陕西师範大学
SHAANXI NORMAL UNIVERSITY

西安交通大學
XI'AN JIAOTONG UNIVERSITY

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简报
Newsletter

新概念传感器与分子材料研究院
Institute of New Concept Sensors and Molecular Materials

目 录 Contents

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硕士生王俊杰获国家留学基金委资助赴西班牙攻读博士学位

Master's student Wang Junjie funded by China Scholarship Council to pursue a Ph.D. in Spain

近日，国家留学基金委公布了 2026 年国家建设高水平大学公派研究生项目录取人员名单，陕西师范大学新概念传感器与分子材料研究院硕士研究生王俊杰（导师为房喻教授）获公派留学奖学金资助，拟赴西班牙加泰罗尼亚纳米科学及纳米技术研究所攻读博士学位。

Recently, the China Scholarship Council (CSC) announced the list of candidates for the 2026 State-Sponsored Graduate Student Program for High-Level Universities, and Wang Junjie, a master's student at the Institute of New Sensors and Molecular Materials at Shaanxi Normal University (his advisor is Prof. Fang Yu), has been awarded a scholarship and is set to pursue a Ph.D. at the Institute of Nanoscience and Nanotechnology of Catalonia in Spain.

薄鑫参加 2026 全球产业科技创新合作大会暨中澳创新周活动

Bo Xin attends 2026 Global Industrial Technology Innovation Conference and China-Australia Innovation Week

2026 年 6 月 1 至 3 日，陕西师范大学新概念传感器与分子材料研究院薄鑫副研究员参加了在上海举行的"2026 全球产业科技创新合作大会暨中澳创新周"，并在"绿色低碳技术赋能可持续未来（氢能专场）"专家讨论环节针对下一代电解水技术的机遇与挑战等问题参与互动回答。

From June 1 to 3, 2026, Assoc. Prof. Bo Xin of the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University attended the "2026 Global Industrial Technology Innovation Conference and China-Australia Innovation Week" held in Shanghai. During the expert panel discussion titled "Green and Low-Carbon Technologies to Power a Sustainable Future (Hydrogen Energy Session)," he participated in a Q&A session addressing issues such as the opportunities and challenges of next-generation water electrolysis technology.

房喻院士出席 2026 年材料化学国际合作高端论坛

Fang Yu attends 2026 High-Level Forum on International Cooperation in Materials Chemistry

2026 年 6 月 5 日，房喻院士在苏州出席了中国科学技术大学苏州高等研究院 2026 年材料化学国际合作高端论坛。

On June 5, 2026, Prof. Fang Yu attended the 2026 High-Level Forum on International Cooperation in Materials Chemistry, hosted by the Suzhou Institute for Advanced Research of the University of Science and Technology of China, in Suzhou.

丁立平教授参加第一届全国原子级制造计量技术研讨会并作报告

Ding Liping presents at First National Symposium on Atomic-Level Manufacturing Metrology

2026 年 6 月 7 日，陕西师范大学新概念传感器与分子材料研究院丁立平教授参加了在西安举办的“第一届全国原子级制造计量技术研讨会”，并在 Engineering Workshop 分论坛作了题为“界面限域薄膜制备技术及荧光传感应用”的邀请报告，介绍了界面限域聚合组装纳米膜的制备技术原理和在 CBRN、重要物理量等方面检测应用的研究成果。

本次会议由中国微米纳米技术学会和中国微米纳米技术学会原子级制造计量技术分会主办，精密微纳制造技术全国重点实验室、西安交通大学仪器科学与技术学院等单位联合承办。

On June 7, 2026, Prof. Ding Liping from the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University attended the First National Symposium on Atomic-Level Manufacturing and Metrology held in Xi'an. At the Engineering Workshop session, Ding Liping presented an invited report titled Interface-Confined Film Preparation Techniques and Their Applications in Fluorescence Sensing, in which she introduced the principles behind the preparation of interface-confined polymer-assembled nanomembranes and presented research findings on their applications in detection for CBRN and key physical parameters.

The conference was organized by the Chinese Society of Micro/Nano Technology and its Branch of Atomic-Level Manufacturing and Metrology, and co-hosted by the National Key Laboratory of Precision Micro/Nano Manufacturing Technology and the School of Instrument Science and Technology at Xi'an Jiaotong University.

赵智豪获批 2026 年西安市科协青年人才托举计划项目

Zhao Zhihao funded by 2026 XAST Youth Talent Support Program

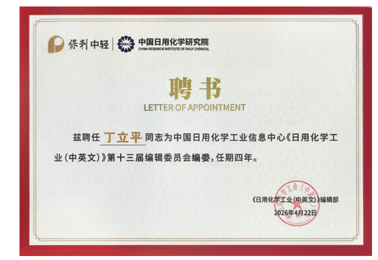
近日，西安市科学技术协会公布了 2026 年度青年人才托举计划项目评审结果，陕西师范大学新概念传感器与分子材料研究院赵智豪老师获得 A 类项目资助。

Recently, the Xi'an Association for Science and Technology announced the results of the 2026 Youth Talent Support Program evaluation, and Dr. Zhao Zhihao from the Institute of New Concept Sensors and Molecular Materials was awarded Category A funding.

丁立平教授获聘《物理化学学报》《日用化学工业》编委

Ding Liping appointed to Editorial Board of Acta Physico-Chimica Sinica and Daily Chemical Industry

近日，陕西师范大学新概念传感器与分子材料研究院丁立平教授被《物理化学学报》期刊聘为第七届编辑委员会编委，聘期为 2026 年 7 月至 2029 年 12 月；被中国日用化学工业信息中心《日用化学工业（中英文）》期刊聘为第十三届编辑委员会编委，任期四年。



Recently, Prof. Ding Liping of the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University was appointed to the 7th Editorial Board of the journal Acta Physico-Chimica Sinica, with a term running from July 2026 to December 2029. She was also appointed to the 13th Editorial Board of the journal Daily Chemical Industry (Chinese and English edition), published by the China Information Center for the Daily Chemical Industry, for a four-year term.

房喻院士出席延长石油“十五五”发展规划研讨会

Fang Yu attends Yanchang Petroleum “15th Five-Year Plan” Development Planning Symposium

2026 年 6 月 16 日，房喻院士在西安应邀出席延长石油“十五五”发展规划研讨会，与其他 12 位两院院士共同探讨延长石油服务保障国家能源安全，促进石化产业绿色低碳高质量发展的科学路径和战略举措。

On June 16, 2026, Prof. Fang Yu was invited to attend the Yanchang Petroleum “15th Five-Year Plan” Development Planning Symposium in Xi'an, where he joined 12 other academicians from the Chinese Academy of Sciences and the Chinese Academy of Engineering to discuss scientific approaches and strategic measures for Yanchang Petroleum to serve and safeguard national energy security and promote the green, low-carbon, and high-quality development of the petrochemical industry.

房喻院士出席第 11 届催化与传感环境国际会议

Fang Yu attends and co-chairs CASE2026-Xi'an

2026 年 6 月 18 日，房喻院士应邀出席在西安举办的第 11 届催化与传感环境国际会议并担任联合主席。

本届会议包含泰国曼谷、马来西亚吉隆坡、中国厦门、上海和西安五个系列分会，西安分会由西安交通大学生命医学光子学与传感研究所、新概念传感器与分子材料研究院联合举办，吸引了来自英国、爱尔兰、泰国、以色列、马来西亚等国家的 30 余位专家学者参会交流。

陕西师范大学新概念传感器与分子材料研究院刘太宏教授和彭浩南教授参加了相关会议活动。

催化与传感环境国际会议由中国工程院钱旭红院士、英国巴斯大学 Tony D. James 教授和伯明翰大学 John S.

Fossey 教授共同发起，迄今已举办十届，在相关领域具有广泛国际影响力。

On June 18, 2026, Prof. Fang Yu was invited to attend the 11th Catalysis and Sensing for Our Environment Symposium and Networking Event (CASE) held in Xi'an and served as a co-chair.

This conference consists of five series of sub-conferences held in Bangkok, Thailand; Kuala Lumpur, Malaysia; and Xiamen, Shanghai, and Xi'an, China. This Xi'an branch conference was jointly organized by the Institute of Biomedical Photonics and Sensing and the Institute of New Concept Sensors and Molecular Materials at Xi'an Jiaotong University, attracting more than 30 experts and scholars from countries including the United Kingdom, Ireland, Thailand, Israel, and Malaysia to participate and exchange ideas.

Prof. Liu Taihong and Prof. Peng Haonan from the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University participated in the relevant conference activities.

The Catalysis and Sensing for Our Environment Symposium was jointly initiated by Qian Xuhong, an academician of the Chinese Academy of Engineering, Prof. Tony D. James of the University of Bath, and Prof. John S. Fossey of the University of Birmingham. To date, the conference has been held ten times and has gained widespread international influence in the relevant fields.

陕师大研究院举办跨团队学术交流会

Cross-Team Academic Exchange Meeting held

2026 年 6 月 19 日，陕西师范大学新概念传感器与分子材料研究院与化学化工学院绿色催化与合成研究团队举办了学术交流会。

翟宾宾博士代表研究院汇报了界面限域纳米膜研究进展，绿色催化与合成团队的王超教授、李超群教授、康腾飞副研究员、董建洋副研究员及李刚博士分别汇报了各自的研究方向和科研进展。

房喻院士、肖建良教授、薛东教授进行了点评并提出了合作建议，双方围绕未来跨学科深入合作展开了交流与讨论。

交流会由丁立平教授主持，近 20 名研究院师生参加了交流会。

On June 19, 2026, the Institute of New Concept Sensors and Molecular Materials and the Green Catalysis and Synthesis Research Team of the School of Chemistry and Chemical Engineering at Shaanxi Normal University held an academic exchange meeting.

Dr. Zhai Binbin, representing the institute, reported on research progress in interface-confined nanomembranes. From the Green Catalysis and Synthesis Team, Prof. Wang Chao, Prof. Li Chaoqun, Assoc. Prof. Kang Tengfei, Assoc. Prof. Dong Jianyang, and Dr. Li Gang each presented their respective research areas and progress.

Prof. Fang Yu, Prof. Xiao Jianliang and Prof. Xue Dong provided comments and suggestions for collaboration. Both sides engaged in exchanges and discussions regarding future in-depth interdisciplinary cooperation.

The meeting was moderated by Prof. Ding Liping, and nearly 20 faculty members and students from the institute attended the event.

房喻院士赴延安参加中国化学会系列活动

Fang Yu speaks at Chinese Chemical Society events in Yan'an

2026 年 6 月 24 日，房喻院士应邀赴延安市参加中国化学会系列活动。

24 日上午，房喻院士在延安大学杨家岭校区参加中国化学会承办的 2026 年中国科协党校（科技人才学院）“领航计划”青年科技人才国情研修活动，为约 80 名化学、能源和材料领域中国科协青年科技人才培育工程博士生专项计划入选者作题为“科学的价值与学者的使命—我的点滴思考”的专题报告。

24 日下午，房喻院士在陕西省延安市新区第一中学参加中国化学会“无处不化学”主题科普活动，为 700 余名师生作题为“化学：连接万物，创造未来”的科普报告。

本次活动由中国化学会主办，延安市科学技术协会、延安大学化学与化工学院和中国化学会科普工作委员会共同承办。

On June 24, 2026, Prof. Fang Yu was invited to Yan'an to participate in a series of events organized by the Chinese Chemical Society.

In the morning, Fang Yu attended the "Navigator Program" National Conditions Training Program for Young Scientific and Technological Talents, organized by the Chinese Chemical Society and hosted by the Party School of the China Association for Science and Technology (Academy of Science and Technology Talents). He delivered a special report titled "The Value of Science and the Mission of Scholars—My Reflections" to about 80 doctoral students selected for the CAST Young Scientific and Technological Talent Cultivation Project's Special Program in the fields of chemistry, energy, and materials.

In the afternoon, Fang Yu participated in a science outreach event themed "Chemistry Is Everywhere," organized by the Chinese Chemical Society at the Yan'an New District First High School, where he delivered a lecture titled "Chemistry: Connecting All Things, Creating the Future" to more than 700 teachers and students.

The events were organized by the Chinese Chemical Society and co-hosted by the Yan'an Association for Science and Technology, the School of Chemistry and Chemical Engineering at Yan'an University, and the Science Popularization Committee of the Chinese Chemical Society.

研究院教师参加应用表面与胶体化学教育部重点实验室首届青年学者交流会

INCSMM teachers attend First Young Scholars Exchange Meeting of MOE Key Laboratory of Applied Surface and Colloid Chemistry

2026 年 6 月 26 日下午，新概念传感器与分子材料研究院教师参加了在陕西师范大学长安校区举办的应用表面与胶体化学教育部重点实验室首届青年学者交流会。

开幕式由重点实验室主任杨鹏教授主持。在学术报告环节，赵奎等 12 位青年学者分别汇报了自己的研究工作。研究院彭浩南教授和马佳妮教授分别作了题为“薄膜荧光传感中的‘传能’与‘传质’和“有机分子光化学反应机制”的报告。刘生忠、李兴伟、赵奎及丁立平四位教授轮流主持报告

会，并进行了点评和指导。

房喻院士出席会议并作总结发言。他寄语青年学者应首先扎实做好基础研究，切忌急于求成；要立足实际，保持独立判断和学术定力，勇于坚持自己的研究方向，持之以恒终将有所成就；并强调坚持与努力是学术成长的关键，同时研究方向的特色和凝练也至关重要。

化学化工学院刘成辉院长主持了闭幕式并讲话。化学化工学院、材料科学与工程学院领导、重点实验室成员及来自化学化工学院、材料科学与工程学院和地理科学与旅游学院的青年教师参加了会议。

On June 26, 2026, faculty members from the Institute of New Concept Sensors and Molecular Materials attended the First Young Scholars Exchange Meeting hosted by the Ministry of Education Key Laboratory of Applied Surface and Colloid Chemistry at Shaanxi Normal University's Chang'an Campus.

The opening ceremony was presided over by Prof. Yang Peng, director of the Key Laboratory. During the presentation session, Prof. Zhao Kui and other 11 young scholars presented their research work. Prof. Peng Haonan and Prof. Ma Jiani from the institute presented reports titled "Energy Transfer and Mass Transfer in Film Fluorescence Sensing" and "Mechanisms of Photochemical Reactions in Organic Molecules", respectively. Professors Liu Shengzhong, Li Xingwei, Zhao Kui, and Ding Liping took turns chairing the session, offering commentary and guidance.

Prof. Fang Yu attended the conference and delivered the closing remarks. He advised young scholars to first lay a solid foundation in basic research and avoid rushing for quick results; to remain grounded in reality, maintain independent judgment and academic resolve, and have the courage to stick to their chosen research direction, as perseverance will ultimately lead to success. He also emphasized that persistence and hard work are key to academic growth, while the distinctiveness and refinement of one's research direction are equally crucial.

School of Chemistry and Chemical Engineering dean Liu Chenghui presided over the closing ceremony and delivered remarks. The event was attended by officials from the School of Chemistry and Chemical Engineering and the School of Materials Science and Engineering, members of the Key Laboratory, and young faculty members from these two schools and the School of Geography and Tourism.

边红涛教授参加第十届全球华人物理与天文大会并作邀请报告

Bian Hongtao presents at 10th OCPA International Conference in Singapore

2026 年 6 月 22 日至 27 日，陕西师范大学新概念传感器与分子材料研究院边红涛教授参加了在新加坡举行的第十届全球华人物理与天文大会（OCPA10），并作题为 Anion Binding in Solution Investigated by Ultrafast Vibrational Spectroscopy 的邀请报告。

本届会议由国际华人物理学家与天文学家组织主办，美国物理学会提供支持，旨在促进全球物理学家的国际科研合作与交流。来自亚洲、欧洲和美洲 20 余个国家的近 500 名专家学者参加了先后在新加坡新达城会议中心和新加坡国立大学两个会场举行的会议。

From June 22 to 27, 2026, Prof. Bian Hongtao from the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University attended the 10th OCPA International Conference (OCPA10) held in Singapore, where he presented an invited report titled "Anion Binding in Solution Investigated by Ultrafast Vibrational Spectroscopy".

Organized by the International Organization of Chinese Physicists and Astronomers and supported by the American Physical Society, this conference aimed to promote international research and collaboration among physicists worldwide. It was held at two venues—the Suntec Convention Center and the National University of Singapore—and was attended by nearly 500 experts and scholars from more than 20 countries in Asia, Europe, and the Americas.

房喻院士获聘高等学校化学教育研究中心第五届学术委员会副主任

Fang Yu appointed vice chair of Fifth Academic Committee of Center for Chemistry Education in Higher Education

2026年6月28日，房喻院士出席在北京大学召开的高等学校化学教育研究中心第五届学术委员会第一次会议，并获聘第五届学术委员会副主任。

房喻院士还为部分委员颁发了聘书，并作了题为“AI赋能与发展新阶段的教育——我的点滴思考”的学术报告。

高等学校化学教育研究中心由教育部于1985年成立，40年来在推动高等化学教育改革、促进教学研究交流、支持《大学化学》期刊建设等方面发挥了重要作用。北京大学原校长林建华教授担任研究中心主任，并兼任第五届学术委员会主任。

On June 28, 2026, Prof. Fang Yu was appointed vice chair of the Fifth Academic Committee of the Research Center for Chemistry Education in Higher Education, at the first meeting of the Fifth Academic Committee held at Peking University.

Fang Yu also presented letters of appointment to some committee members and delivered a report titled “AI-Empowered Education in a New Phase of Development: My Reflections”.

The Research Center was established by the Ministry of Education in 1985. Over the past 40 years, it has played a significant role in advancing reforms in higher education chemistry, promoting exchanges in teaching and research, and supporting the development of the journal University Chemistry. Prof. Lin Jianhua, former president of Peking University, serves as director of the Research Center and concurrently as chair of the Fifth Academic Committee.

ADVANCED FUNCTIONAL MATERIALS

RESEARCH ARTICLE | Full Access

Systematic Tuning of Acridine ICT: Multi-Phase Polarity Sensitivity and Tailored Applications in Encryption and Sensing

Zhen Yan, Yaqin Tian, Xubin Wang, Min Li, Min Qiao, Rong Miao, Liping Ding, Yu Fang

吖啶ICT特性的系统调控：多相极性敏感性及其在加密与传感中的定制化应用

Zhen Yan, Yaqin Tian, Xubin Wang, Min Li, Min Qiao, Rong Miao*, Liping Ding*, and Yu Fang. https://doi.org/10.1002/adfm.76331

有机荧光分子材料因其独特的电子结构与丰富的光物理性质，已成为光功能材料领域的研究热点。得益于其结构可调性、发光性能可控性等特点，该类材料在化学传感、信息防伪、光电器件及生物医学等多个前沿领域展现出广阔的应用前景。开展对ICT分子体系的系统研究，厘清其结构与性能的关联，对于推动高性能荧光材料的理性设计与应用拓展具有重要意义。

本研究通过引入不同强度的吸电子基团，系统调控了一系列吖啶衍生物的分子内电荷转移（ICT）特性。增强吸电子能力能够缩小HOMO–LUMO能隙、增强ICT效应，并使这三种荧光团展现出独特的溶剂变色与蒸汽致变色行为。值得注意的是，当掺杂到不同极性的聚合物基质中时，这些荧光团还表现出固态变色现象，并保持较高的荧光量子产率，从而有效抑制聚集诱导猝灭效应。这种多相极性敏感性使其发射波长覆盖450~660 nm范围，为智能传感、多色显示及高级信息加密等多种功能应用提供了便利。其中，经丙二腈单元修饰的ACR–FCN因其ICT特性的变化，对生物胺表现出独特的非单调荧光响应。基于该响应，可通过便携式传感器实时可视

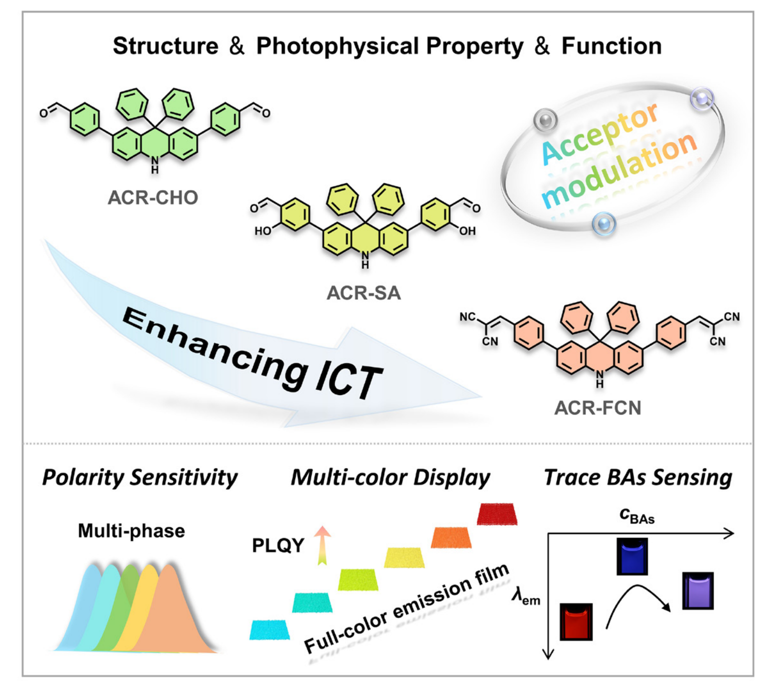


图1. 吖啶基衍生物的ICT性能调控及功能应用示意图

Figure 1. Schematic illustration of ICT strategy for acridine-based derivatives and functional applications

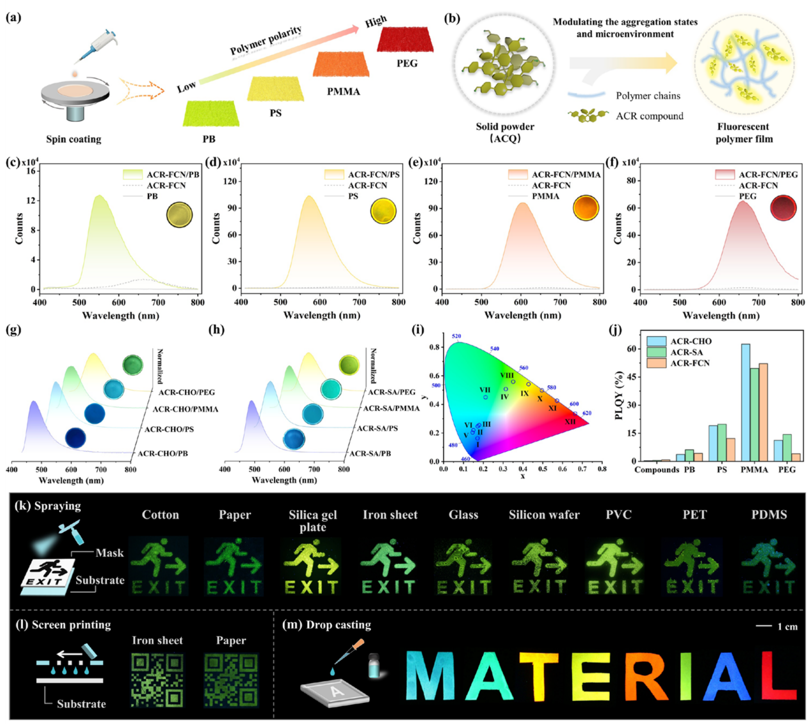


图 2. (a) 染料负载聚合物薄膜制备流程示意图；(b) 荧光团在聚合物网络内可能分布方式的示意图；(c–f) ACR–FCN 掺杂聚合物薄膜及纯聚合物与 ACR–FCN 薄膜参比样品的荧光光谱：(c) ACR–FCN/PB；(d) ACR–FCN/PS；(e) ACR–FCN/PMMA；(f) ACR–FCN/PEG；(g) ACR–CHO 掺杂聚合物薄膜的荧光发射光谱（ACR–CHO/PB、ACR–CHO/PS、ACR–CHO/PMMA、ACR–CHO/PEG）；(h) ACR–SA 掺杂聚合物薄膜的荧光发射光谱（ACR–SA/PB、ACR–SA/PS、ACR–SA/PMMA、ACR–SA/PEG）；(c–h) 插图为薄膜在 365 nm 紫外灯下拍摄的照片；(i) 荧光聚合物薄膜的 CIE 色度坐标，Ⅰ 代表 ACR–CHO/PB，Ⅻ 代表 ACR–FCN/PEG；(j) 吖啶化合物在固态及聚合物薄膜中的荧光量子产率；(k) 通过将 ACR–CHO/PEG 的 THF 溶液喷涂到不同基底上制备的“EXIT”荧光图案；(l) 通过将 ACR–CHO/PEG 的 THF 溶液在铁片和纸上丝网印刷制备的二维码；(m) 通过滴涂法在纸或光学玻璃上制备的荧光彩色字母“MATERIAL”。

Figure 2. (a) Schematic illustration of preparation of dye-loaded polymer films; (b) Illustration of the possible distribution of fluorophores within the polymer network; (c-f) The fluorescence spectra of ACR-FCN-doped polymer films and the reference films casted with pure polymers and ACR-FCN: (c) ACR-FCN/PB; (d) ACR-FCN/PS; (e) ACR-FCN/PMMA; and (f) ACR-FCN/PEG; (g) The fluorescence emission spectra of ACR-CHO-doped polymer films (ACR-CHO/PB, ACR-CHO/PS, ACR-CHO/PMMA, ACR-CHO/PEG); (h) The fluorescence emission spectra of ACR-SA-doped polymer films (ACR-SA/PB, ACR-SA/PS, ACR-SA/PMMA, ACR-SA/PEG); Insets of c-h: the images of the films taken under 365 nm UV light; (i) The CIE chromaticity coordinates of the fluorescent polymer films, I represents ACR-CHO/PB and VII represents ACR-FCN/PEG; (j) The fluorescence quantum yields of the acridine compounds in solid state and polymer films; (k) Fluorescent patterns ‘EXIT’ fabricated by spraying solution of ACR-CHO/PEG (in THF) onto different substrates; (l) QR codes prepared by screen printing of ACR-CHO/PEG (in THF) on iron sheet and paper; (m) Fluorescent colorful letters “MATERIAL” prepared by drop casting on paper or optical glass.

化监测食品新鲜度，对腐胺的裸眼检测限低至 1 ppm。本研究阐明了受体调控在调控 ICT 性质中的关键作用，并建立了从分子设计到多功能应用的完整研究流程。

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Organic fluorescent materials have attracted significant interest due to their unique electronic structure and optical properties, combined with distinct advantages such as structural diversity, and facile tunability. The electronic structure of fluorescent materials is critically important as it governs the photophysical properties of the corresponding compounds, which plays a key role in diverse applications including sensing, anti-counterfeiting, optical switches, and photoelectric displays. Systematic studies focusing on the ICT mechanism in molecular systems for advanced applications are urgently needed.

Precise regulation of the electronic structures of functional molecules remains a key challenge in the development of multifunctional materials. Herein, we report the systematic tuning of intramolecular charge transfer (ICT) characteristics in a series of acridine derivatives by introducing electron-withdrawing groups of varying strengths. Elevating the electron-withdrawing ability narrows the HOMO-LUMO gap, enhances ICT, and endows the three fluorophores with distinct solvatochromic and vapochromic behaviors. Strikingly, these fluorophores also exhibit solid-state chromism with high fluorescence quantum yields when doped into polymer matrices of different polarities, which effectively suppresses aggregation-caused quenching. Such multiphase polarity sensitivity enables a broad emission range spanning 450 ~ 660 nm, facilitating versatile applications in smart sensing, multicolor displays, and advanced information encryption. Notably, ACR-FCN, bearing malononitrile units as acceptor, displays a unique nonmonotonic response toward biogenic amines due to the alternation of its ICT properties. This allows visual, real-time monitoring of food freshness via a portable sensor, with a naked-eye detection limit of 1 ppm for putrescine. This work elucidates the critical role of acceptor modulation in tuning ICT properties and establishes a comprehensive workflow from molecular design to multifunctional applications.

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研究亮点 Research Highlight


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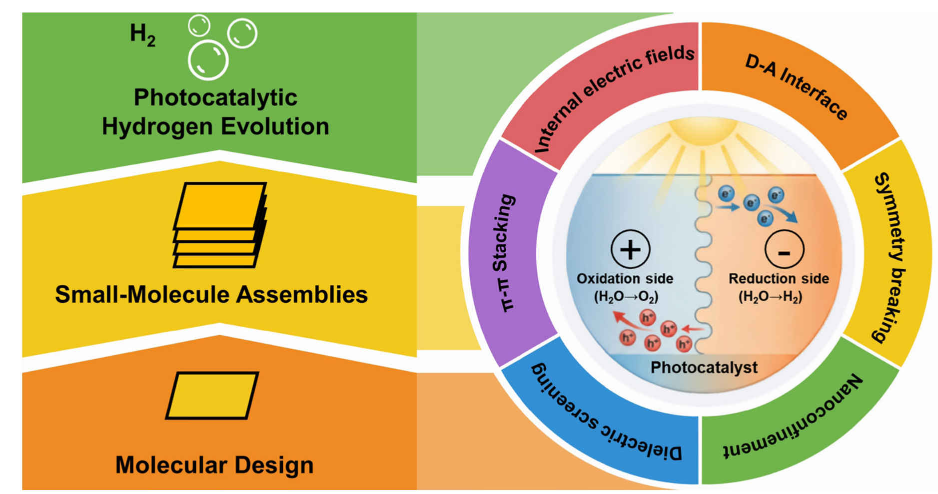
Engineering ordered small-molecule assemblies for photocatalytic hydrogen evolution
Min Qiao, Xiaolin Zhu,* Liping Ding* and Yu Fang

面向光催化析氢的有序小分子组装体的构筑

Min Qiao, Xiaolin Zhu*, Liping Ding*, Yu Fang. J. Mater. Chem. A, DOI: 10.1039/d6ta00877a



太阳能驱动的光催化产氢（H_2），是可持续能源转化与存储领域的核心研究方向。在新兴光催化体系中，有序小分子组装体为调控电子结构与分子间排列提供了独特平台。然而，其性能从根本上受限于弗伦克尔激子较强的结合能（约 0.3–1.0 eV），导致激子更倾向于发生快速的成对复合，而非进行有效的电荷分离。在此类体系中，电荷分离并非由单一主导因素（如内建电场）所决定，而是源于多种相互竞争又协同作用的机制，包括分子间轨道耦合、堆积依赖的极化效应、界面能级匹配以及激子态演化等。在已报道的诸多研究中，这些效应往往高度耦合，致使各自贡献难以被清晰区分。本文从分子、超分子及界面三个尺度出发，系统评述了分子设计、有序性与界面集成如何协同影响有序小分子组装体中的激子动力学及电荷传输行为。在分子尺度上，本文审视了偶极工程策略，并强调了极性、分子构型与空间位阻、以及轨道取向之间的内在关联；在超分子尺度上，分析了堆积模式、结晶性与形貌如何调控集体电子性质及激子解离路径；在界面尺度上，探讨了给体–受体相互作用与杂化结构如何为电荷分离引入额外的驱动力。本文尤其关注不同机制在何种条件下占据主导，并指出常用描述符（如分子偶极矩）的局限性。通过整合多尺度认知，本综述为理解当前的结构–性能关系提供了批判性见解，并提出了若干可实验验证的分子光催化剂优化策略，旨在推动太阳能制氢技术的实际应用。

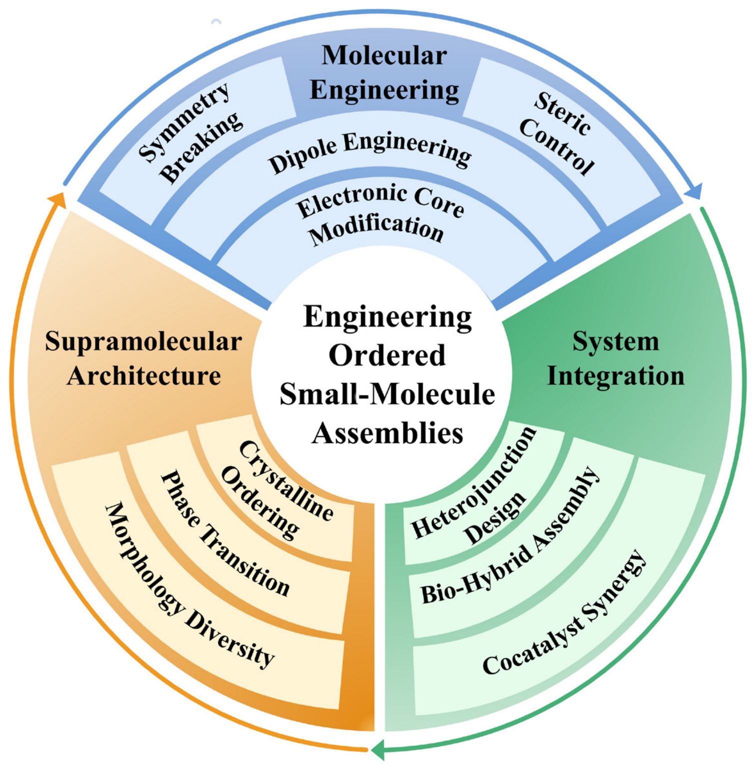


图 1. 小分子光催化剂的多尺度协同设计
Figure 1. Multi-scale synergistic design framework for small-molecule photocatalysts

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The pursuit of solar-driven hydrogen (H_2) evolution via photocatalysis is central to sustainable energy conversion and storage. Among emerging systems, ordered small-molecule assemblies offer unique opportunities for tuning electronic structure and intermolecular organization, yet their performance is fundamentally constrained by the strong binding energy of Frenkel excitons (~0.3–1.0 eV), which favors rapid geminate recombination over effective charge separation. Rather than being governed by a single dominant factor such as internal electric fields, charge separation in these systems arises from multiple competing and cooperating mechanisms, including intermolecular orbital coupling, packing-dependent polarization, interfacial energetics, and exciton-state evolution. However, in many reported studies, these effects are strongly coupled, making their individual contributions difficult to distinguish. This review critically examines how molecular design, supramolecular order, and interfacial integration influence exciton dynamics and charge transport in ordered small-molecule assemblies. At the molecular level, we reassess dipole engineering strategies and highlight the interplay between polarity, steric geometry, and orbital alignment. At the supramolecular level, we analyze how packing modes, crystallinity, and morphology govern collective electronic properties and exciton dissociation pathways. At the interfacial level, we discuss how donor–acceptor interactions and hybrid architectures introduce additional driving forces for charge separation. Particular emphasis is placed on identifying the conditions under which different mechanisms dominate, as well as the limitations of commonly used descriptors such as molecular dipole moment. By integrating insights across these scales, this review provides a critical perspective on current structure–property relationships and outlines experimentally testable directions for improving molecular photocatalysts for solar hydrogen production.

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Outlook

Small Organic Molecule-Based Multicolor Fluorescent Smart Materials: From Design Principles and Optical Properties to Versatile Applications

Zhen Yan, Taihong Liu,* Liping Ding,* and Yu Fang

基于有机小分子的多色荧光智能材料：从设计原理与光学特性到多功能应用

Zhen Yan, Taihong Liu,* Liping Ding,* and Yu Fang. https://doi.org/10.1021/acscentsci.6c00693

作为功能材料科学领域的新兴前沿，多色荧光智能材料因其固有的多功能性以及可精准调控的荧光特性而备受关注，从而为构建日趋复杂且功能多样的平台提供了可能。本展望系统总结了基于小有机分子的多色荧光材料的最新研究进展，涵盖其设计原理、光学性质及多样化应用。实现多色荧光发射的策略主要包括：基于电子激发态与分子本征结构的经典方法，以及调控分子构象转换、分子聚集态结构等新兴策略。进一步介绍了由上

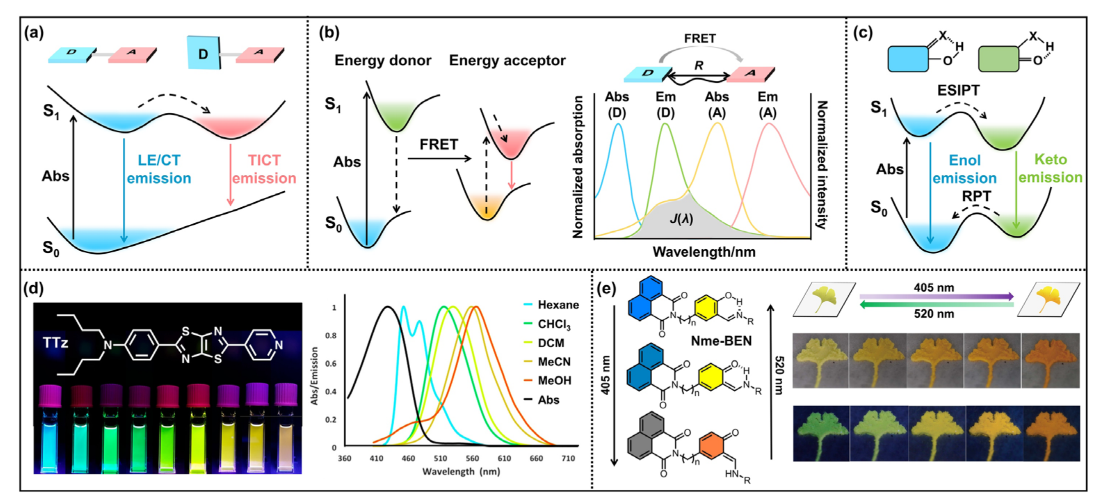

图 1. 描述不同光物理机制的能级图：(a) 分子内电荷转移（ICT）；(b) 荧光共振能量转移（FRET）；(c) 激发态分子内质子转移（ESIPT）；(d) 噻唑并噻唑染料结构及其溶剂依赖性荧光性质；(e) Nme-BEN 结构及 Nme-BEN 粉末在光照下的可逆变色现象。S0 表示基态，S1 表示第一单重激发态。缩写说明：Abs 为吸收，LE 为局部激发态，CT 为电荷转移，TICT 为扭曲的分子内电荷转移，Em 为发射，J(λ) 表示供体发射与受体吸收之间的光谱重叠程度，RPT 为反向质子转移，R 为供体与受体之间的距离，FL 为荧光。
Figure 1. Jablonski diagrams that illustrate different photophysical mechanisms: (a) intramolecular charge transfer (ICT); (b) fluorescence resonance energy transfer (FRET); (c) excited state intramolecular proton transfer (ESIPT); (d) Structure of thiazolothiazole dye and the solvent-dependent fluorescence property; (e) Nme-BEN structure and reversible color change of Nme-BEN powder upon irradiation. S0 represents the ground state, and S1 the first singlet excited state. Abbreviations: Abs for absorption, LE for locally excited state, CT for charge transfer, TICT for twisted intramolecular charge transfer, Em for emission, J(λ) expresses the degree of spectral overlap between the donor emission and the acceptor absorption; RPT for reverse proton transfer, R for the distance between the donor and acceptor, FL for fluorescence.

述设计策略所驱动的多色荧光材料在荧光传感、防伪、信息加密与解密等领域的先进应用。最后，展望了该领域面临的主要挑战与未来机遇，旨在加速智能材料与器件的发展。期望这些见解能够启发更多关于多色荧光智能材料及其先进应用的创新性研究。

多色荧光智能材料仍面临构效关系不明、光学性能不足及多刺激响应等挑战。机器学习可加速分子设计与性质预测，结合原位表征与理论建模，能揭示光物理机制。与柔性基底集成可推动可穿戴传感器，提升生物相容性助力个性化医疗。关键在于设计多可调发光中心材料，兼顾快速响应与高色纯度，深入理解结构－性能－功能关系。

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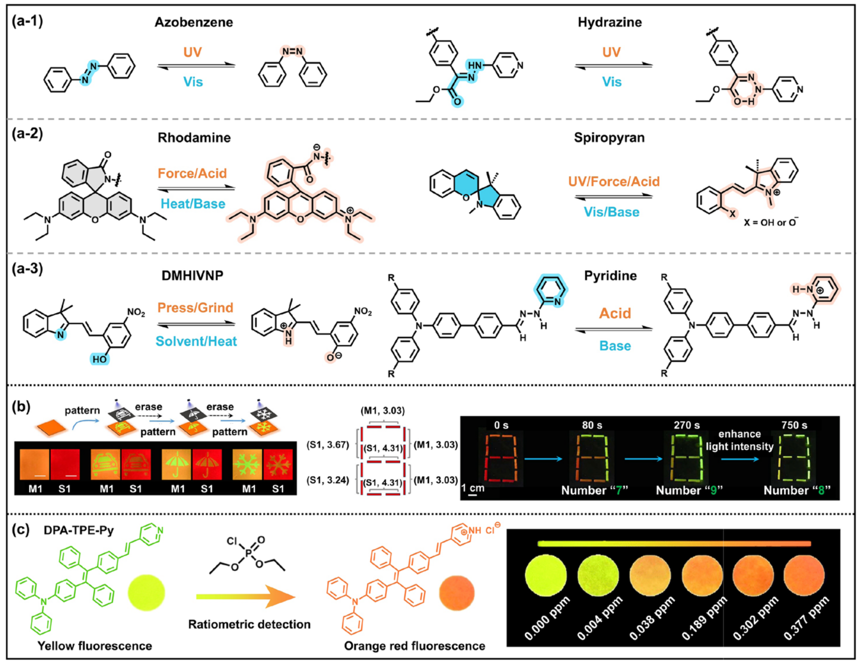

图 2.(a) 基于分子结构变化的功能基团：(a−1) 顺 / 反异构化；(a−2) 开环 / 闭环异构化；(a−3) 质子化 / 去质子化过程；(b) 基于螺吡喃结构的光致图案化与暗态擦除循环过程；(c) DPA−TPE−Py 试纸对 DCP 蒸气响应的颜色变化。

Figure 2. (a) Several functional groups based on molecular structure changes: (a-1) cis/trans isomerization; (a-2) open/closed-ring isomerization; (a-3) protonation/deprotonation process; (b) Repeating the process of light patterning and dark erasing based on spiropyran structure; Photochromic multicolor spiropyran hydrogels at specific pH values upon irradiation; (c) Color change of DPA-TPE-Py test strips in response to diethyl chlorophosphite vapor.

As an emerging frontier in functional material science, multicolor fluorescent materials have garnered significant interest due to their inherent versatility and precisely tunable fluorescent characteristics, enabling the development of increasingly sophisticated and functional platforms. In this Outlook, we summarize the recent advances in small organic molecules-based multicolor fluorescent materials, covering their design principles, optical properties, and versatile applications. The various strategies for achieving multicolor fluorescence emission could range from classic approaches based on modulation of electronic excited states and molecular intrinsic structure to newly emerging methods such as molecular conformation switching and regulation of molecular aggregation/packing. We also present the advanced applications of the multicolor fluorescent materials driven by these design strategies, including fluorescence sensing, anti-counterfeiting, information encryption and decryption. Finally, an outlook into the main challenges and future opportunities for multicolor fluorescent materials is previewed, aiming to accelerate the advancement of smart materials and devices. We hope these insights will inspire further innovative research on multicolor fluorescent smart materials and their advanced applications.

Multicolor fluorescent smart materials still face challenges such as unclear structure-property relationships, insufficient optical performance, and multi-stimulus responsiveness. Machine learning offers a powerful avenue to accelerate molecular design and predict photophysical properties; when integrated with in-situ characterization techniques and theoretical modeling, it can elucidate the underlying photophysical mechanisms. The incorporation of such materials into flexible substrates holds promise for advancing wearable sensor technologies, while improved biocompatibility further supports their application in personalized healthcare. The core objective lies in designing materials featuring multiple tunable luminescent centers that reconcile rapid switching capability with high color purity, guided by a profound understanding of the structure-property-function relationship.

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Acridine-Functionalized Fluorescent Nanofilm Toward High-Performance Detection and Visualization of Ethylenediamine Vapor

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吖啶功能化纳米膜的制备及其乙二胺的高灵敏可视化传感

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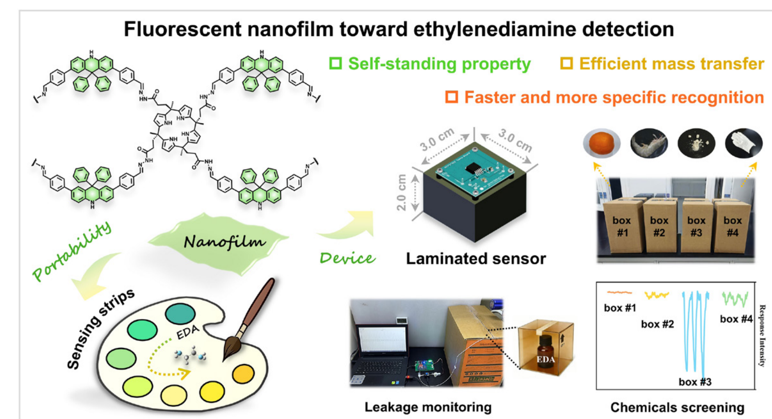
https://doi.org/10.1021/acssensors.6c00624



乙二胺（EDA）因其在工业应用中的重要性及潜在的安全风险而备受关注。EDA 具有较强的腐蚀性与全身毒性，不仅可对皮肤及呼吸道黏膜造成显著刺激甚至不可逆损伤，对水生生物也具有高危害性。根据 WHO 的相关指引，暴露于 10 ppm 的 EDA 即可能引发呕吐、头晕乃至急性肾损伤等健康风险。开发能够实现实时、快速、高灵敏且适用于现场检测的 EDA 检测技术，已成为迫切需求。

在本研究中，以醛基功能化的吖啶衍生物（ACR−2CHO）和杯 [4] 吡咯四酰肼衍生物（CPTH）为前体，通过气液界面聚合反应成功制备兼具柔韧性与尺寸可调性的 ACC 荧光纳米膜。与单体 ACR−2CHO 相比，纳米膜凭借其独特的网络结构，实现荧光单元的有效空间隔离，显著抑制了 ACQ 效应。该纳米膜对 EDA 表现出比率型响应，伴随荧光颜色由绿色向黄橙色的明显转变。将 ACC 纳米膜作为活性传感单元集成于传感平台，该传感器对 EDA 展现出优异的响应与恢复性能，分别低至 3.0 s 和 3.5 s，检出限为 1.2 ppm，同时具备良好的稳定性和重复性。该传感器成功运用于危险化学品筛查及泄漏检测等实际场景中 EDA 的实时检测。从分子精准设计到器件功能集成的研究体系，为实时现场 EDA 检测提供了理想的荧光薄膜材料。

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Ethylenediamine (EDA) has attracted considerable attention due to its importance in industrial applications and the associated potential safety risks. EDA exhibits strong corrosivity and systemic toxicity, capable of causing significant irritation and even irreversible damage to the skin and respiratory mucosa, as well as posing a high hazard to aquatic organisms. According to the World Health Organization (WHO) guidelines, concentration limits of EDA in industrial sites and environmental exposure is 10 ppm. Therefore, development of rapid and highly sensitive technologies for on-site monitoring EDA is of significant importance.

Herein, a flexible and uniform fluorescent nanofilm (denoted as ACC) was fabricated via an interfacial confined condensation strategy between an aldehyde-functionalized acridine fluorophore (ACR-2CHO) and a calix[4]pyrrole derivative (CPTH). Compared with the monomer ACR-2CHO, the nanofilm, owing to its unique network structure, achieves effective spatial isolation of fluorescent units, thereby significantly suppressing the ACQ effect. This nanofilm exhibits a ratiometric response toward EDA, accompanied by a distinct fluorescence color change from green to yellow-orange. By integrating the ACC nanofilm as an active sensing unit into a sensing platform, the resulting sensor exhibits excellent response and recovery performance toward EDA, with response and recovery times as low as 3.0 s and 3.5 s, respectively, a detection limit of 1.2 ppm, as well as good stability and repeatability. The sensor has been successfully applied for real-time detection of EDA in practical scenarios such as hazardous chemical screening and leakage detection. The research system, ranging from precise molecular design to functional device integration, provides an ideal fluorescent film material for real-time on-site EDA detection.

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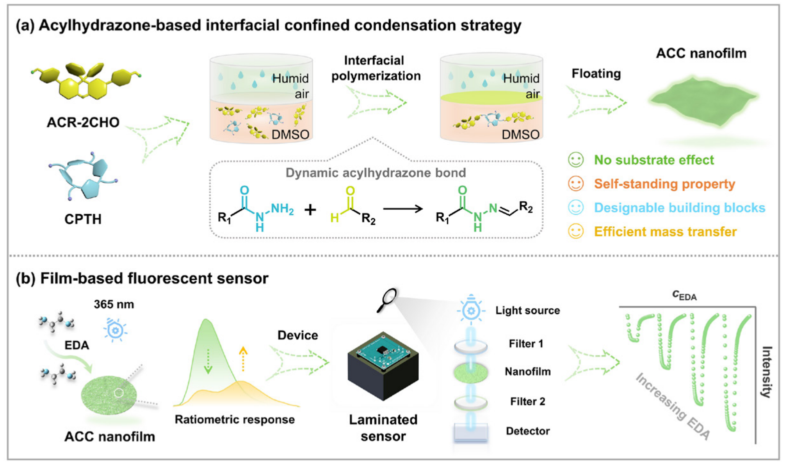

图 1.（a）各构筑单元的示意结构图以及通过界面限域聚合策略制备纳米膜的过程示意图；（b）基于 ACC 纳米膜构筑的薄膜基荧光传感器及其用于检测 EDA 气体的示意图。
Figure 1. (a) Schematic structures of the building blocks and representation of the nanofilm formation process through an interfacial confined condensation strategy; (b) Film-based fluorescent sensor using the ACC nanofilm as a key component for detecting EDA vapor.

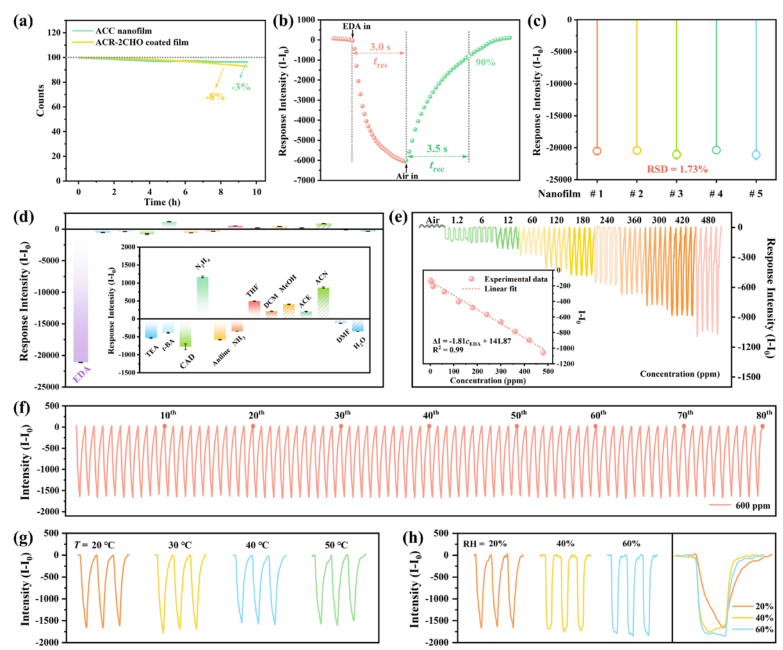

图 2.（a）利用自建传感平台，在持续 9 小时的光照（~400 nm）下，ACC 纳米薄膜的光化学稳定性测试结果；（b）纳米薄膜对乙二胺（EDA）的响应曲线；（c）使用五个独立制备的纳米薄膜进行重复性评估；（d）该纳米薄膜传感器在饱和 EDA 蒸气及若干潜在干扰物存在下的响应对比，每组测量至少重复三次；（e）传感器对不同浓度 EDA 蒸气的响应曲线，插图为响应强度与 EDA 浓度之间的关系图；（f）重复性测试结果，展示该传感器在 80 次暴露－恢复循环中的稳定循环性能；（g）ACC 纳米薄膜在不同环境温度下对 EDA 蒸气的响应情况；（h）ACC 纳米薄膜在不同环境湿度下对 EDA 蒸气的响应，右侧曲线为不同湿度条件下的响应动力学对比。
Figure 2. (a) Photochemical stability of the ACC nanofilm monitored using the home-built sensing platform within 9 h continuous light irradiation (~ 400 nm); (b) Response curve of the nanofilm to EDA; (c) Reproducibility evaluation using five independently prepared nanofilms; (d) Response comparison of the nanofilm-based sensor upon exposure to saturated EDA and some potential interferences, where each measurement was repeated at least three times; (e) Sensor responses to different concentrations of EDA vapor, insets: the relationship between the response intensity and EDA concentration; (f) Repeatability test showing stable cycling performance over 80 exposure-recovery cycles; (g) Response of ACC nanofilm to EDA vapor at different environmental temperatures; (h) Response of ACC nanofilm to EDA vapor at different humidity, and the right curves show the kinetic comparison at different humidity.

ACS APPLIED MATERIALS & INTERFACES
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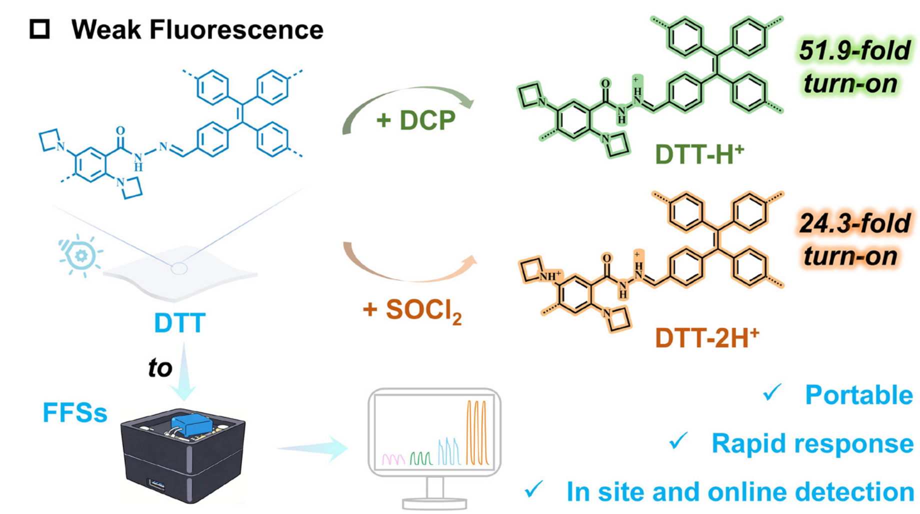
Interfacial Fluorescent Nanofilms for Rapid and Discriminative Detection of Diethyl Chlorophosphate and Thionyl Chloride

Yaqin Tian,# Zhen Yan,# Yong Chen, Lizhi Zhang, Ruijuan Wen, Xiaolin Zhu,* Liping Ding,* and Yu Fang

用于快速且区分检测氯磷酸二乙酯和亚硫酰氯的界面荧光纳米膜

Yaqin Tian#, Zhen Yan#, Yong Chen, Lizhi Zhang, Ruijuan Wen, Xiaolin Zhu*, Liping Ding*, Yu Fang. https://doi.org/10.1021/acsami.6c05572



氯磷酸二乙酯（DCP）和亚硫酰氯（$SOCl_2$）是重要的有机合成中间体，广泛应用于医药、农药、染料和聚合物等领域。然而，这些化学品同时也是剧毒且易挥发的物质，对公共安全和人类健康构成重大风险。因此，开发针对这些危险蒸气的快速、高灵敏且可现场检测的方法，对于保障环境安全和公众健康具有极其重要的意义。

本研究中，我们设计并合成了一种氮杂环丁烷功能化的酰肼衍生物（DATH），并选择四苯乙烯基醛（TFPE）作为另一构筑单元。通过空气 /DMSO 界面限域自组装策略，制备了一种自支撑、光滑、厚度与尺寸可调且基底适应性优异的纳米膜。所得纳米膜初始无荧光，但在暴露于 DCP 和 $SOCl_2$ 蒸气后，显示出显著的荧光增强并伴随明显的发射颜色变化。进一步将该纳米膜集成到实验室自搭建的传感平台中，成功实现了对 DCP 和 $SOCl_2$ 的实时在线监测。该传感器的响应时间在 3.0 秒以内，对 DCP 和 $SOCl_2$ 的检测限分别为 0.52 ppm 和 1.31 ppt，并在 40 个循环中表现出优异的重复性。根据 DCP 和 $SOCl_2$ 与常见干扰物（包括三氟乙酸（TFA）和盐酸（HCl））之间不同的响应动力学，可以实现对 DCP 和 $SOCl_2$ 的选择性检测。这些结果突显了界面组装荧光纳米膜在快速、区分性检测高危险性蒸气方面的巨大潜力，为环境安全监测与预警应用提供了有前景的解决方案。

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Diethyl chlorophosphate (DCP) and thionyl chloride ($SOCl_2$) are important organic synthetic intermediates that are widely used in pharmaceuticals, pesticides, dyes, and polymers. However, these chemicals are also highly toxic, volatile substances that pose significant risks to public safety and human health. Therefore, the development of rapid, sensitive, and on-site detection methods for these hazardous vapors is of great importance for environmental safety and public health.

Herein, we designed and synthesized an azetidinone-functionalized hydrazide derivative (DATH) and employed a tetraphenylethylene-based aldehyde (TFPE) as the complementary building block. Through an air/DMSO interfacial confined self-assembly strategy, we prepared a free-standing, smooth nanofilm featuring tunable thickness and size as well as excellent substrate adaptability. The prepared nanofilm is initially nonfluorescent but displays pronounced fluorescence enhancement accompanied by distinct emission color changes upon exposure to DCP and SOCl2 vapors. By integration of the nanofilm into a lab-built sensing platform, real-time and online monitoring of DCP and SOCl2 was successfully realized. The sensor exhibits a fast response time within 3.0 s, detection limits of 0.52 ppm for DCP and 1.31 ppt for SOCl2, and excellent repeatability over 40 cycles. Selective detection of DCP and SOCl2 can be realized according to their different response kinetics from common interferents such as trifluoroacetic acid (TFA) and hydrochloric acid (HCl). These results underscore the great potential of interfacial-assembled fluorescent nanofilms as a versatile material platform for rapid and discriminative detection of highly hazardous vapors, offering promising applications for environmental safety monitoring and early warning applications.

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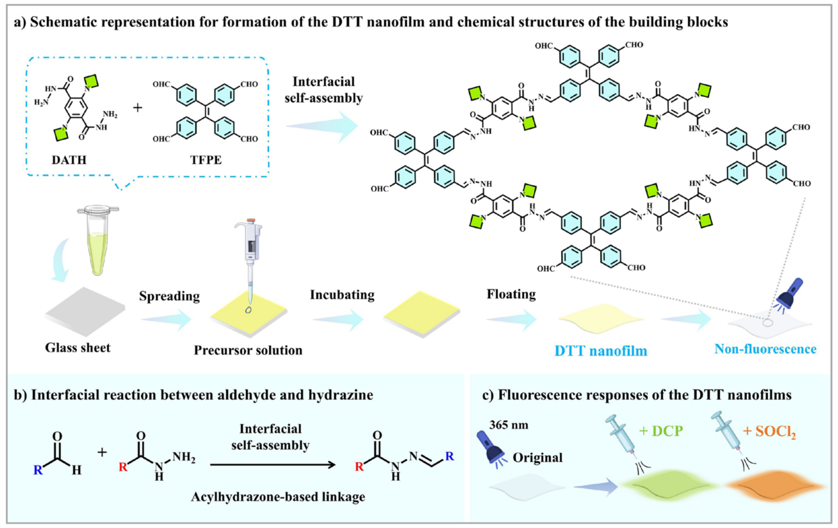

图 1.（a）氮杂环丁烷酰肼衍生物（DATH）和四醛基四苯乙烯（TFPE）的化学结构及 DTT 纳米膜在潮湿空气 /DMSO 界面形成过程的示意图；（b）纳米膜形成过程中涉及的动态共价酰腙缩合反应；（c）DTT 纳米膜对 DCP 和 $SOCl_2$ 蒸气呈现视觉可区分荧光响应的示意图。

Figure 1. (a) Chemical structures of the azetidinone hydrazide derivative (DATH) and tetraphenylethylene-based aldehyde (TFPE), and the schematic of formation process of the DTT nanofilm at the humid air/DMSO interface; (b) Dynamic covalent acylhydrazone condensation involved in the nanofilm formation process; (c) Schematic illustration of the visually differentiated fluorescence responses of DTT nanofilm toward DCP and $SOCl_2$ vapors.

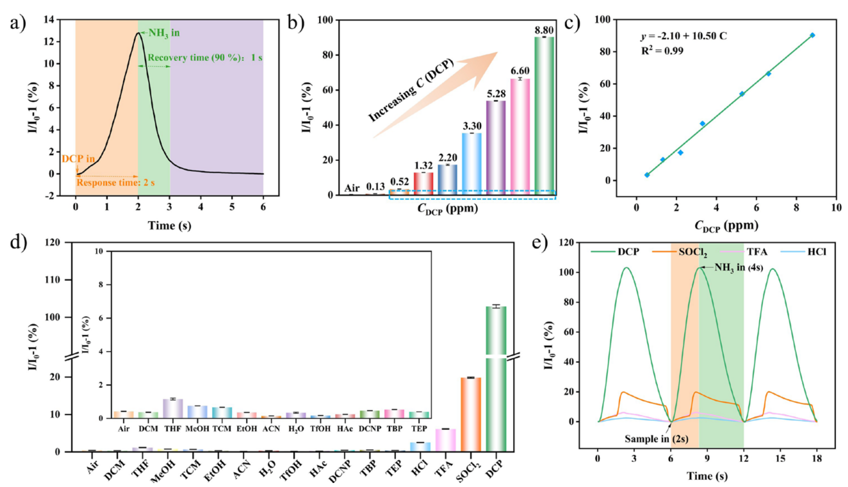

图 2.（a）纳米膜在暴露于 1.32 ppm DCP 蒸气时的响应－恢复瞬态曲线；（b）纳米膜对不同浓度 DCP 蒸气的传感器响应，误差棒代表三次独立测量的标准差；（c）响应强度与 DCP 浓度之间的线性关系；（d）在相同条件下，纳米膜对饱和 DCP 蒸气及潜在干扰物的响应对比，插图为纳米膜对部分常见有机溶剂、水、酸性化合物及神经毒剂类似物的响应强度；（e）薄膜传感器对气态 HCl、TFA、$SOCl_2$ 及 DCP 的动态响应曲线。所用 NH_3 为约 60000 ppm 的饱和蒸气。（注：所有响应均在 550 nm 波长下监测）

Figure 2. (a) The response-recovery transient curve of the nanofilm upon exposure to DCP vapor (1.32 ppm); (b) Sensor responses of the nanofilm toward DCP vapors at different concentrations, with error bars representing the standard deviation of three independent measurements; (c) The linear relationship between the response intensity and DCP concentration; (d) Comparative responses of the nanofilm to saturated DCP vapor and selected potential interferents under identical conditions, with the inset showing the response intensity of the nanofilm to some common organic solvents, water, acidic compounds, and analogues of the nerve agent; (e) Dynamic response traces of the film sensor toward gaseous HCl, TFA, $SOCl_2$ and DCP. The used NH_3 is saturated vapor at ca. 60000 ppm. (Note: all the responses were monitored at 550 nm).

THE JOURNAL OF PHYSICAL CHEMISTRY B
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Synergistic Singlet-Triplet Regulation in Platinum(II)-Acetylide Triads with Strong Two-Photon Absorption and Optical Power Limiting

Published as part of The Journal of Physical Chemistry B special issue "Yu Fang Festschrift".

Yibo Zhao, Shufei Li, Xingtong Zhou, Taihong Liu,* Liping Ding, and Yu Fang

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铂 (II)– 乙炔三分体中单重态 – 三重态协同调控及非线性吸收

Yibo Zhao, Shufei Li, Xingtong Zhou, Taihong Liu*, Liping Ding, and Yu Fang. J. Phys. Chem. B, 2026, DOI: https://doi.org/10.1021/acs.jpcb.6c02968

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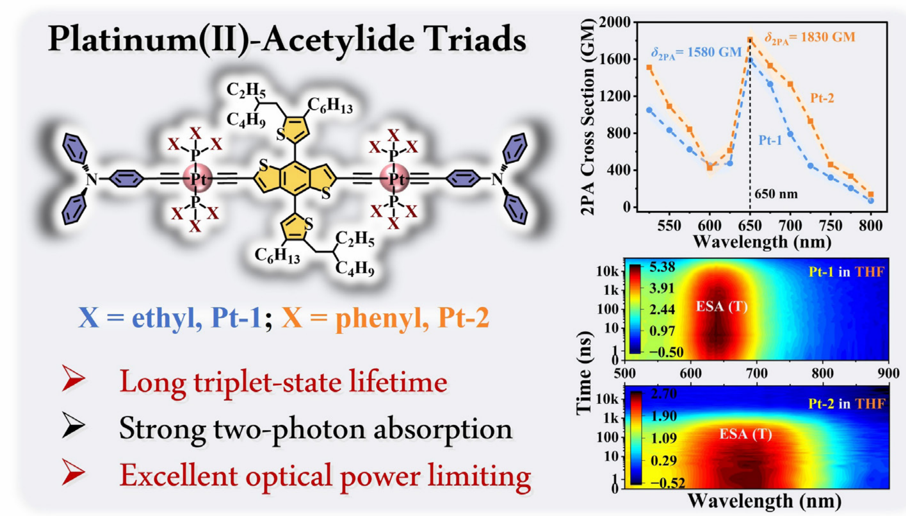
* Published as part of The Journal of Physical Chemistry B special issue "Yu Fang Festschrift".



揭示有机金属配合物的光物理跃迁机制具有重要科学意义，阐明其分子内光物理转变及激发态本征动力学机制仍面临挑战。本文设计合成了含三乙基膦配体的铂 (Ⅱ)– 乙炔三分体配合物 Pt–1 和含三苯基膦配体的配合物 Pt–2；基于核磁分析、稳态光谱、超快瞬态吸收以及开孔 Z– 扫描等技术，开展了系统对比研究。首先通过核磁位移与共轭结构之间的关系，并对比类似物 BDT–TPA，阐释了具有稠密核外电子的铂 (Ⅱ) 原子的核磁屏蔽效应对共轭效应的影响。同时，刚性平面分子构型赋予该系列配合物扩展的 π 共轭体系，有效促进了配体到金属电荷转移 LMCT 及配体间电荷转移 LLCT。进一步对比分析，阐释了铂 (Ⅱ)– 乙炔 d 轨道配位作用、配体芳香性及空间位阻对稳态与非线性光学性质的显著影响。结果分析表明，得益于强自旋轨道耦合与配体介导的共轭效应，两种铂 (Ⅱ) – 乙炔三分体均表现出增强的系间窜越效率与较长的三重态寿命。值得注意的是，在 650

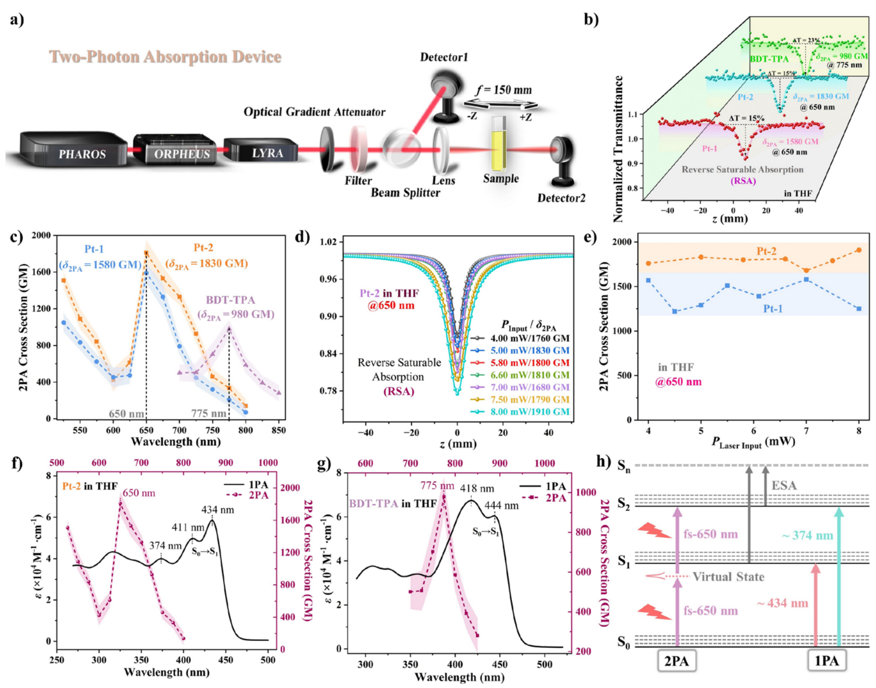


图 1. 三分体 Pt−1，Pt−2 和参比类似物 BDT−TPA 的双光子吸收数据

Figure 1. Two-photon absorption data of the triads Pt-1, Pt-2, and the reference analogue BDT-TPA

nm 处飞秒激光激发下，配合物 Pt–2 在 THF 溶液中展现出 1830 GM 的最大双光子吸收截面值，明显不同于 BDT–TPA 参比化合物在 775 nm 处的最大值 980 GM。基于双光子吸收机制的高性能光限幅测试表明，两种铂（Ⅱ）– 乙炔三分体配合物均具有低起始阈值和相对优异的限幅阈值，可归因于高效的激发态吸收与显著的 LMCT 特性。理论计算也进一步加深了对相关物理性质的理解和分析。该工作不仅为理解铂（Ⅱ）– 乙炔配合物的本征光物理机制提供了新见解，也为非线性光学应用开辟了新思路。

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Unveiling the intramolecular photophysical transitions and intrinsic excited-state dynamics of organometallic complexes is of critical importance yet remains challenging. Herein, two platinum(II)-acetylide triads, namely Pt-1 bearing the triethylphosphine ligands and Pt-2 with the triphenylphosphine ligands, were rationally synthesized and investigated comprehensively. The NMR shielding phenomena of Pt(II) atoms with dense extranuclear electron are elucidated properly through comparative studies on a reference analogue BDT-TPA. The rigid planar molecular geometries endow the triads with extended π-conjugation, which promotes efficient ligand-to-metal charge transfer (LMCT) and ligand-to-ligand charge transfer (LLCT). Furthermore, significant effect of Pt(II)-acetylide d-π coordination, ligand aromaticity, and steric hindrance on the steady-state and nonlinear optical properties are also elucidated comparatively. Benefiting from strong spin-orbit coupling and ligand-mediated conjugation, both Pt(II)-acetylide triads exhibit enhanced intersystem crossing rates and prolonged triplet-state lifetimes. Notably, Pt-2 displays a maximum two-photon absorption cross-section of 1830 GM in THF upon femtosecond excitation at 650 nm, which is obviously higher than that of 980 GM at 775 nm observed for BDT-TPA. High-performance optical power limiting assessments based on the two-photon absorption mechanism reveal that both triads possess low onset thresholds around 0.06 $J\cdot cm^{-2}$ and favorable limiting thresholds around 0.25 $J\cdot cm^{-2}$. Theoretical calculations further correlate the superior nonlinear optical performance with efficient excited-state absorption as well as prominent LMCT characteristics. This study not only affords mechanistic insights into the intrinsic photophysics of the Pt(II)-acetylide complexes but also sheds light on the potential nonlinear optical applications.

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布达佩斯技术与经济大学 Zsolt Kelemen 副教授应邀作报告

A/Prof. Zsolt Kelemen from Budapest University of Technology and Economics invited to give a report

2026 年 6 月 2 日上午，匈牙利布达佩斯技术与经济大学 Zsolt Kelemen 副教授应邀到访陕西师范大学新概念传感器与分子材料研究院，并作题为“三维芳香碳硼烷的共轭机制与电子效应调控”的学术报告。

凯莱门副教授的研究探讨三维碳硼烷与二维芳香体系之间的相互作用机制，揭示了超共轭效应与环张力的核心影响，通过进一步拓展硼位点取代碳硼烷体系，展示出如何利用超共轭效应调控硼 – 硼键长。他在硼位点修饰体系中首次实现了聚集诱导发光特性，为新型碳硼烷光电材料的设计提供了全新思路。

报告会由马佳妮教授主持，30 多名研究院师生参加了报告会，并与凯莱门副教授进行了交流讨论。

On June 2, 2026, Assoc. Prof. Zsolt Kelemen from the Budapest University of Technology and Economics in Hungary visited the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University, and presented a report titled “Conjugation Mechanisms and Electronic Effect Regulation in Three-Dimensional Aromatic Carboranes”.

Zsolt Kelemen's research explores the interaction mechanisms between three-dimensional carboboranes and two-dimensional aromatic systems, revealing the pivotal roles of the hyperconjugation effect and ring strain. By further expanding the carboborane system through boron-site substitution, he demonstrates how the hyperconjugation effect can be utilized to regulate boron-boron bond lengths. He was the first to achieve aggregation-induced emission in boron-site-modified systems, providing a novel approach for the design of new carboborane optoelectronic materials.

The session was moderated by Prof. Ma Jiani. More than 30 faculty members and students from the institute attended the event and engaged in a discussion with Zsolt Kailemen.

深圳大学黄月圆教授做客研途“面对面”作报告

Huang Yueyuan of Shenzhen University gives a report at Graduate “Face-to-Face” Seminar

2026 年 6 月 8 日下午，深圳大学高等研究院黄月圆教授做客陕西师范大学第十四期研途“面对面”活动，以“学术论文写作的核心‘五问’”为题作专题报告。

黄月圆教授以研究生论文写作的常见问题切入，讲解了学术论文六大章节的固定格式，提出“设问、意义、方法、结论和价值”等核心“五问”，并以摘要、引言、结论等具体章节为例，介绍了论文的写作规范和技巧，对如何合理运用 AI 技术辅助学术写作给出了指导性建议，并与在场研究生就学术语言规范、AI 使用边界等问题进行了互动和交流。

此次报告会由研究生院（党委研究生工作部）主办，化学化工学院、应用表面与胶体化学教育部重点实验

室、新概念传感器与分子材料研究院承办。

On June 8, 2026, Prof. Huang Yueyuan from the Institute for Advanced Study at Shenzhen University presented a report titled “The Core of Academic Writing: Answer the Five Questions” at the 14th session of Shaanxi Normal University’s Graduate “Face-to-Face” Seminar series.

Huang Yueyuan began by addressing common issues in graduate thesis writing, explained the standard format for the six main sections of an academic paper, introduced the core “Five Questions”—“Research Question, Significance, Methodology, Conclusions, and Value”—and used specific sections such as the abstract, introduction, and conclusion as examples to illustrate writing conventions and techniques. She also provided guidance on how to appropriately utilize AI technology to assist with academic writing and engaged in interactive discussions with the graduate students in

attendance on topics such as academic language standards and the appropriate boundaries for AI use.

This session was organized by the Graduate School (Graduate Student Affairs Office of the Party Committee) and hosted by the School of Chemistry and Chemical Engineering, the Ministry of Education Key Laboratory of Applied Surface and Colloid Chemistry, and the Institute of New Concept Sensors and Molecular Materials.

国防科技大学试验训练基地一行来访

NUDT Experimental Training Base visitors received

2026 年 6 月 3 日，国防科技大学试验训练基地政治委员董远中一行到访陕西师范大学新概念传感器与分子材料研究院，并与房喻院士座谈交流。

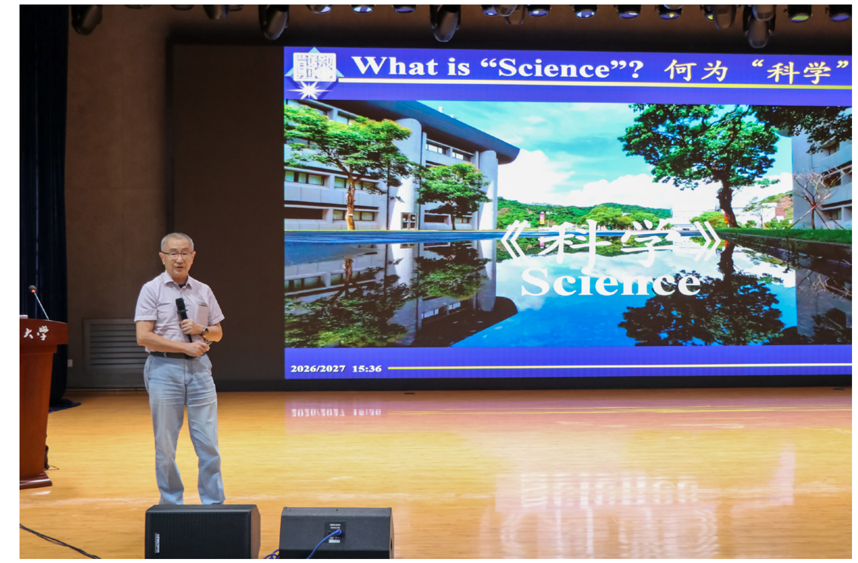
董远中一行参观了研究院成果展厅和先行验证示范工场，了解研究院相关技术的发展，并与房喻院士就加强合作，推动军地融合创新发展进行了座谈交流。

On June 3, 2026, a delegation led by Dong Yuanzhong, Political Commissar of the Experimental Training Base at the National University of Defense Technology, visited the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University and met with Prof. Fang Yu.

Dong Yuanzhong toured the institute’s exhibition room and Pilot Test and Demo Workshop to learn about the development of its technologies, and held discussions with Fang Yu on strengthening cooperation and promoting integrated innovation between the two institutions.

吴奇院士做客“曲江讲坛”作报告

Academician Wu Qi delivers a lecture at Qujiang Forum



2026 年 6 月 8 日下午，深圳大学食品科学与加工中心主任吴奇院士做客陕西师范大学第 111 期“曲江讲坛”，以《何为科学研究》为题作专题报告。

报告中，吴奇院士结合自身数十年的科研经历与认识论学习感悟，围绕“何为科学？何为研究？何为物理真实与数学真实的同构？何为知识？何为基础研究？何为技术研究？”等一系列根本性问题展开阐述。他指出区分物理真实与数学真实、厘清知识与研究的本质，是青年学者成长过程中必须正视的课题，并用多个具体研究案例阐释了从现象到本质的探索路径，鼓励青年教师和研究生在科研中保持追问精神。

房喻院士出席并主持报告会，并在总结中表示，吴奇院士的报告澄清了科学研究中若干易混淆的基本概念，展现了如何从认识论高度指导具体实验设计，对青年教师和研究生树立正确的科学观、提升研究能力具有重要意义。他勉励在场师生学习吴院士严谨求实的治学态度，在科研道路上坚持强化基础、重视实践、勇于创新。

此次报告会由研究生院（党委研工部）主办，化学化工学院、应用表面与胶体化学教育部重点实验室、新概念传感器与分子材料研究院承办，相关单位和学院负责人、教师、辅导员和研究生共 400 余人参加了报告会。

On June 8, 2026, Academician Wu Qi, director of the Center for Food Science and Processing at Shenzhen University, delivered a lecture titled “What Is Science?” at the 111th session of the “Qujiang Forum” at Shaanxi Normal University.

In his report, Wu Qi drew upon his decades of research experience and insights gained from the study of epistemology to address a series of fundamental questions, including What is science? What is research? What is the isomorphism between physical reality and mathematical reality? What is knowledge? What constitutes basic research? and what is applied research? He stressed that distinguishing between physical reality and mathematical reality, and clarifying the essence of knowledge and research, are issues that young scholars must confront as they develop their careers. Using multiple specific research examples, he elucidated the path of exploration from phenomena to essence, encouraging young faculty members and graduate students to maintain a spirit of inquiry in their research.

Prof. Fang Yu attended and presided over the lecture. In his concluding remarks, he noted that Academician Wu Qi’s presentation clarified several fundamental concepts in scientific research that are often misunderstood, demonstrating how epistemological principles can guide specific experimental designs. He emphasized that this lecture is of great significance for young faculty members and graduate students in establishing a sound scientific outlook and enhancing their research capabilities. He encouraged the faculty and students in attendance to emulate Wu’s rigorous and pragmatic approach to scholarship, and to persist in strengthening their foundational knowledge, valuing practical experience, and embracing innovation as they pursue their research careers.

The session was organized by the Graduate School (Department of Graduate Student Affairs of the Party Committee), and the Office of Social Sciences, and hosted by the School of Chemistry and Chemical Engineering, the Ministry of Education Key Laboratory of Applied Surface and Colloid Chemistry, and the Institute of New Concept Sensors and Molecular Materials. More than 400 participants attended the event, including heads of relevant departments and schools, faculty members, student counselors, and graduate students.

中国科学院福建物构所徐刚研究员和大连化物所冯亮研究员应邀作报告

CAS FIRSM Researcher Xu Gang and DICP Researcher Feng Liang invited to give reports

2026 年 6 月 11 日下午，中国科学院福建物质结构研究所徐刚研究员和大连化学物理研究所冯亮研究员应邀到访陕西师范大学新概念传感器与分子材料研究院，并分别作题为“导电 MOF 薄膜及其气敏传感性能”和“薄膜基化学传感器表界面调控及多模态信号转换研究”的学术报告。

报告中，徐刚研究员介绍了其团队发展的“界面限域组装”策略，通过系列薄膜制备新方法，解决了 MOF 高质量薄膜制备难题，并开展了 MOF 薄膜材料在化学电阻气敏传感器方面的应用基础研究。

冯亮研究员阐述了分子扩散动力学、表界面官能化、能带缺陷工程、原子级内建电场等多尺度调控策略，解析了上述策略在加速界面分子扩散、抑制荧光猝灭以及优化半导体能带结构中的关键作用，揭示了化学信息向光 / 电多模态信号高效转换的微观机理。

报告会由副院长丁立平教授主持，50 多名研究院师生参加了报告会，并与两位报告人进行了交流讨论。

On June 11, 2026, Researcher Xu Gang from the Fujian Institute of Research on the Structure of Matter, and Researcher Feng Liang from the Dalian Institute of Chemical Physics, both affiliations of the Chinese Academy of Sciences, were invited to visit the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University, and presented reports titled “Conductive MOF Films and Their Gas-Sensitive Properties” and “Research on Interfacial Regulation and Multimodal Signal Conversion in Film-Based Chemical Sensors”, respectively.

Xu Gang introduced the “interface-confined assembly” strategy developed by his team, in which they overcame the challenge of producing high-quality MOF films through a series of novel film fabrication methods, and conducted fundamental research on the application of MOF film materials in chemical resistance gas sensors.

Feng Liang elaborated on multi-scale control strategies, including molecular diffusion kinetics, interfacial functionalization, band structure defect engineering, and atomic-scale built-in electric fields. He analyzed the key roles these strategies play in accelerating interfacial molecular diffusion, suppressing fluorescence quenching, and optimizing semiconductor band structures, thereby revealing the microscopic mechanisms underlying the efficient conversion of chemical information into multimodal optical and electrical signals.

The sessions were moderated by INCSMM vice dean Prof. Ding Liping, and attended by more than 50 faculty members and students from the institute, who engaged in discussions with the two presenters.

加拿大安大略省科技创新界人士代表团来访

Visitors from science, technology, and innovation community in Ontario, Canada received

2026 年 6 月 25 日，加拿大安大略省科技创新界人士代表团一行七人到访陕西师范大学新概念传感器与分子材料研究院，并在副院长丁立平教授的带领下参观了研究院展厅，了解了研究院基本情况、发展理念、科研团队和科研概况，及研究院在传感器和分子材料领域的研发进展与成果转化应用情况。

代表团由加拿大安大略省前研究、创新与科学厅厅长莫伟力博士带队，包括加拿大安大略省公共政策与公共管理专家、安大略省生命科学与科研成果转化领域专家、多伦多大学机器人学科创始人和加中科技联盟共同主席等专业人士。

此次交流访问由中国国际人才交流中心组织，陕西省科技厅和陕师大科技处相关人员陪同来访。

On June 25, 2026, a seven-member delegation of representatives from Ontario, Canada’s science, technology, and innovation community visited the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University. Led by vice dean Prof. Ding Liping, the delegation toured the institute’s exhibition room and learned about its basic profile, development philosophy, research overview and research team, as well as its R&D progress and the commercialization and application of its achievements in the fields of sensors and molecular materials.

The delegation was led by Dr. Gholam Reza Moridi, former Ontario minister of Research, Innovation, and Science, and included an expert in public policy and public administration, an expert in the fields of life sciences and research commercialization, the founder of robotics program at the University of Toronto, and the co-chair of the Canada-China Technology Alliance, among other professionals.

This visit was organized by the China International Talent Exchange Center, and the delegation was accompanied by officials from the Shaanxi Provincial Department of Science and Technology and SNNU Office of Science and Technology.

东南大学宋爱国教授应邀作报告

Prof. Song Aiguo from Southeast University invited to give a report

2026 年 6 月 29 日上午，东南大学宋爱国教授应邀到访陕西师范大学新概念传感器与分子材料研究院，并作题为“机器人柔性触觉传感器技术及应用”的学术报告。

宋爱国教授介绍了机器人柔性触觉传感器技术的发展现状与应用前景，阐述了压阻式、电容式、压电式、光学式等柔性触觉传感器的分类及性能特点，分析了该领域的关键技术与发展趋势，并结合团队近年来的代表性研究成果介绍了柔性触觉传感器在人机交互、医疗健康、智能制造等领域的典型应用及相关产品。

在交流环节，宋爱国教授与现场师生围绕柔性触觉传感器的应用场景、信号处理方法以及敏感材料、未来发展方向等问题展开了交流与讨论，并解答了师生提出的问题。

报告会由副院长丁立平教授主持，研究院及化学化工学院师生 30 余人参加了报告会。

On June 29, 2026, Prof. Song Aiguo from Southeast University was invited to visit the Institute of New Concept Sensors and Molecular Materials at Shaanxi Normal University, where he presented a report titled “Flexible Tactile Sensor Technology and Applications for Robots”.

Prof. Song provided an overview of the current state of development and future prospects of flexible tactile sensor technology for robots, discussed the classification and performance characteristics of flexible tactile sensors, including piezoresistive, capacitive, piezoelectric, and optical types, and analyzed key technologies and development trends in this field and, drawing on his team’s representative research achievements in recent years, introduced typical applications and related products of flexible tactile sensors in areas such as human-computer interaction, healthcare, and smart manufacturing.

During the Q&A session, Prof. Song discussed with faculty and students in attendance on topics such as the application scenarios of flexible tactile sensors, signal processing methods, sensitive materials, and future development directions, and answered their questions.

The session was moderated by vice dean Prof. Ding Liping, and attended by more than 30 faculty members and students from the institute and the School of Chemistry and Chemical Engineering.

守其本心，此去山河自有声

——2026 年毕业寄语

刘凯强

又是一年毕业季，又到了挥手作别的时刻。茫茫人海，能够以师生名分同行数载，本就十分难得。无论这场相遇是否命中注定，它终究都是一份不可重来、值得珍藏的美好缘分。

回望过去的几年，我想大家心中难免会有五味杂陈：或欣喜，或沮丧；或兴奋，或感伤；或如释重负，或依依不舍。那些被学业“折磨”的日日夜夜，那些因细枝末节而“遭受”导师批评与提醒的时刻，那些实验室近乎苛刻的要求与种种不自由，那些反复修改、推倒重来的艰难过程，以及学位制度的严肃庄重与评审专家“不留情面”的严谨……凡此种种，无论你们心怀感恩，还是仍有疑惑与不解；无论你们曾经想着“赶紧逃离”，还是此刻发自肺腑地百般不舍，毕业以后，这一切终将沉淀为你们生命深处的回忆。

其实，这段经历不仅见证了你们的成长，也唤醒并锤炼了你们内心深处的坚韧、清醒与担当。也正是这些看似琐碎、刻板，甚至有些艰辛的经历，赋予了你们自我超越与持续成长的能力，并将在今后的道路上支撑你们走得更加从容与坚定。

毕业之后，有的同学将离开校园，走向工作岗位；有的同学将继续深造，开启新的学习和科研旅程。但无论你们选择哪一条道路，人生都将翻开新的篇章。如果离开校园、走向社会，江湖路远，世事浩荡，你们的身份也将随之改变。无论职场还是人情往来，能够像导师们这般心存善意“斤斤计较”却不求回报的“挑剔”，今后恐怕会变得十分稀缺；也很难再有像大学校园学生时代这般宽松和谐、允许试错、容纳青涩与莽撞的环境。

你们将真正走入更为复杂、更为宽阔的人生现场，面临职场的角逐与命运的考验，承担家庭与生活的多方责任，经历社会大潮带来的冲击。你们会遇到柴米油盐的琐碎，也可能面临尽孝与尽责之间的两难，你们会见识规则的边界，也会体会现实的冷峻；会感受到自食其力、自得其乐的幸福，也难免遭遇人情冷暖、事与愿违，甚至不公不平带来的失望。

如果你们选择继续深造，虽然身份似乎未变，但新的重要任务已经等着你去完成。新的环境、新的导师、新的课题，也意味着新的标准与新的压力。学术之路与人生之路一样，从未有过坦途。希望你们用心面对新的学习生活，真诚善待自己的师长与同门，用乐观上进、刻苦耐劳的行动回应他们的期望，用十年如一日的坚持不断提升自己、成就自己。

无论你们未来经历怎样的人生境遇，这些其实都是在世为人的常态。人生本就不易，人总是在不断选择、承担、失去与获得之间，完成对自我的认可与塑造。愿你们在顺境中不轻狂，在逆境中不沉沦；在掌声中不迷失，在冷遇中不失志；在利益面前守得住底线，在风雨之中护得住本心。记得学会善待自己与他人，心存感恩，心怀敬畏；既要有仰望星空的理想，也要有脚踏实地的笃定。只有敢于负重前行的人，才是真正的英雄；只有历经风霜而心中始终有光的人，才配得上诗与远方。

毕业之际，虽有万般不舍，但更多的是对你们未来深切的期望与祝福。今年高考作文题引用了东汉应劭《风俗通义》中的话：“日月不失其体，故蔽而复明；江汉不失其源，故穷而复通。”其实后面还有一句：“圣人不失其德，故废而复兴。”此时此刻，这段话恰似对即将远行的你们最诚恳的训诫，也是我在临行之际送给你们的一份真诚嘱托。

这段学习经历即将成为过往，但“体”不可失，“源”不可断，“德”不可忘。“不失其体”，无论外界如何遮蔽，都不能改变自身应有的品格与操守；“不失其源”，无论未来道路如何曲折，都不能忘记自己从哪儿出发、因何而坚持；“不失其德”，无论将来处境如何变迁，都不能丢掉立身处世最根本的良知、善良与担当。

人这一生，真正陪伴自己走完全程的，从来不是一时的际遇、身份与荣辱，而是始终未曾改变的本真与德行。守其本心，则纵有风雨，终能见日月；不失其志，则虽历山河，自会有回响。

无论你们未来身处何方，无论在哪里学习、从事什么样的职业，无论遭遇何种境遇，无论你们的秉性棱角将与生活产生怎样的碰撞，我都真心希望你们能始终守得住内心的善良与正义，守得住对自然与科学的敬畏、对规则与秩序的尊重、对生命与世界的热爱，也守得住那份不随波逐流的风骨。愿你们永远不放弃一如既往的勤奋，永远不忘记一心向上的初衷；愿你们在各自的人生山河里，既有独当一面的底气，也有温暖他人的胸怀。

自毕业离校起，这里便只是你们曾经的驻地；开启新生活，入世走江湖，才是你们今后真正的人生命题。愿你们带着师长的期许与祝福，奔赴山海，不惧风雨；闯过千难万险，归来仍是“精神少年”。

数载寒窗磨一剑，
再入江湖砺此身。
心怀天下望明月，
此去山河自有声。

Stay true to your heart, and the mountains and rivers will speak for themselves as you journey on — A Message to the Class of 2026

Liu Kaiqiang

It's graduation season once again, and the time has come to bid farewell. In this vast world, it is truly rare to have walked side by side as teacher and student for several years. Whether this encounter was destined or not, it remains a beautiful bond that cannot be repeated and is well worth cherishing.

Looking back on the past few years, I believe everyone must have mixed feelings: joy and frustration; excitement and melancholy; a sense of relief and a touch of reluctance. Those days and nights "tormented" by academic work, those moments when you "endured" your advisor's criticism and reminders over minor details, the nearly exacting demands and various restrictions of the laboratory, the arduous process of repeated revisions and starting over from scratch, as well as the solemnity of the degree system and the "uncompromising" rigor of the review experts... All of these experiences—whether you feel gratitude or still harbor doubts and confusion; whether you once thought of "escaping as quickly as possible," or now feel a deep, heartfelt reluctance to leave—after graduation, all of this will eventually settle into memories deep within your lives.

In fact, this experience has not only borne witness to your growth, but has also awakened and honed the resilience, clarity, and sense of responsibility deep within you. It is precisely these seemingly mundane, routine, and even arduous experiences that have endowed you with the ability to surpass yourselves and continue to grow, and that will sustain you as you move forward with greater composure and determination.

After graduation, some of you will leave campus to enter the workforce, while others will pursue further studies, embarking on new journeys of learning and research. But whichever path you choose, a new chapter in your lives is about to begin. If you leave campus to enter society—where the road ahead is long and the world is vast—your roles will inevitably change. Whether in the workplace or in your personal relationships, the kind of "picky" yet benevolent "nitpicking"—done without seeking anything in return, as your mentors have done—will likely become a rare commodity in the future. It will also be difficult to find an environment as relaxed and harmonious as the one you experienced as students on campus, where trial and error is permitted and where youthful inexperience and recklessness are embraced.

You will truly step into a more complex and expansive arena of life, facing workplace competition and the trials of fate, shouldering multiple responsibilities toward family and daily life, and weathering the impacts of the surging tides of society. You will encounter the mundane details of daily life and may face the dilemma of balancing filial duty with professional responsibilities; you will learn the limits of rules and experience the harsh realities of life; you will feel the happiness of self-reliance and finding joy in your own efforts, yet you will inevitably encounter the coldness and warmth of human relationships, setbacks, and even the disappointment brought by injustice and unfairness.

If you choose to pursue further studies, although your status may appear unchanged, important new responsibilities await you. A new environment, new advisors, and new research topics also mean new standards and new pressures. The path of academia, like the path of life, is never smooth sailing. I hope you will approach your new academic life with dedication, treat your professors and peers with sincerity and kindness, and respond to their expectations with optimism, ambition, and hard work. May you continuously improve and achieve your full potential through unwavering perseverance, day in and day out.

No matter what life throws your way in the future, these are all part of the human experience. Life is inherently difficult; we constantly navigate between making choices, shouldering responsibilities, and experiencing both loss and gain, all while shaping and affirming our sense of self. May you remain humble in times of prosperity and resilient in the face of adversity; may you not lose your way amid applause nor lose heart when met with indifference; may you uphold your principles when faced with temptation and stay true to your inner self amidst life's storms. Remember to treat yourself and others with kindness, to carry gratitude in your heart, and to hold reverence in your soul. You must have ideals that reach for the stars, yet also the steadfastness to keep your feet firmly on the ground. Only those who dare to carry their burdens forward are true heroes; only those who, having weathered life's storms, still carry a light within their hearts, are worthy of poetry and distant horizons.

As you graduate, though I am filled with a thousand feelings of reluctance to part, what I feel most deeply are my sincere hopes and blessings for your future. This year's college entrance exam essay question quoted a line from Fengsu Tongyi (General Principles of Customs and Traditions) by Ying Shao of the Eastern Han Dynasty: "The sun and

moon do not lose their essence, so though obscured, they shine again; the Yangtze and Han Rivers do not lose their source, so though blocked, they flow again." In fact, there is a line that follows: "The sage does not lose his virtue, so though set aside, he rises again." At this very moment, these words serve as the most sincere counsel for you as you set out on your journey, and they are also my heartfelt advice to you as you depart.

This learning experience is about to become a thing of the past, but we must not lose our "essence", sever our "source", or forget our "virtue". "To preserve one's essence" means that no matter how the outside world may obscure the truth, one must never compromise one's inherent character and moral standards; "to preserve one's source" means that no matter how winding the path ahead may be, one must never forget where one began or why one persists; "to preserve one's virtue" means that no matter how circumstances may change in the future, one must never abandon the fundamental conscience, kindness, and sense of responsibility that guide one's conduct in life.

In the course of a person's life, what truly accompanies one to the very end is never fleeting fortune, status, or honor and disgrace, but rather the unchanging essence and virtue that have always been within. If one remains true to one's original heart, even amidst storms, one will eventually see the sun and moon; if one does not lose one's resolve, even after traversing mountains and rivers, there will surely be an echo.

No matter where you may find yourselves in the future, no matter where you study or what careers you pursue, no matter what circumstances you face, and no matter how your unique personalities may clash with the realities of life, I sincerely hope that you will always hold fast to the kindness and justice within your hearts; that you will preserve your reverence for nature and science, your respect for rules and order, and your love for life and the world; and that you will maintain the integrity to stand firm against the tide. May you never abandon your unwavering diligence, nor forget your original aspiration to strive for excellence; may you, in the vast landscapes of your own lives, possess both the confidence to stand on your own and the generosity to warm the hearts of others.

From the moment you graduate and leave campus, this place will be nothing more than a chapter in your past; embarking on a new life and venturing out into the world is what truly defines your future. May you set out into the world with the hopes and blessings of your teachers, fearless in the face of wind and rain; may you overcome countless hardships and return as the "spirited youths" you once were.

After years of diligent study, I have honed my skills;

now I return to the world to test my mettle.

With the world in my heart, I gaze upon the bright moon;

as I set out, the land and rivers will speak for themselves.

以“做中学” 重塑义务教育科学课堂

房 喻

当今世界，科技革命与产业变革深度交织，创新型国家建设对人才素养提出了全新要求。人工智能的加速渗透，深刻倒逼教育重新审视“培养什么人、如何培养人”这一根本命题。在知识获取日益便捷、标准答案可以即时生成的时代，科学教育不能再以知识记忆和程式化操作为重心，而必须回归到对未知的探究、对问题的发现、对失败的重构中来。正是在这一背景下，教育部印发《义务教育阶段科学教育“做中学”领航行动指南》（以下简称《指南》），可谓正当其时。结合本人长期从事化学科学实验研究、参与中小学科学普及与人才培养的实践体会，就《指南》的精神内涵与实施路径谈几点认识。

一、问题辨识：当“科学课”不再像“做科学”

近年来，中小学科学教育的硬件条件显著改善，学生纸笔测试成绩持续提升。然而，走进真实的科学课堂却发现，科学教学与科学研究之间的深层割裂依然突出，其典型症候可概括为“操作程序化、结论标准化、失败禁区化”。学生按照既定步骤完成实验，记录预期现象，填写标准结论，即可顺利“过关”。整个过程极少涉及变量关系的自主探索，甚少面对异常数据的意义拷问，更不容许方案调整与过程反复，而后者，恰恰构成科学研究的日常形态。

众所周知，科学研究的常态，是在试错中逼近真相，在异常中寻觅机会。而当前的科学教育，却把这样一个生成性、反思性的探索过程，简单化为以“对”“错”论结果的“照方抓药”。学生习得的只能是对确定答案的复现能力，而非面对不确定世界的问题意识和应变能力。

人工智能的到来进一步放大了这一问题的紧迫性。《指南》的高明之处，正在于它直指课堂内核：科学教育必须从“知识传授型”走向“实践建构型”，让学生真正动手做科学，而非用笔“复述”科学。这不仅是教学方式的调整，更是育人逻辑的深层转换。

二、学段架构：顺应认知发展，构建科学实践梯度

科学思维的形成，必须依托亲身经历的问题解决过程。《指南》旗帜鲜明地提出“以学生为主体，以实践为路径”，其本质是将探究的主动权还给学生，使科学教育回归“从实践中来、到实践中去”的应有逻辑。

在育人原则上，《指南》体现出鲜明的问题导向与人文关怀。价值层面，强调在动手过程中涵养严谨求实、不惧失败的科学品格；学生发展层面，坚持保护好奇心、尊重个体差异；实施路径层面，倡导打破校园围墙，让课堂知识与真实科研情境有效对接。三条原则相互支撑，共同指向科学教育必须尊重事实、尊重过程、尊重成长。

在学段设计上，《指南》体现出清晰的认知梯度。小学阶段以具象观察和简单操作为主，重在激发兴趣与积累感性经验；初中阶段进阶为自主设计方案、控制变量、分析误差并尝试反思迭代，对应抽象思维发展和科学方法训练的关键期。这一安排与我个人的科研实践感受高度一致，也就是说，科学能力的形成，必须经历从“看”到“做”再到“思”的螺旋上升。

三、实施路径：课时、教学、评价、协同的系统重构

细读《指南》，能够感受到其强烈的“落地”意识。它在课时配置、教学转型、评价改革和社会协同四个维度上，给出了具有操作性的制度安排。

课时保障方面，《指南》明确要求 4 至 9 年级每学期至少完成 1 项完整的探究实践任务，时长不少于 4 课时，1 至 3 年级不作额外要求。这一规定从制度层面为科学实践争取了不可挤占的时间空间，同时低年级不作硬性规定，体现了对儿童认知特点的尊重。

教学方式方面，《指南》围绕生命健康、生态环境、地球奥秘、航空航天、新兴产业和人工智能六大主题，引导学校开展跨学科、项目式、贴近真实情境的科学探究活动。以二氧化碳制取实验为例，传统教学往往按部就班、结论先行。按“做中学”理念重新设计，学生需自主尝试不同酸浓度与碳酸盐用量的组合，观测气体产率变化，排查装置漏气点，分析产物差异原因。这实际上就是变量控制、证据推理和方案迭代的科学研究雏形。教师的核心任务不再是提供标准流程，而是引导学生在试错中建立自己的认知结构。

评价改革方面，《指南》明确不新增科学专项纸笔考试，而将探究过程表现纳入综合素质档案，重点考察问题意识、动手实操、反思改进与团队协作。即使实验最终结果不理想，只要学生能合理解释偏差成因并提出改进思路，即应给予积极认定。这种“重思维、轻结果”的评价取向，是对科学容错本质的尊重，也是对人工智能时代“结论易得、思维难求”的深刻回应。

协同育人方面，《指南》推动高校实验室、科研院所、高新企业向中小学开放共享。亲手完成一次实验获得的认知体验，远胜于被动记忆知识；一线科研人员分享一次真实的研究失败经历，其教育力量常超过精心编排的“成功案例”。打破校园围墙，既是破解资源瓶颈的有效策略，更是科学文化深度浸润的重要途径。

四、时代应答：在不确定中培养确定的科学素养

人工智能正在深度介入知识生产，标准答案的价值加速递减。创新型国家建设所渴求的，不再是记忆型、复制型人才，而是能够在复杂情境中发现问题、在信息洪流中辨别真伪、在试错迭代中逼近解决方案的复合型创新人才。义务教育阶段科学教育的战略定位，必须从“为后续学习储备知识”提升为“为终身发展塑造科学思维方式和行动品格”。

《指南》的深层价值，正在于它引导一场根本性的教育回归：让科学课从“记忆与复现”走向“探究与对话”，从“标准化应答”走向“真实问题解决”，从“追求完美结果”走向“尊重事实过程”，真正实现育人观念的根本转变。

落实《指南》，无需刻意打造华丽的课堂景观，需要的是扎扎实实地从每一个实验项目、每一次探究活动做起。鼓励学生动手，允许学生犯错，引导学生反思。让“做中学”成为科学课堂的常态，让科学教育回归实践本源。唯有如此，我们才能在人工智能加速演进的未来格局中，培育出一代兼具科学理性、人文情怀与创新勇气的建设者，为创新型国家建设筑牢最重要的人才根基。

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Reshaping Science Classrooms in Compulsory Education Through "Learning by Doing"

Fang Yu

In today's world, the technological revolution and industrial transformation are deeply intertwined, and the development of an innovative nation has placed entirely new demands on the qualities of talent. The accelerating penetration of artificial intelligence has compelled the education sector to fundamentally reexamine the core question of "what kind of people to cultivate and how to cultivate them". In an era where knowledge is increasingly accessible and standard answers can be generated instantly, science education can no longer focus on rote memorization and formulaic procedures; instead, it must return to the exploration of the unknown, the discovery of problems, and the reconstruction of failure. It is precisely against this backdrop that the Ministry of Education's issuance of the Guidelines for the "Learning by Doing" Pioneering Initiative in Science Education during Compulsory Education (hereinafter referred to as the Guidelines) is most timely. Drawing on my long-term experience in chemical research and my practical involvement in science popularization and talent cultivation in primary and secondary schools, I would like to share a few insights regarding the spirit and implementation pathways of the Guidelines.

I. Identifying the Problem: When "Science Class" Is No Longer Like "Doing Science"

In recent years, the infrastructure for science education in primary and secondary schools has improved significantly, and students' scores on paper-and-pencil tests have continued to rise. However, a visit to an actual science classroom reveals that the deep disconnect between science instruction and scientific research remains striking. Its typical symptoms can be summarized as "proceduralized operations, standardized conclusions, and prohibition of failure". Students simply follow predetermined steps to complete experiments, record expected phenomena, and fill in standardized conclusions to successfully "pass". The entire process rarely involves independent exploration of relationships between variables, seldom prompts students to question the significance of anomalous data, and does not allow for adjustments to experimental designs or iterative processes—yet it is precisely these elements that constitute the everyday practice of scientific research.

As is well known, the norm in scientific research is to approach the truth through trial and error and to seek opportunities in anomalies. Yet current science education has reduced this generative, reflective process of exploration to a formulaic approach that judges results as "right" or "wrong". Students learn only the ability to reproduce predetermined answers, rather than the critical thinking and adaptability needed to navigate an uncertain world.

The advent of artificial intelligence has further amplified the urgency of this issue. The ingenuity of the Guidelines lies in their focus on the very core of the classroom: science education must shift from a "knowledge-transmission" model to a "practice-based construction" model, enabling students to truly engage in hands-on scientific activities rather than merely "recounting" scientific concepts in writing. This is not merely an adjustment to teaching methods, but a profound transformation in the logic of education.

II. Grade-level Framework: Aligning with Cognitive Development to Establish a Gradual Progression in Scientific Practice

The development of scientific thinking must be grounded in the process of solving problems through firsthand experience. The Guidelines clearly advocate for "student-centered learning and practice-based approaches", which essentially means returning the initiative in inquiry to students and restoring science education to its proper logic of "deriving from practice and returning to practice".

In terms of educational principles, the Guidelines demonstrate a distinct problem-oriented approach and a humanistic perspective. At the value level, they emphasize cultivating a scientific character—one that is rigorous, pragmatic, and unafraid of failure—through hands-on activities; at the student development level, they insist on protecting curiosity and respecting individual differences; and at the implementation level, they advocate breaking down the walls of the campus to effectively bridge classroom knowledge with real-world research contexts. These three principles mutually reinforce one another and collectively underscore that science education must respect facts, respect the process, and respect growth.

In terms of grade-level design, the Guidelines reflect a clear cognitive progression. The elementary school stage focuses primarily on concrete observation and simple hands-on activities, emphasizing the stimulation of interest and the accumulation of intuitive experience; the middle school stage progresses to independent design of experiments, control of variables, analysis of errors, and attempts at reflection and iteration, corresponding to the critical period for the development of abstract thinking and training in the scientific method. This arrangement is highly consistent with my personal experience in scientific research—that is, the development of scientific competence must follow a spiral progression from "observing" to "doing" and then to "thinking".

III. Implementation Path: Systematic Restructuring of Class Hours, Teaching, Assessment, and Collaboration

A close reading of the Guidelines reveals a strong emphasis on practical implementation. It provides actionable institutional arrangements across four dimensions: class hour allocation, teaching transformation, assessment reform, and social collaboration.

Regarding the guarantee of class hours, the Guidelines explicitly require that students in grades 4 through 9 complete at least one full inquiry-based practical assignment each semester, lasting no fewer than four class hours, while no additional requirements are imposed on students in grades 1 through 3. This provision secures dedicated time and space for science-based practical activities at the institutional level, while the absence of mandatory requirements for lower grades reflects respect for children's cognitive development.

In terms of teaching methods, the Guidelines center on six major themes—life and health, the ecological environment, the mysteries of the Earth, aerospace, emerging industries, and artificial intelligence—to guide schools in conducting interdisciplinary, project-based, and real-world science inquiry activities. Take the carbon dioxide production experiment as an example: traditional teaching often follows a step-by-step approach that presents conclusions first. Redesigned according to the "learning by doing" philosophy, students must independently experiment with different combinations of acid concentrations and carbonate quantities, observe changes in gas yield, identify leaks in the apparatus, and analyze the reasons for differences in the products. This is, in fact, the embryonic form of scientific research involving variable control, evidence-based reasoning, and iterative refinement of hypotheses. The teacher's core task is no longer to provide a standard procedure, but to guide students in building their own cognitive frameworks through trial and error.

Regarding assessment reform, the Guidelines clearly state that no new paper-and-pencil exams for science special projects will be introduced; instead, performance during the inquiry process will be incorporated into comprehensive quality portfolios, with a focus on evaluating problem-solving awareness, hands-on practical skills, reflection and improvement, and teamwork. Even if the final experimental results are not ideal, students should receive positive recognition as long as they can reasonably explain the causes of deviations and propose ideas for improvement. This assessment approach—which "emphasizes thinking over results"—reflects respect for the inherently forgiving nature of science and serves as a profound response to the reality of the AI era, where "conclusions are easy to obtain, but critical thinking is hard to come by".

In terms of collaborative education, the Guidelines encourage universities, research institutes, and high-tech enterprises to open their facilities to elementary and secondary schools for shared use. The cognitive experience gained from conducting an experiment firsthand far surpasses that of passively memorizing knowledge; when frontline researchers share a real-life account of a research failure, its educational impact often exceeds that of a carefully scripted "success story". Breaking down the walls of the campus is not only an effective strategy for overcoming resource constraints but also a vital pathway for deep immersion in scientific culture.

IV. Responding to the Times: Cultivating Scientific Literacy That Brings Certainty Amid Uncertainty

Artificial intelligence is becoming deeply involved in knowledge production, and the value of "standard answers" is rapidly diminishing. What is needed to build an innovative nation is no longer talent that relies on memorization and replication, but rather multidisciplinary innovators capable of identifying problems in complex situations, distinguishing truth from falsehood amid a flood of information, and converging on solutions through trial and error and iterative refinement. The strategic positioning of science education in compulsory education must be elevated from "stockpiling knowledge for subsequent learning" to "shaping scientific ways of thinking and character traits for lifelong development".

The profound value of the Guidelines lies in guiding a fundamental shift in education: moving science classes from "memorization and reproduction" to "inquiry and dialogue", from "standardized responses" to "solving real-world problems", and from "pursuing perfect results" to "respecting the factual process", thereby truly bringing about a fundamental transformation in educational philosophy.

To implement the Guidelines, there is no need to deliberately create a flashy classroom environment; what is required is a solid, step-by-step approach starting with every experiment and every inquiry activity. We should encourage students to get hands-on, allow them to make mistakes, and guide them in reflection. Let "learning by doing" become the norm in science classrooms, and let science education return to its practical roots. Only in this way can we, in a future landscape shaped by the rapid evolution of artificial intelligence, nurture a generation of builders who possess scientific rationality, humanistic sensibilities, and the courage to innovate—thereby laying the most crucial talent foundation for building an innovative nation.

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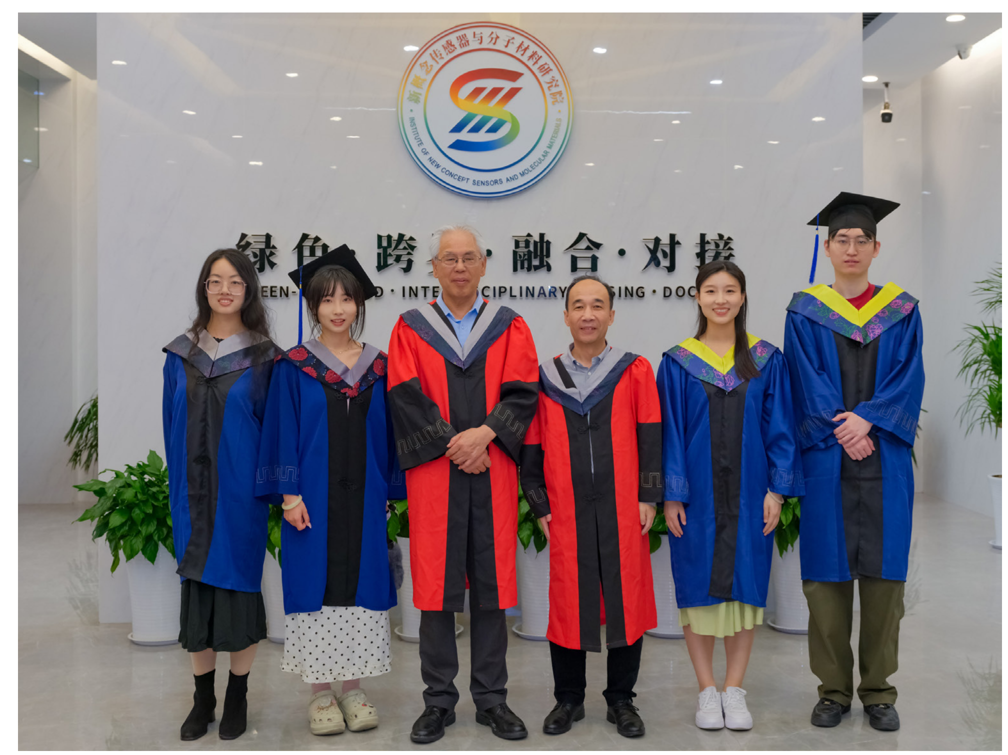

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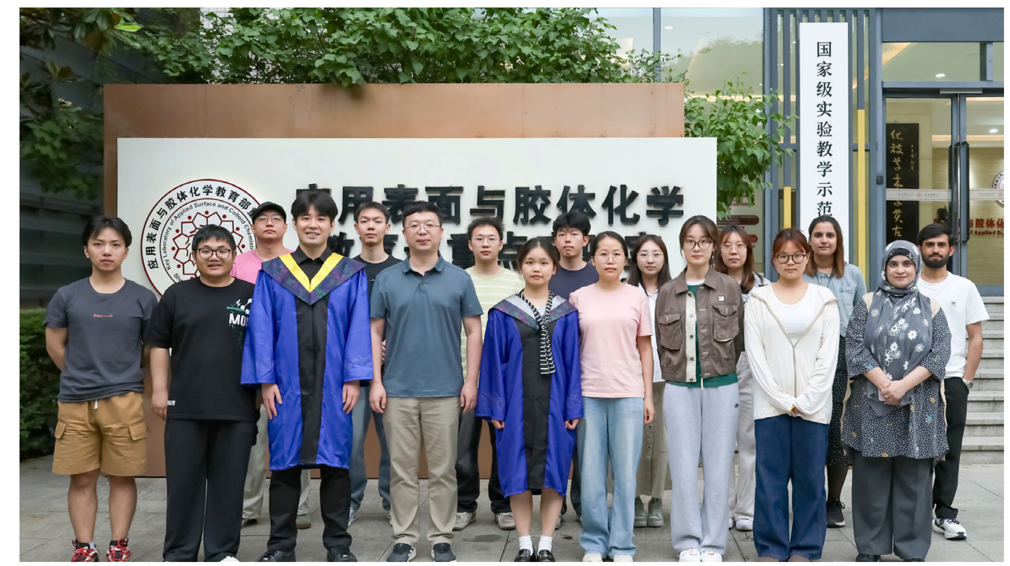

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