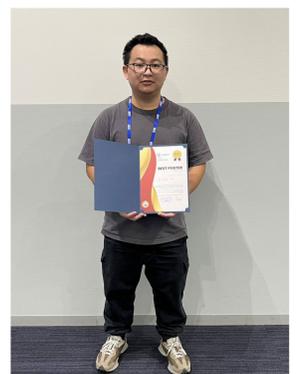
▲ 2025-11-22 洪至朋同學赴日本大阪參加第14屆ICMSET壁報論文發表。



▲ 2025-11-22 陳建志同學赴日本大阪參加第14屆ICMSET壁報論文發表。



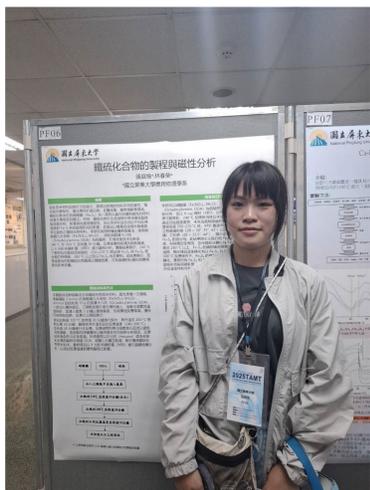
▲ 2025-11-22 吳毓宸同學赴日本大阪參加第14屆ICMSET壁報論文發表。



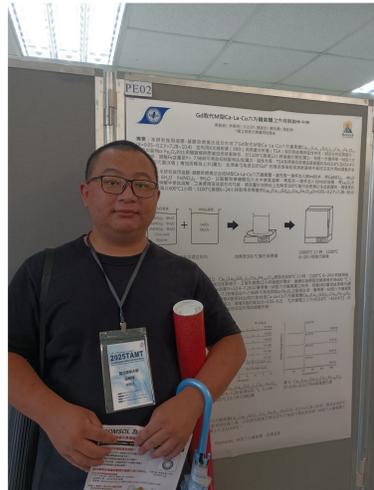
▲ 2025-11-22 吳毓宸同學赴日本大阪參加第14屆ICMSET壁報論文發表取得Best Poster Presentation獎項。



▲ 2025-07-16 洪至朋同學赴國立陽明交通大學參加第37屆TAMT壁報論文發表。



▲ 2025-07-16 張庭瑜同學赴國立陽明交通大學參加第37屆TAMT壁報論文發表。



▲ 2025-07-16 吳毓宸同學赴國立陽明交通大學參加第37屆TAMT壁報論文發表。



▲ 2025-07-16 陳政憬、馮鈺淇、吳毓宸、張庭瑜、林沛涵同學赴國立陽明交通大學參加第37屆TAMT壁報論文發表。

2025 國立屏東大學理學院 中長程計畫暨各系特色成果展示會

應用物理系-磁光電子實驗室
主持老師:許華書教授

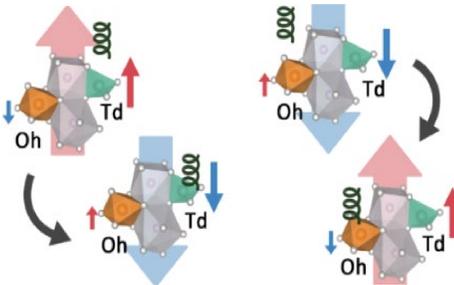
Research Highlight

Bidirectional Magnetization Switching in a Ferrimagnetic Insulator by a Monochiral Cu(II)-Leucine Complex

Wei-Hsiang Liao, Joshua S. Webb, Yu-Hui Xue, Yao Zhang, Yu-Ying Chang, Muhammad Ali Hashmi, Patricia A. Hunt, Simon Granville*, Yu-Cheng Shao*, Muhammad Hanif*, and Hua-Shu Hsu*

ACS Appl. Electron. Mater.2026, DOI:10.1021/acsaelm.5c02560

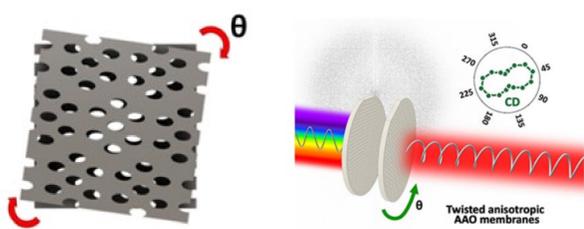
We demonstrate bidirectional magnetization switching in TmIG thin films without applied current or external magnetic field, enabled by CISS from a single-handed D-leucine-based Cu coordination polymer. UV-vis CD confirms the chiral adsorbate, and XAS links the switching to site-selective interactions with Fe sublattices at octahedral and tetrahedral sites, indicating energy-resolved CISS control in a ferrimagnet.



Long-range structural anisotropy governs macroscopic chiroptical response in twisted anodic aluminum oxide membranes

Yu-Ying Chang, Yun-Kai Hsu, Yi-Sheng Hsu, Yan-Lin Zhong, Jun-Xiao Lin, Tsz-Fang Hsu*, and Hua-Shu Hsu*

Appl. Phys. Lett. 127, 261701, 2025

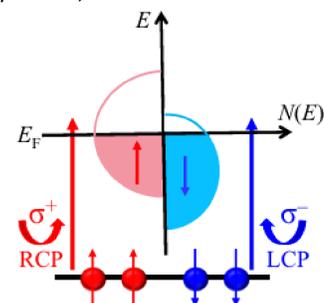


We report twist-angle-dependent CD in separated bilayer AAO membranes. Fourier analysis shows long-range C2 anisotropy, producing a $\sin(2\theta)$ CD modulation that simulations reproduce with weak pore ellipticity. Rotating the bilayer angle enables continuously tunable, reconfigurable chiroptical states.

Giant temperature-independent ultraviolet circular dichroism in Co₂MnX(X = Ga, Ge) Heusler magnetic thin films

Yao Zhang, Jie Sung, Yue-feng Yin, Yu-Ying Chang, Nikhil V. Medhekar, Simon Granville*, and Hua-Shu Hsu*

Phys. Rev. Applied 24, 034052 – Published 19 September, 2025



Strong UV-CD is often limited by material absorption. We observe giant, temperature-independent UV MCD in Co₂MnGa thin films, governed by magnetization and arising from Co-Mn 3d hybridization, consistent with spin-polarized DOS calculations. We also propose and validate two general rules to identify other large-MCD materials for temperature-robust CD applications.

Student Outcomes and Performance



• Academic Exchange Visit of French Students to Taiwan for Research Collaboration and Cultural Engagement



• Ping-Qian Yang conducting a 5-month research internship and exchange at Institut Jean Lamour(IJL), France.



• On February 12, 2025, students Wei-Hsiang Liao and Zheng-Fong Li traveled to New Zealand to present a poster at the 11th AMN Conference.

Research Project

• 國科會計畫-基於自旋極化能帶解析的磁性資訊調控與光偏振訊號轉換研究

(NSTC 114-2112-M-153-002)

• 國科會計畫-臺捷(CZ)雙邊協議型擴充增值(add-on)國合作研究計畫-自旋極化氧化鋅奈米結構

(NSTC 113-2923-M-153-001-MY3)

2025 國立屏東大學理學院 中長程計畫暨各系特色成果展示會

應用物理系-光電暨能源材料實驗室

主持人：李文仁老師

◆主持國科會計畫：1 件

1. 開發具有高能量效率與長期充放電穩定性的鈎液流電池電極(NSTC 112-2221-E-153-001-MY3)，2023/08/01至2026/07/31。

◆取得發明專利：1 項

1. 專利名稱：氮氧化鈦鍍膜改質碳氈電極及製備方法及包含該碳氈電極之液流電池，中華民國發明專利(1869076)，發明人：李文仁，專利權人：國立屏東大學，專利權期間：2025/01/01至2043/11/27。

◆發表SCI期刊論文：6 篇

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