陕西师范大学 SHAANXI NORMAL UNIVERSITY

化学化工学院 School of Chemistry & Chemical Engineering

新概念传感器与分子材料研究院 INSTITUTE OF NEW CONCEPT SENSORS AND MOLECULAR MATERIALS

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Institute of New Concept Sensors and Molecular Materials Newsletter

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房喻院士赴西安市临潼区华清中学主讲“新年开学第一课”

Fang Yu presents “First Lesson of New Semester” at Huaqing Middle School in Lintong, Xi’an

2024 年 3 月 1 日下午，房喻院士赴西安市临潼区在由陕西省科协、西安市科协主办的院士进校园科普报告会华清中学主场活动上主讲“新年开学第一课”。

报告会上，房喻院士以“教育：个人的希望、民族的未来”为题，以其在临潼学习和成长经历为切入点，从科学是未来、人才是主体、教育是基础等方面展开介绍。他强调，只有重视教育、重视基础科学、重视基础研究才能更好地贯彻新发展理念，构建新发展格局、推动可持续发展，实现中华民族伟大复兴。同时，他勉励同学们继承弘扬、践行科学家精神，把个人理想和国家重大需求相结合，勇当新兴领域与交叉领域的开拓者、关键科技领域的领跑者，抢占世界科技发展的制高点，为实现高水平科技自立自强作出更大贡献。

陕西省科协常务副主席李肇娥，省科协党组成员、副主席李延潮，西安市科协党组书记、常务副主席耿占军，西安市教育局党委书记、局长李红雨，西安市科协党组成员、副主席张传时，临潼区区长苗吉，临潼区副区长薛凡，省市科协、临潼区有关部门领导参加活动。

除了华清中学设立主会场之外，此次活动还在西安高端人才服务基地、西安市临潼区马额中学、西安市临潼区马额初级中学、西安市临潼区陕鼓中学、西安市临潼区铁路中学、西安市临潼区代王初级中学、西安市临潼区西泉初级中学、西安市临潼区雨金中学和蓝田县城关中学分别设立分会场，以“线上线下”相结合的方式，在科普西安抖音平台进行直播，同时在微信公众号、网站、小红书平台进行宣传推广，50 余万名师生参与。

On March 1, 2024, Prof. Fang Yu presented a report of “First Lesson of New Semester after the Chinese New Year” to teachers and students at Huaqing Middle School in Lintong District, Xi’an City, which was the home event of the campus science popularization activity sponsored by Shaanxi Provincial Association for Science and Technology and Xi’an Association for Science and Technology.

In his report titled “Education: Personal Hope and the Future of the Nation”, Fang Yu started with his learning and growth experience in Lintong, and expounded from the aspects of science is the future, educated professionals are the main body, and education is the foundation. He stressed that only by attaching importance to education, basic science and basic research can we better implement the new development concept, build a new development pattern, promote sustainable development and

realize the great rejuvenation of the Chinese nation. At the same time, he encouraged the students to inherit, carry forward and practice the spirit of scientists, combine their personal ideals with the needs of the country, dare to become pioneers in emerging fields and interdisciplinary fields, and front runners in key scientific and technological fields, seize the high ground of world scientific and technological development, and make greater contributions to China's realization of high-level scientific and technological self-reliance.

Shaanxi Science and Technology Association executive vice chairman Li Zhao'e, vice chairman Li Yanchao, Xi'an Science and Technology Association Party secretary and executive vice chairman Geng Zhanjun, X'an Education Bureau Party secretary and director Li Hongyu, vice chairman Zhang Chuanshi, Lintong District governor Miao Ji, Lintong District deputy governor Xue Fan, and other officials from provincial and municipal Science and Technology Associations, relevant Lintong District departments participated in the activity.

Apart from the home venue at Huaqing Middle School, the event also set up online branch venues in Xi'an High-end Talent Service Base, Xi'an Lintong Ma'ei Middle School, Xi'an Lintong Ma'ei Junior Middle School, Xi'an Lintong Shaangu Middle School, Xi'an Lintong Railway Middle School, Xi'an Lintong Daiwang Junior Middle School, Xi'an Lintong Xiquan Junior Middle School, Xi'an Lintong Yujin Middle School and Lantian County Chengguan Middle School respectively. It was broadcast live on the Popular Science Xi'an Tiktok platform, as well as on the WeChat and XiaoHongshu platform, with an audience of more than 500,000 teachers and students.

房喻院士获聘第五届陕西省学位委员会委员

Fang Yu appointed member of fifth Shaanxi Province Academic Degree Committee

2024 年 3 月 17 日，在第五届陕西省学位委员会成立大会暨第一次全体会议上，房喻院士获聘第五届陕西省学位委员并获颁委员聘书。陕西省委常委、常务副省长王晓主持会议并讲话。会议审议了陕西省学位与研究生教育工作报告，安排部署了下一步工作。

On March 17, 2024, at the founding meeting and the first plenary meeting of the fifth Shaanxi Provincial Academic Degree Committee, Prof. Fang Yu was appointed as a member of the fifth committee and was awarded the letter of appointment. Shaanxi province executive vice governor Wang Xiao presided over the meeting and delivered a speech. The meeting reviewed the work report on degree and postgraduate education in Shaanxi province and made arrangement for the subsequent work.

房喻院士出席西安市科协第九届委员会会议并作工作报告

Fang Yu delivers work report at 9th XAST Committee meeting

2024 年 3 月 20 日，房喻院士出席西安市科学技术协会第九届委员会第二次全体会议，并以科协主席身份代表常委会向大会作工作报告，从五个方面总结了西安市科协 2023 年的工作开展情况，并对 2024 年的工作进行安排部署。

On March 20, 2024, Prof. Fang Yu attended the second plenary meeting of the ninth Committee of Xi'an Association for Science and Technology, and delivered a work report in the capacity of XAST chairman on behalf of the Standing Committee, summarizing XAST's work in 2023 from five aspects, and made arrangements for its work in 2024.

房喻院士出席香港中文大学（深圳）“新化学、新材料、新思路”学术论坛

Fang Yu attends “New Chemistry, New Materials, New Paradigms” Forum of the Chinese University of Hong Kong (Shenzhen)

2024 年 3 月 24 日，房喻院士应邀赴深圳出席香港中文大学（深圳）主办的“新化学、新材料、新思路”学术论坛。

学术论坛邀请到中国科学院白春礼院士、清华大学程津培院士、中国工程院干勇院士、复旦大学杨玉良院士、清华大学 / 吉林大学张希院士、上海交通大学丁奎岭院士、哈尔滨工业大学周玉院士等 30 余位材料与化学方向院士参加。

该论坛与“人工智能 +”院士论坛、数学与数据科学前沿高峰论坛和大湾区国际细胞基因治疗和再生医学

论坛四大论坛，作为香港中文大学（深圳）十周年校庆系列学术活动，分别邀请四大重点领域的学界领军人，百余名院士齐聚一堂共探各领域学术前沿，共话学科建设及未来发展。

On March 24, 2024, Prof. Fang Yu was invited to attend the Academic Forum "New Chemistry, New Materials and New Paradigms" hosted by the Chinese University of Hong Kong (Shenzhen) in Shenzhen.

More than 30 academicians in the field of materials and chemistry, including Academician Bai Chunli of Chinese Academy of Sciences, Academician Cheng Jinpei of Tsinghua University, Academician Gan Yong of Chinese Academy of Engineering, Academician Yang Yuliang of Fudan University, Academician Zhang Xi of Tsinghua University/Jilin University, Academician Ding Kuiling of Shanghai Jiao Tong University, and Academician Zhou Yu of Harbin Institute of Technology, were invited to participate in the forum.

The forum, together with the "Artificial Intelligence +" Academician Forum, the Forum on Advances and Development of Mathematics and Data Science and the Greater Bay Area International Cell/Gene Therapy and Regenerative Medicine Symposium, are a series of academic activities celebrating the 10th anniversary of the Chinese University of Hong Kong (Shenzhen). More than 100 academicians from the four key fields were invited to gather together to explore the academic frontiers of the fields and discuss the construction and future development of the disciplines.

房喻院士带队赴深圳砺剑防卫和宁波甬安光科访问调研

Fang Yu visits Shenzhen SRED Technology and Ningbo Yongan Guangke

2024 年 3 月 24 日，房喻院士带队赴深圳砺剑防卫技术集团有限公司访问调研，与集团蔡文斌董事长、许亮总经理等座谈，了解了公司运营情况，产品及新品研发进展，并 2024 年 3 月 24 日，房喻院士带队赴深圳砺剑防卫技术集团有限公司调研，与集团蔡文斌董事长、许亮总经理等座谈，了解了公司运营情况，产品及新品研发进展，并就双方后续合作进行了交流探讨。

3 月 25 日，房喻院士带队赴宁波甬安光科新材料科技有限公司访问调研，参观考察了甬安光科招宝厂区和蛟川厂区，并与甬安光科徐耀总经理及研发管理团队就胶体化学领域的学术和应用问题进行交流探讨，双方表示希望科技型创业企业与学界深入开展合作交流，促进产学研互联互通，不断创新，推动我国材料科学研究与应用的高质量发展。

新概念传感器与分子材料研究院副院长丁立平教授、办公室主任杨小刚及专职科研人员罗艳彦随行参加调研。

On March 24, 2024, Prof. Fang Yu led a team to visit Shenzhen SRED Security and Surveillance Technology Group Co., Ltd., and talked with SRED group Chairman Cai Wenbin and general manager Xu Liang, inquiring about the company's operation, production and new product development progress, and exchanging ideas about the follow-up

cooperation between the two sides.

On March 25, Prof. Fang Yu and his delegation visited Ningbo Yongan Guangke New Material Technology Co., Ltd. They first visited Yongan Guangke's Zhaobao factory and Jiaochuan factory, and discussed academic and application issues in the field of colloid chemistry with general manager Xu Yao and his R&D and management team. Both sides expressed the hope that sci-tech startups and the academic community could carry out in-depth cooperation and exchanges, enhance industry-university-research interconnection, and promote the high-quality development of materials science research and application in China through continuous innovation.

Institute of New Concept Sensors and Molecular Materials vice dean Prof. Ding Liping, Administrative Office director Yang Xiaogang, and research assistant Luo Yanyan, accompanied Fang Yu in the visits.

研究院参观海斯夫生物工程并参加微生物制造技术发展研讨会

INCSMM visits HSF Biotech and participates in Microbial Manufacturing Technology Development Seminar

2024 年 3 月 30 日，新概念传感器与分子材料研究院全体教师、工程技术人员和行政人员前往位于杨凌示范区的陕西海斯夫生物工程有限公司参观调研，并参加了由研究院与海斯夫共同主办的微生物制造技术发展研讨会。

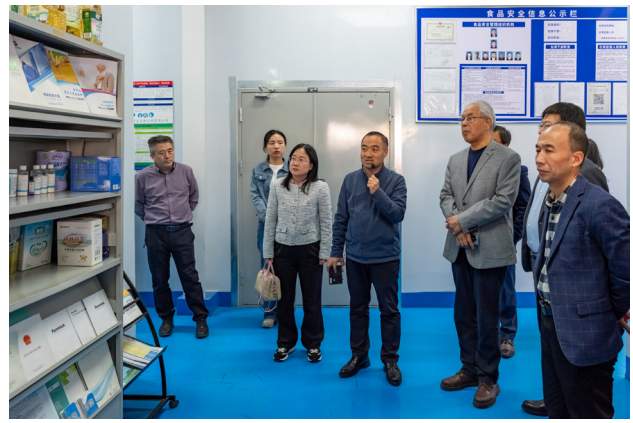
上午，房喻院士带领研究院一行近 30 人来到杨凌示范区火炬创业园，参观调研了的海斯夫生物工程第一和第二生产基地。陕西师范大学食品工程与营养科学学院副院长、西部果品资源高值利用（教育部）工程中心副主任、海斯夫技术总监孟永宏教授为大家介绍、讲解了海斯夫的产品特点、生产设备、生产工艺及经营情况。

在随后举行的微生物制造技术发展研讨会上，赵鹏涛博士和张帅博士分别以“食品加工与智能监测研究进展”和“膳食类凝胶与功能材料研究进展”为题作了报告。孟永宏教授进一步介绍了海斯夫公司的经营理念和目标愿景，并介绍了陕西省合成生物与智能制造创新中心的相关情况。马佳妮、边红涛老师分别提问，与报告人进行了讨论交流。房喻院士在总结讲话中肯定了海斯夫艰苦奋斗的企业精神，希望海斯夫的发展越来越好。

海斯夫生物生产部总经理郭建琦、陕西师范大学西部果品资源高值利用（教育部）工程中心副主任白浩、西北农林科技大学化学与药学院高锦明教授等陪同参观调研并出席了研讨会。

下午，研究院一行前往西北农林科技大学博览园，参观了昆虫馆和中国农业博物馆。

On March 30, 2024, teachers, engineers and administrative staff of the Institute of New Concept Sensors and Molecular Materials visited Shaanxi HSF Biotech Co., Ltd. in Yangling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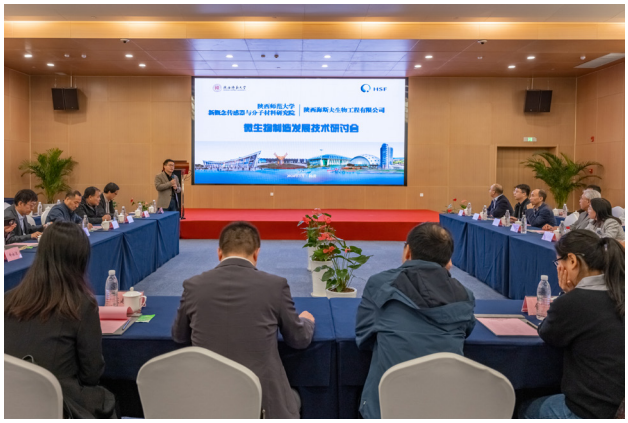
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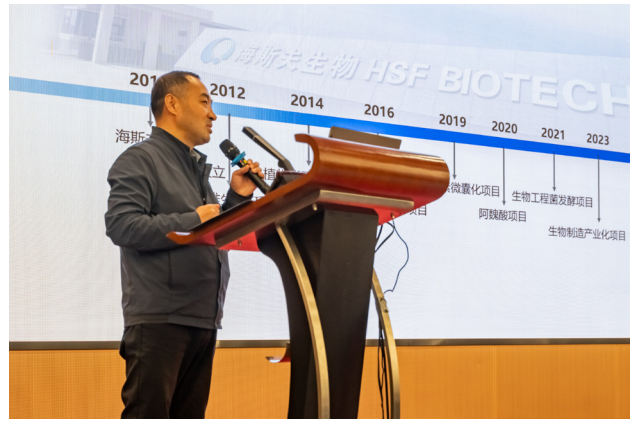
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阿魏酸项目
生物制造产业化项目


微生物制造发展技术研讨会

Demonstration Zone, and participated in the Microbial Manufacturing Technology Development Seminar co-sponsored by the Institute and HSF Biotech.

In the morning, Prof. Fang Yu led the INCSMM group of nearly 30 people to the Torch Entrepreneurship Park in Yangling Demonstration Zone to visit and investigate the first and second production bases of HSF Biotech. Prof. Meng Yonghong, vice dean of School of Food Engineering and Nutritional Science of Shaanxi Normal University, deputy director of Engineering Center of High Value Utilization of Western Fruit Resources (Ministry of Education) and HSF technical director, introduced and explained the product characteristics, production equipment, production process and operation of HSF Biotech.

In the subsequent seminar on the development of microbial manufacturing technology, Dr. Zhao Pengtao and Dr. Zhang Shuai presented reports on the topic of "Research progress in Food processing and intelligent monitoring" and "Research progress in dietary gels and functional materials" respectively. Prof. Meng Yonghong further introduced the business philosophy, goal and vision of HSF Biotech, and introduced the relevant situation of Shaanxi Province Synthetic Biology and Intelligent Manufacturing Innovation Center. Prof. Ma Jiani and Prof. Bian Hongtao asked questions respectively and discussed them with the presenters. In his concluding speech, Prof. Fang Yu affirmed the hard work and enterprise spirit of HSF and gave his best wishes for HSF's development.

General manager Guo jianqi of HSF production department, deputy director Bai Hao of SNNU Engineering Center of High Value Utilization of Western Fruit Resources (Ministry of Education), and Prof. Gao Jinming of the School of Chemistry and Pharmacology at Northwest Agricultural and Forestry University, accompanied the visit and attended the seminar.

In the afternoon, the INCSMM group went to the NUAF Museum Garden and visited the Insect Museum and the China Agricultural Museum.

薄鑫参加 2024 电催化与电合成国际研讨会并作报告

Bo Xin presents at 2024 Int'l Symposium on Electrocatalysis and Electrosynthesis

2024 年 3 月 31 日，薄鑫副研究员参加了在天津举行的“中国化学会 2024 电催化与电合成国际研讨会”，并作了题为“温和条件制备高效氮掺杂电解水催化剂”的学术报告。

本次论坛由中国化学会电化学专业委员会主办，南开大学承办，旨在推动电催化与电合成同固态电池、燃料电池、人工智能、数字经济等交叉融合，将新能源的创新链、产业链和人材链有机衔接，推动智能网联新能源汽车、氢能、新材料等新兴产业和未来产业加快形成新质生产力，促进低碳能源体系构建与社会可持续发展。

On March 31, 2024, Assoc. Prof. Bo Xin participated in 2024 International Symposium on Electrocatalysis and Electrosynthesis and gave a presentation titled Preparation of the Efficient N-doped Electrocatalysts for Water Electrolysis via Mild-Condition.

The forum, organized by the Professional Committee of Electrochemistry of the Chinese Chemical Society and hosted by Nankai University, aims to promote the cross-integration of electrocatalysis and electrosynthesis with solid-state batteries, fuel cells, artificial intelligence, digital economy, etc., organically connecting the innovation chain, industrial chain and talent chain of new energy, updating the new productive forces in emerging and future industries such as intelligent networked new energy vehicles, hydrogen energy and new materials, and promoting the construction of a low-carbon energy system and sustainable social development.

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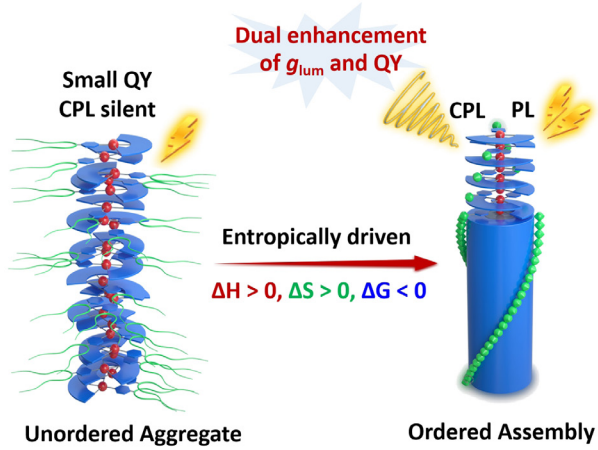
Supramolecular Chemistry Hot Paper

Dual Enhancement of Phosphorescence and Circularly Polarized Luminescence through Entropically Driven Self-Assembly of a Platinum(II) Complex

Yanqing Wang[+], Na Li[+], Liangwen Chu, Zelin Hao, Junyu Chen, Jiang Huang, Junlin Yan, Hongtao Bian, Pengfei Duan, Jing Liu,* and Yu Fang*

铂配合物熵驱动自组装提升手性材料的圆偏振发光不对称性和发光效率



分子组装是提升有机小分子圆偏振发光(Circularly Polarized Luminescence，CPL)不对称性的有效手段，也是CPL领域的重要发展方向之一。然而，传统的焓驱动自组装为放热过程，升温会导致组装体解聚，显著削弱CPL材料的发光性质。如何同时提升CPL材料的圆偏振发光不对称因子(glum)和发光效率(QY)，并克服热淬灭现象，是该领域的关键科学问题。

最近，光子鼻与分子材料科研团队的刘静教授和国家纳米科学中心的段鹏飞研究员合作，利用熵驱动自组装策略构筑了具有反常热响应特征的超分子体系，实现了glum和QY的同步增大。作者设计合成了含有手性中心、吡啶三氮唑三齿配体和三乙二醇(TEG)链的两性铂(II)配合物(L–Pt)。L–Pt在水/1,4–二氧六环中的自组装为熵驱动过程，即升温触发L–Pt分子组装成高度有序的纳米结构，相邻L–Pt分子间的激子耦合作用引起分子手性传递并被显著放大，同时Pt···Pt作用和π–π堆积显著增强了L–Pt组装体的QY：当体系温度从25 °C升至60 °C时，QY从15%增加至53%，同时glum从0.04×10^{-2}升高到0.06，而且该敏化过程可以通过改变温度而调控，实现了glum和QY的同步可逆变化，表明可以通过调控分子间弱相互作用实现体系光物理性质的智能调控。L–Pt固态自组装薄膜的glum和QY高达0.16和69%，显著优于其他CPL组装体系的手性发光性质。

熵驱动自组装策略不仅同时提升了CPL材料的glum和QY，同时增强了发光材料的抗热淬灭性能，为解决CPL领域的关键科学问题提供了新思路，将促进该领域进一步发展。

该项研究以Hot Paper形式发表在Angewandte Chemie International Edition期刊上。

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Molecular self-assembly has been recognized as an effective strategy to enhance circularly polarized luminescence (CPL), representing one of the most important areas in CPL field. However, the commonly reported supramolecular CPL-active materials, typically formed through enthalpically driven assembly of amphiphilic fluorophores, often exhibiting thermo disassembly of fluorescent advanced structures and significantly weakening the chiroptical properties. Apparently, improving the circularly polarized luminescence dissymmetry factor (glum), luminescence efficiency (QY), and thermal quenching resistance of chiral materials poses a significant challenge.

To address these challenges, we present an innovative strategy utilizing the entropically driven self-assembly of amphiphilic phosphorescent platinum(II) complexes (L-Pt) with tetraethylene glycol chains, resulting in unique temperature dependencies. The entropically driven self-assembly of L-Pt leads to a synergistic improvement in phosphorescence emission efficiency (QY was amplified from 15% at 25 °C to 53% at 60 °C) and chirality, both in the ground state and the excited state (glum value has been magnified from 0.04 × 10^{-2} to 0.06) with increasing temperature. Notably, we observed reversible modulation of phosphorescence and chirality observed over at least 10 cycles through successive heating and cooling, highlighting the intelligent control of luminescence and chiroptical properties by regulating intermolecular interactions among neighboring L-Pt molecules. Importantly, the QY and glum of the L-Pt assembly in solid state were measured as 69% and 0.16 respectively, representing relatively high values compared to most self-assembled CPL systems. This study marks the pioneering demonstration of dual thermo-enhancement of phosphorescence and CPL and provides valuable insights into the thermal effects on high-temperature and switchable CPL materials.

The work is published as a Hot Paper in the journal Angewandte Chemie International Edition.

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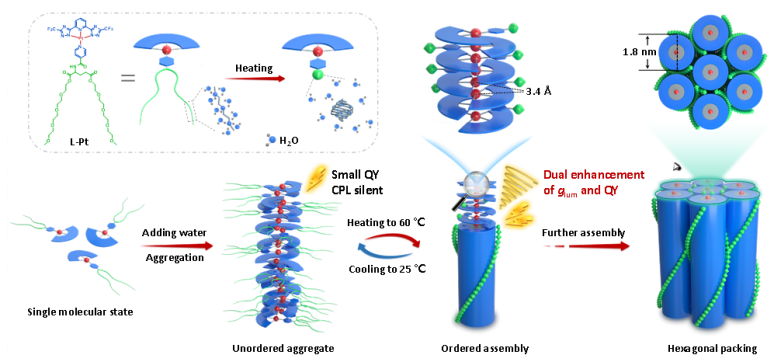

图 1. 铂 (II) 配合物熵驱动自组装实现手性组装体发光不对称性和发光效率的同步增大

Figure 1. Dual Enhancement of Phosphorescence and Circularly Polarized Luminescence through Entropically Driven Self-Assembly of a Platinum(II) Complex

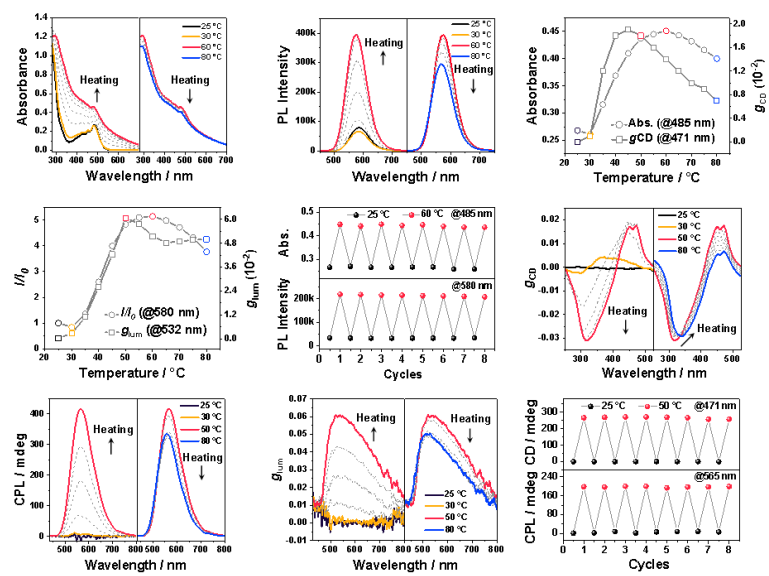

图 2. 铂 (II) 配合物组装体发光性质的反常热响应性质

Figure 2. The unique temperature-dependent luminescence properties of L-Pt assemblies.

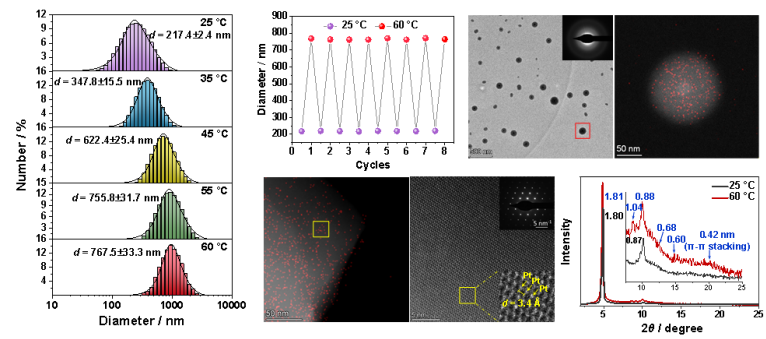

图 3. 铂 (II) 配合物组装体微观形貌

Figure 3. The advanced structure of L-Pt assemblies

CHEMISTRY OF MATERIALS

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Unlocking Multicolor Emissions in the Crystalline State through Dimerization and Configurational Transformation of a Single Fluorophore

Yangtao Shao, Rongrong Huang,* Guanyu Jiang, Qiyuan Shi, Hexi Wei, Gang Wang, Weijie Chi, Haonan Peng,* Xiaogang Liu,* and Yu Fang*

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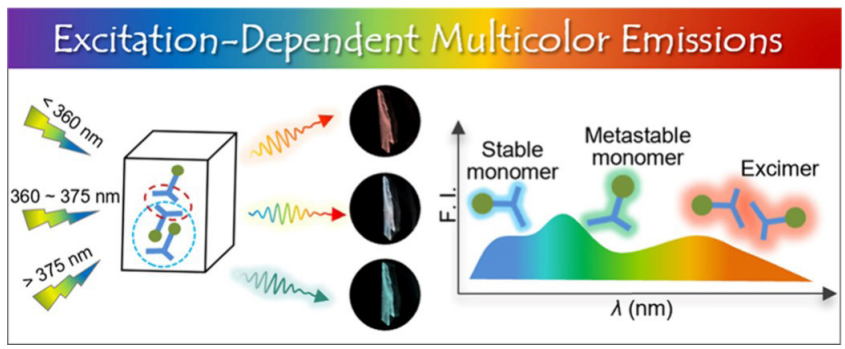
通过单个荧光团的二聚化和构型转变解锁晶体状态下的多色发射



具有可调特性的多色发光材料在材料科学中有着广泛的应用前景。不幸的是，通过混合多种类型的荧光团来实现多色发射的传统方法受到限制，特别是光谱不稳定，聚集引起的猝灭和能量转移。直到现在，从固态的单一类型的荧光团中追求多色发射仍然是一个艰巨的挑战。

从理论上来说，制造基于单荧光团的多色发射材料的关键在于产生多个发射中心（最好超过两个）。这可以通过仔细控制基态和 / 或利用分子内 / 分子间激发态结构转换，并挑战卡沙规则（如图 1 所示）来实现。

在这项研究中，我们引入了 N,N' – 二苯基二氢二苯并 [a,c]– 吩嗪 (DPAC)，增加了两个邻碳硼基单元，创造了一种新的荧光团 CbDPAC。由于丰富的分子间相互作用网络产生了新的发射中心，如构象异构体和准分子，CbDPAC 晶体呈现出三个不同的发射带，分别在 405、470 和 620 nm 处达到峰值。这项工作激发了具有可定制特性的智能荧光团的合理分子工程，并开创了刺激响应发光技术的多种可能性。

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全文链接：https://doi.org/10.1021/acs.chemmater.3c02993

Multicolor luminescent materials with tunable properties hold great promise for a wide range of applications in materials science. Unfortunately, the conventional approach to achieving multicolor emissions by blending multiple types of fluorophores is hindered by limitations, notably, spectral instability, aggregation-caused quenching, and energy transfer. The pursuit of multicolor emissions from a single type of fluorophore in the solid state has, until now, remained a formidable challenge.

The key to creating single-fluorophore-based multicolor emissive materials lies in the ability to generate multiple emissive centers (preferably more than two). This can be achieved by

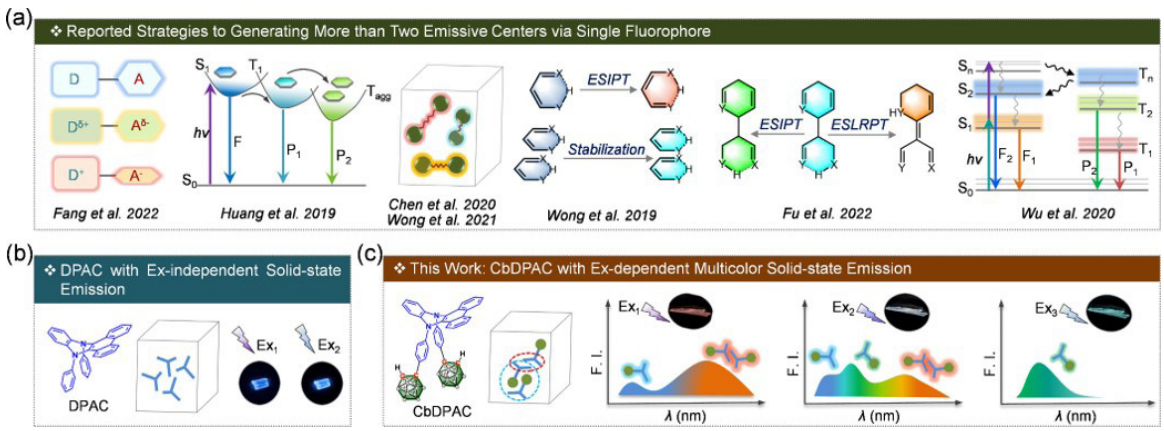

图 1. (a) 通过单个荧光团产生两个以上发射中心的报告策略的示意图。(b) 固态 DPAC 的荧光特性，以及 DPAC 晶体堆积形式的卡通图解。(c) CbDPAC 晶体的激发相关多色发射示意图，以及 CbDPAC 晶体的填充形式卡通图。

Figure 1.(a) Schematic Illustrations for the Reported Strategies for Generating More than Two Emissive Centers via Single Fluorophores. (b) Fluorescent Properties of DPAC in the Solid State, and the Cartoon Illustration Showing the Packing Form of the DPAC Crystal. (c) Schematic Illustration for the Excitation-Dependent Multicolor Emission of the CbDPAC Crystal, and the Cartoon Illustration Showing the Packing Form of the CbDPAC Crystal.

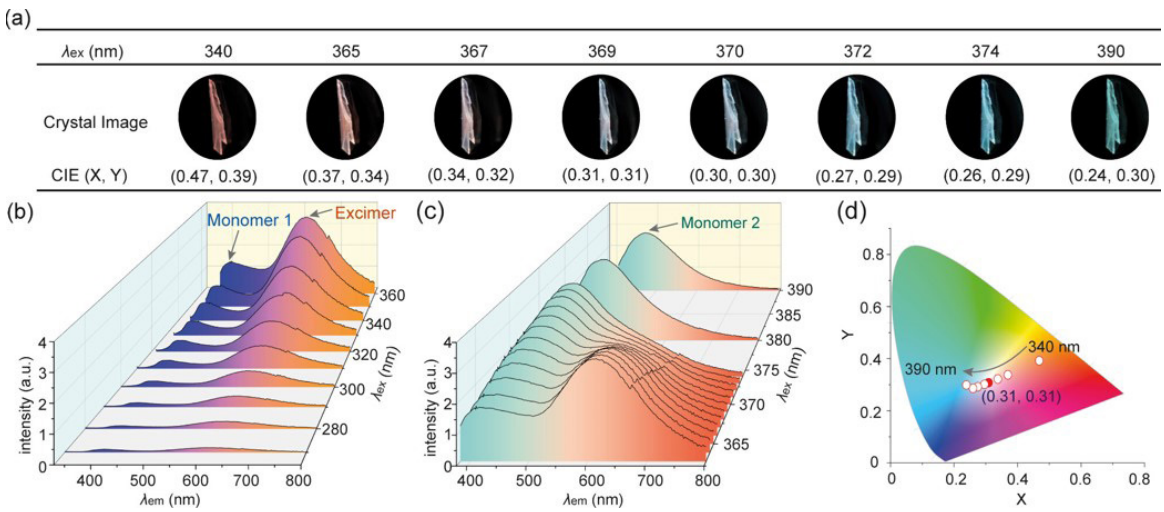

图 2. (a) CbDPAC 晶体在不同波长照射下的荧光图像以及相应的国际发光委员会 (CIE) 值。(b, c) CbDPAC 晶体在不同激发波长下的荧光光谱。(d) 晶体 CbDPAC 在不同波长照射下的 CIE 坐标图。红点表示 369 nm 激发波长下的 CIE 值。注：单体 1 为稳定构象异构体，单体 2 为亚稳定构象异构体。

Figure 2. (a) Fluorescence images of the CbDPAC crystal under illumination at various wavelengths and the corresponding Commission International de l'Eclairage (CIE) values. (b, c) Fluorescence spectra of the CbDPAC crystal recorded at various excitation wavelengths. (d) CIE coordinate diagram of crystal CbDPAC under illumination at various wavelengths. The red dot represents the CIE value under the excitation wavelength of 369 nm. Notes: monomer 1 and monomer 2 refer to stable and metastable conformational isomers, respectively.

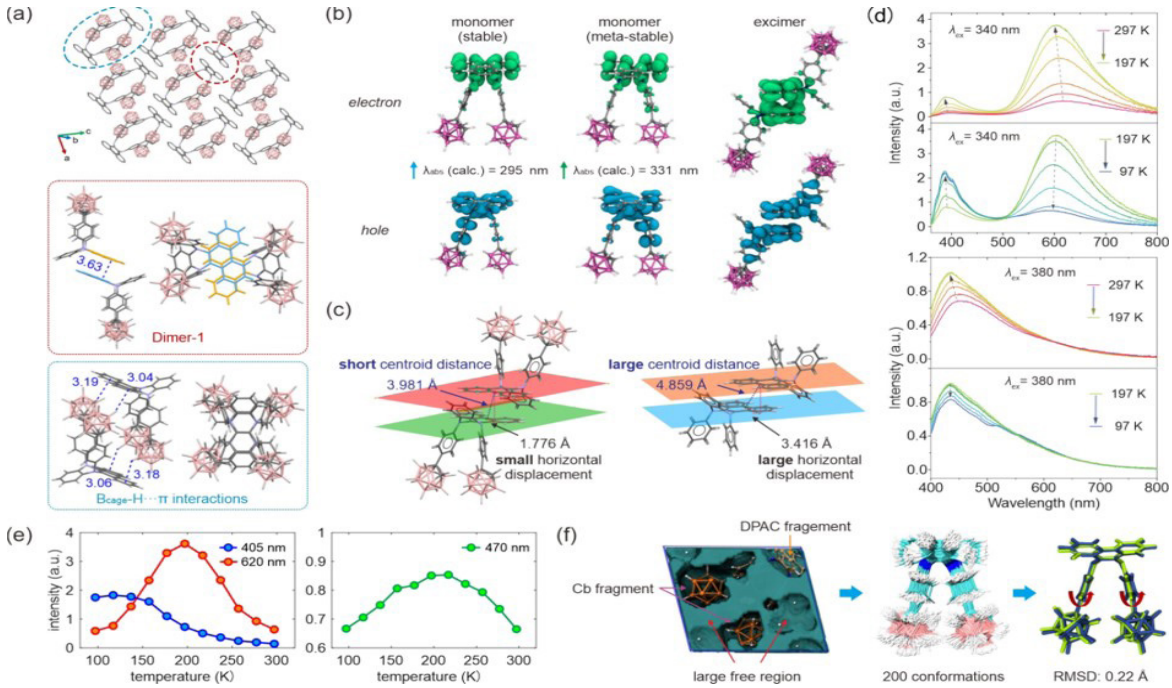

图 3. (a) CbDPAC 的分子填充 (顶部)，其中氢原子被省略，红色和蓝色圆圈突出显示了两种类型的分子间相互作用。红圈图为二聚体 −1 中分子间的 π···π 相互作用 (中)，蓝圈图为分子间的 Bcage − H···π 相互作用 (下)。(b) 稳定单体 (左)、亚稳单体 (中) 和准分子 (右) 的电子和空穴分布。计算出的稳定和亚稳单体的紫外 − 可见吸收波长如图所示。由于其激发态高昂的成本与建模相关，二聚体 1 在基态优化作为“准分子”的代表。(c) CbDPAC 晶体与参考 DPAC 晶体中 DPAC 间质心距离和水平位移的比较。(d) CbDPAC 晶体在 340 和 380 nm 激发下的温度依赖性荧光光谱。(e) 三个发射峰 (405、620 和 470 nm) 的荧光强度随温度的变化关系。(f) CbDPAC 晶体中的自由体积 (左)，200 个 CbDPAC 构象的重叠结构 (中)，稳定 (黄色) 和亚稳 (蓝色) 单体构象的重叠 (右)，以及两种构象对应的均方根偏差 (RMSD)。

Figure 3.(a) Molecular packing of CbDPAC (top), where hydrogen atoms are omitted for clarity, and two types of intermolecular interactions are highlighted in red and blue circles. The picture in the red circle shows the intermolecular π•••π interactions in dimer-1 (middle), and the picture in the blue circle shows intermolecular Bcage-H•••π interactions (bottom). (b) Electron and hole distributions of the stable monomer (left), metastable monomer (middle), and excimer (right). The calculated UV−vis absorption wavelengths of the stable and metastable monomers are shown in the inset. Dimer 1, optimized in its ground state, acts as a proxy for the “excimer” due to the prohibitive costs associated with modeling its excited state. (c) Comparison of the inter-DPAC centroid distance and horizontal displacement in the CbDPAC crystal and the reference DPAC crystal. (d) Temperature-dependent fluorescence spectra of the CbDPAC crystal excited at 340 and 380 nm. (e) Fluorescence intensity of the three emission peaks (405, 620, and 470 nm) as a function of temperature. (f) Free volume (left) in the CbDPAC crystal, the overlapping structures of the 200 CbDPAC conformers (middle), the overlapping of the stable (in yellow) and metastable (in blue) monomer conformations (right), and the corresponding root-mean-square deviation (RMSD) of the two conformations.

carefully controlling ground-state and/or harnessing intra-/intermolecular excited-state structural transformations, and challenging Kasha's rule (as illustrated in Figure 1).

In this study, we have introduced N,N′-diphenyl dihydrodibenzo[a,c]-phenazines (DPAC), augmented with two o-carboranyl units, to create a novel fluorophore CbDPAC. The CbDPAC crystal exhibits three distinct emission bands peaking at 405, 470, and 620 nm, respectively, arising from a rich intermolecular interaction network that generates novel emission centers, such as conformational isomers and excimers. This work inspires the rational molecular engineering of smart fluorophores with tailorable properties and inaugurates diverse possibilities for stimuli-responsive luminescent technologies.

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From the journal:
Chemical Communications

A facile N-doped NiFe(B) (Oxy)hydroxide monolithic electrode for enhanced water oxidation†

Check for updates

Yushu Li,‡[a] Huizhen Han,‡[a] Xiuhang Wang,[a] Yu Sun,[a] Yulian Zhao,[a] Shiyi Tao,[a] Aoxing Duan,[a] Yi Ma,*[a] Xin Bo*[a] and Zenglin Wang*[a]

简单方法制备氮掺杂镍铁（硼）羟基氢氧化物整体式析氧活性电极

在镍铁羟基氢氧化物体系中进行氮掺杂，可有效提升其电化学水氧化催化活性，但常规氮掺杂需通过高温、高压、特定气氛等极端条件获得，不利于催化材料的规模化制备。本团队利用非金属硼元素半金属性和较大原子半径的特点，通过化学镀制得的镍铁硼间隙固溶体合金前驱体；随后在温和条件下（仅 120 °C），前驱体老化为羟基氢氧化物，期间硼原子与气相中的氨发生置换，获得硼诱导氮掺杂镍铁（硼）羟基氢氧化物整体式电极。活性电极在碱性介质中的析氧催化活性显著增强，其起始过电位仅为 225 mV。同时，系统的研究了材料的电子结构、电化学比表面积、亲水性等因素对催化活性的影响。此外，本方法还可进一步拓展至硫元素的掺杂。本研究为电解水制氢阳极析氧催化电极的规模化开发提供了技术支持，助力我国“双碳”进程。

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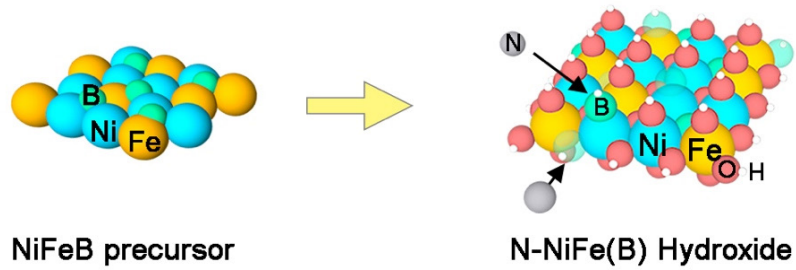
全文链接：https://pubs.rsc.org/en/content/articlelanding/2024/cc/d3cc05190k



N-doped (oxy)hydroxide systems can effectively enhance the electrochemical water oxidation catalytic activity. However, conventional N doping requires extreme conditions such as high temperature, high pressure, and specific atmospheres, which are not conducive to the large-scale preparation of catalytic materials. Our team utilized the semi-metallic nature and large atomic radius of the non-metallic boron element to prepare NiFeB interstitial solid-solution alloy precursors by electroless plating; subsequently, the precursor was aged into (oxy)hydroxide under the mild conditions (merely 120 °C), during which boron atoms were substituted with ammonia in the gas phase, resulting in boron-induced N-doped NiFe(B) (oxy)hydroxide monolithic electrode. The catalytic activity of the active electrode for oxygen evolution in alkaline media is significantly enhanced with an onset overpotential of 225 mV. At the same time, the influence of factors such as electronic structure, electrochemical surface area, and hydrophilicity of the material on the catalytic activity were systematically investigated. In addition, this method can be further extended to the sulfur doping. This study provides technical support for the large-scale preparation of catalytic electrodes for electrochemical water oxidation, promoting China's Carbon Peaking and Carbon Neutrality process.

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Room-Temperature Phosphorescence Materials Featuring Triplet Hybrid Local Charge Transfer Emission

Qiyuan Shi,# Nannan Ding,# Zhaolong Wang, Xinyu Gou, Lingya Peng, Jiani Ma,* and Yu Fang*

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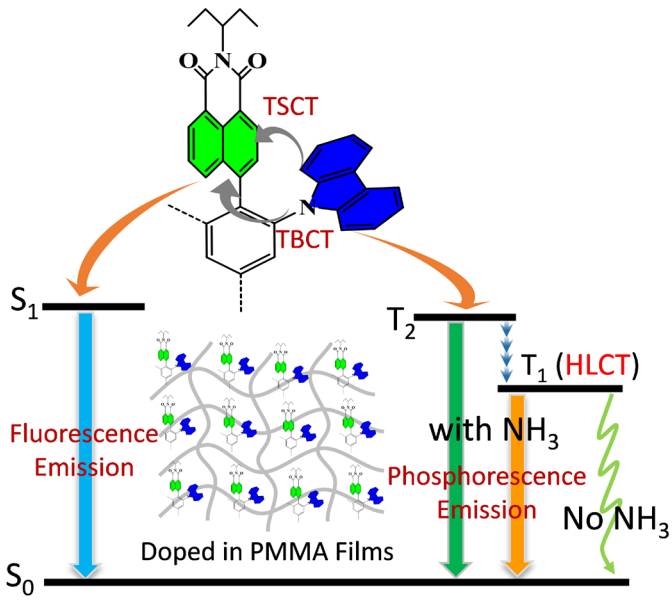
基于三重态杂化局域电荷转移态发射的室温磷光材料



有机室温磷光材料因其长寿命等诸多特点在众多领域得到了广泛应用。为了开发具备刺激响应性和变色功能的磷光薄膜材料，一种重要的策略是将有机小分子与聚合物掺杂形成薄膜，该方法具有成本低、可调性强等特点。目前，大多数报道的有机小分子磷光体系主要以三重局域态作为发光中心，但其对微环境的敏感性较差，限制了其应用。因此，更有效的策略就是将电荷转移态引入磷光体系以提高其对微环境的敏感性。然而，实现具有刺激响应性的室温磷光材料仍然是一个挑战。截至目前，关于在外界刺激下发出室温磷光并具有变色效应的研究报道仍然相对较少。

本文通过在 4– 苯基 –1,8– 萘酰亚胺（NMI）的苯环邻对位引入咔唑单元，成功制备了三种有机小分子（NMI–Cz, NMI–2Cz, NMI–3Cz），并且成功的引入了具有电荷转移性质的三重态。将该分子体系于 PMMA 掺杂而形成的薄膜浸泡在氨水中后，由于高分子和氨分子对分子内振转运动的抑制，点亮了分子在薄膜态的室温磷光，且磷光颜色随时间推移由橙红色变为绿色。理论计算的结果表明橙红色磷光是该分子体系自身的磷光颜色，而长寿命的绿色磷光来源于分子与氨分子形成的分子间电荷转移复合物。研究表明，咔唑的引入使得目标分子具有电荷转移性质，提高了其对微环境的敏感性。此外，由于咔唑数量的增多使得电荷转移能力增强而导致磷光持续时间变短。这种肉眼可见的磷光颜色的改变实现了对氨气分子的传感，并有望发

展为氨气薄膜磷光传感器。

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全文链接：https://pubs.acs.org/doi/10.1021/acs.jpclett.4c00359

Organic room temperature phosphorescent materials have been widely used in various fields due to their prolonged lifetime and many other characteristics. In order to develop phosphorescent thin film materials with stimulus responsiveness and color-changing functions, an important strategy is to dope organic small molecules into polymer matrices to form thin films, which has the advantages of low cost and strong adjustability. Currently, most reported organic small molecule phosphorescent systems mainly use triplet local states as the luminescent centers, but their sensitivity to the microenvironment is poor, limiting their applications. Therefore, a more effective strategy is to introduce charge transfer states into the phosphorescent system to enhance its sensitivity to the microenvironment. However, achieving room temperature phosphorescent materials with stimulus responsiveness remains a challenge. To date, there are still relatively few research reports on room temperature phosphorescence with color-changing effects under external stimuli.

In this context, we successfully synthesized three organic small molecules (NMI-Cz, NMI-2Cz, NMI-3Cz) by introducing carbazole fragments at the ortho and para position of the benzene ring of 4-phenyl-1,8-naphthalimide (NMI). Furthermore, it successfully introduced triplets with charge transfer properties. After doping the target compounds in PMMA and floating them in ammonia, the suppression of intramolecular vibration and rotation by polymer and ammonia molecules resulted in the observation of room temperature phosphorescence, with the phosphorescent color changing from orange-red to green over time. Theoretical calculations suggest that the orange phosphorescence is the intrinsic phosphorescent color of this molecular system, while the long-lived green phosphorescence originates from intermolecular charge transfer complexes formed between the target molecules and ammonia molecules. Research has shown that the introduction of carbazole endows the target molecule with charge transfer properties, thereby increasing its sensitivity to the microenvironment. Additionally, the increased quantity of carbazole enhances the charge transfer capability, leading to a shortened phosphorescence lifetime. This visible change in phosphorescent color achieves sensing of ammonia molecules and holds promise for the development film based phosphorescent sensors of ammonia.

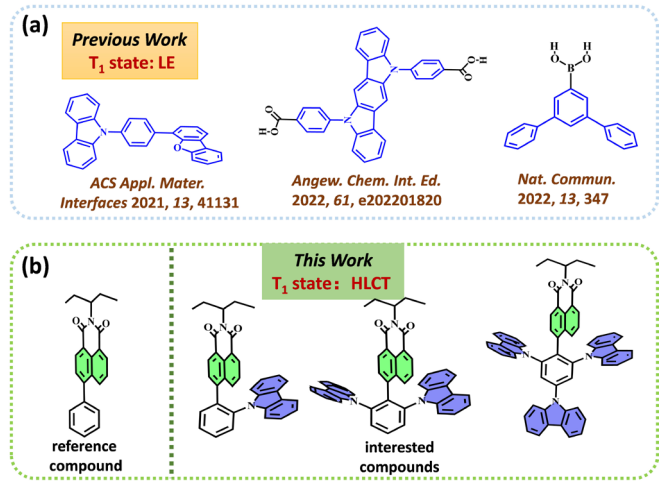

图 1. (a) 典型的具有 3LE 特征的磷光材料，(b) 本工作设计的具有 3HLCT 特征的磷光材料，具备对微环境高度敏感响应性。

Figure 1. (a) Typical phosphorescence materials depicting 3LE and (b) designed phosphorescence materials featuring with 3HLCT, which are more sensitive to microenvironmental Perturbation.

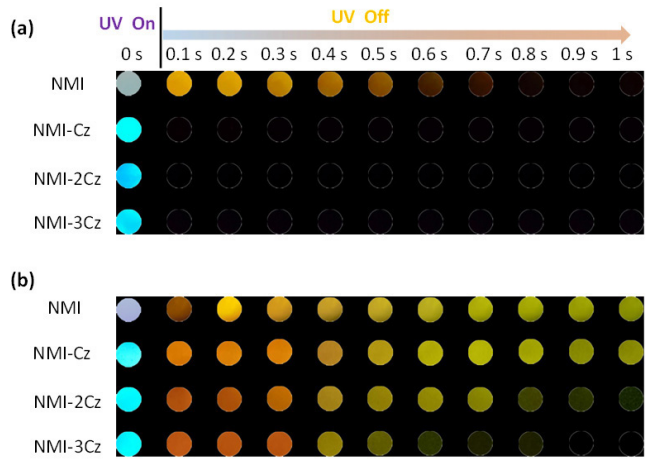

图 2. NMI，NMI−Cz，NMI−2Cz，NMI−3Cz 掺杂薄膜在（a）没有氨水，（b）浮于氨水中状态下在 365 nm 光源移除前后的发光照片。

Figure 2. Films of NMI, NMI-Cz, NMI-2Cz, and NMI-3Cz recorded upon switching a 365 nm lamp on and off (a) without ammonia and (b) floating in ammonia.

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REVIEW

Recent Advances in Analyzing Protein and Peptide Structures at Interfaces Using Vibrational Sum-Frequency Generation†

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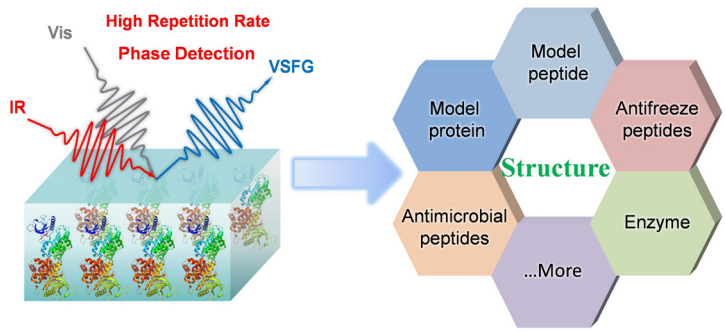
利用和频振动光谱探索蛋白质与多肽界面结构的最新研究进展



【背景介绍】

蛋白质和多肽在各种生物过程和技术发展中扮演着关键角色，其界面结构对于疾病诊断、药物输送和生物材料的研究至关重要。然而，由于这些体系的复杂性和分析方法的局限性，深入研究受到一定的阻碍。尽管 X 射线晶体学和冷冻电镜等先进技术在分析蛋白质结构方面取得了显著进展，但对实际条件下表面结合蛋白质结构的理解仍然有限，因此该领域面临着一定的挑战。和频振动光谱技术已成为分析蛋白质界面分子结构的有效手段。

【综述概要】

本综述简要介绍了和频振动光谱的基本理论和实验方法，着重讨论了利用光纤激光器作为光源的相位测量和实验装置的研究进展。和频振动光谱是一种具有界面选择性的非线性光谱，其信号来源于二阶非线性极化率。当可见光和红外光在样品表面时间和空间上重合时，会产生和频信号。经过几十年的发展，和频振动光谱的技术手段不断更新，Wang 课题组开发的内部外差相分辨和频振动光谱允许在不引入额外相位参考标准样品的情况下获得样品的相位信息。通过在稳态和频振动光谱基础上引入额外一束超快中红外脉冲，可以获取界面分子的动力学信息，Ye 课题组利用了这种方法研究了界面上多种生物分子的超快动力学。近年来，Wang 课题组研发了一种更经济易得的高分辨率和频振动光谱方法，适用于探测表面结构和动力学的各种应用。

此外，本综述按类别组织，如模型肽和蛋白质、抗菌肽、手性等相关模型。列举了近三年（2021–2023）的研究成果，研究多集中在牛血清白蛋白、溶菌酶和纤维蛋白原的分析上。许多实验使用合成的模型肽来实现在分子水平上对蛋白质表面相互作用的分析。对模型肽的探索为确定蛋白质取向的策略奠定了基础，特别是通过分析侧链甲基和酰胺。这体现了和频振动光谱在揭示多肽和蛋白质界面分子结构方面的潜力，为进一步利用和频振动光谱探索不同类型多肽和蛋白质的结构和功能提供了有益支持。

【挑战与机遇】

尽管 SFG 光谱学有望解决各种问题，但仍面临一些挑战。其中包括：（i）对于蛋白质的三级和高级结构的探索有限；（ii）光谱的复杂性仍然难以解释，特别是关于诸如水的 O–H 和蛋白质多肽的 N–H 之间的耦合现象。（iii）激光光谱学方法的一个共同挑战是实现系统稳定性、操作简便性，以及制备真正反映生物相关性的高质量生物样品。

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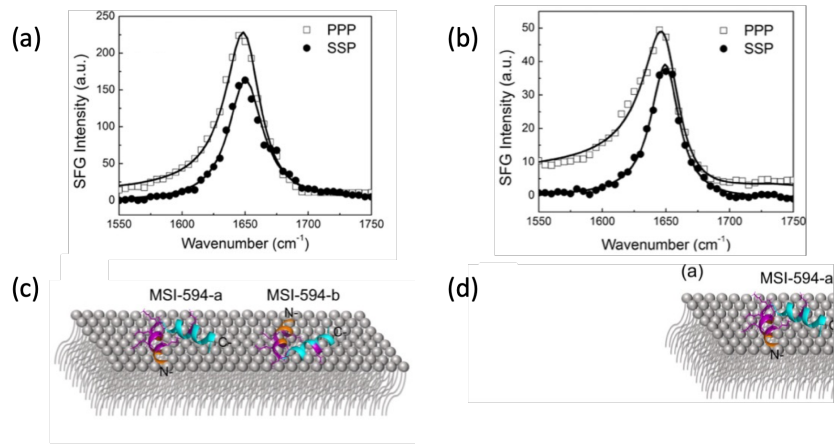

(a) 抗菌肽 MSI−594 在 7:3 的 POPC/POPG 脂质双分子层的 SFG 光谱，以及可能的构型 (c), (b) 抗菌肽 MSI−594A 在 7:3 的 POPC/POPG 脂质双分子层的 SFG 光谱的 SFG 光谱，以及可能的构型 (d)

(a) MSI-594 associated with a 7:3 POPC/POPG lipid bilayer; (b) MSI-594A associated with a 7:3 POPC/POPG lipid bilayer. Possible configurations of (c) MSI-594 associated with the POPC or 7:3 POPC/POPG lipid bilayer; (d) MSI594A associated with the POPC lipid bilayer.

Background

The structure of protein and peptide at interfaces plays a crucial role in various biological processes and technological advancements. Understanding these structures is critical for diagnosing diseases, drug delivery and developing biomaterials. However, the complexity of these systems and limitations in analytical tools have hindered the in-depth exploration. Despite significant efforts in determining protein structures using advanced techniques like X-ray crystallography and cryo-electron microscopy, the understanding of surface-bound protein structures in real conditions remains relatively limited, posing a current challenge in this field. Vibrational sum frequency generation (SFG) spectroscopy has been developed as a versatile method for elucidating molecular structures of proteins across interfaces.

Overview

This review is intended to introduce the basic principle of SFG spectroscopy, discusses its current advancements in phase measurement, SFG is an interface-selective spectroscopy, and its signal originates from the second-order nonlinear polarizability. In a typical SFG setup, visible light and IR light are focused on the surface of the sample, overlapping in both time and space and then generate sum frequency signal. After decades of development, the techniques and methods of SFG are updated and improved. Wang's group developed internal heterodyne phase-resolved (IHPR) SFG to obtain phase information, the same quartz crystal serves both as the SFG phase standard and the reference. By introducing a pair of ultrafast mid-IR pulses to induce a vibrational transition, the dynamic information related with the energy transfer at interfaces can be obtained. Ye group used this method to study the ultrafast dynamics of a variety of biomolecules at interfaces. Recently, Wang and coworkers developed a cost-effective version of sub-wavenumber SFG spectrometer. This innovation presents a more affordable and accessible approach to conducting powerful high resolution SFG studies, ideal for diverse applications in examining molecular surfaces and interfaces' structures and dynamics.

Research on the study of proteins at interface using SFG initially focused on investigating the physical interactions between protein side chains and polymer surfaces. Numerous studies have centered on the analysis of bovine serum albumin, lysozyme, and fibrinogen. However, the intricate nature and repetitiveness of amino acid side chains pose challenges in interpreting protein SFG spectra in terms of main chain folding or side chain structure. Consequently, many experiments employ synthetic model peptides to enable a detailed examination of protein-surface interactions at the molecular level. The exploration of model peptides has laid the groundwork for strategies in determining protein orientation, particularly through the analysis of side chain methyl groups and amides. This concise review aims to establish a foundation for future studies and applications exploring different types of peptides and proteins at interfaces using SFG.

Opportunities and challenges

Although SFG spectroscopy holds promise for addressing various issues, it still encounters several challenges. These include: (i) Previous applications have primarily focused on elucidating the secondary structure of single-component systems, with limited exploration of tertiary and higher-order structures of proteins. (ii) The complexity of the anticipated vibrational spectrum remains challenging to interpret, particularly regarding phenomena such as the coupling between the O-H extension of water and the N-H extension of a protein polypeptide. (iii) A common challenge across laser spectroscopy methods is achieving system stability, ease of operation, and user-friendly interfaces for integration with other techniques, along with the preparation of high-quality biological samples that truly reflect biological relevance, often relying on model systems at present.

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Titanium Dioxide and N-Doped Carbon Hybrid Nanofiber Modulated Ru Nanoclusters for High-Efficient Hydrogen Evolution Reaction Electrocatalyst

Chenxi Zhang, Honghua Song, Zhichong Wang, Qing Ye, Dan Zhang, Yanxia Zhao ✉, Jiani Ma ✉, Yongliang Cheng ✉

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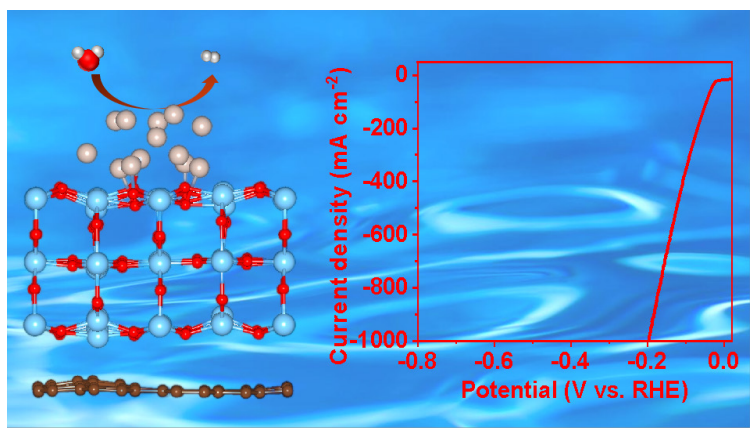
二氧化钛和氮掺杂碳杂化纳米纤维修饰的钌纳米团簇用于高效析氢反应电催化剂



碱性析氢反应（HER）中缓慢的水离解动力学和复杂的反应途径，导致了高能垒和低能量利用效率，不利于碱性水裂解的应用。为了解决上述问题，通常需要高活性的 HER 电催化剂来加速反应动力学和减小能量消耗。与铂相比，Ru 的价格相对较低，因此被认为是铂基 HER 电催化剂的理想替代品。然而，由于强金属 – 氢键和缓慢的水解离动力学，其在碱性溶液中的 HER 活性仍不令人满意。为了解决上述问题，最有效的方法之一是通过设计合适的载体来构建异质结构，一种新型电催化剂载体不仅要调节 Ru 的局部电子环境，加快水的解离，优化 H* 吸附；而且要具有良好的导电性，能加快电子传输速率。

在本文中，我们通过静电纺丝以及随后的热处理，构建了分散在二氧化钛以及氮掺杂的碳材料复合异质结纳米纤维上的钌纳米团簇 (Ru/TiO_2/NC) 作为高效的 HER 电催化剂。氢结合能测试、氢自由基淬灭实验和理论计算等一系列理化表征结果表明，与单一的碳材料和二氧化钛相比，TiO_2/NC 作为支撑材料能更有效地促进水的解离，并优化对 *H 的吸附，从而显著提高 Ru 的 HER 活性。最佳的 Ru/TiO_2/NC 纳米纤维只需要只需 18 mV 的过电位就能达到 10 mA cm^{-2} 的电流密度，在

碱性溶液中优于优于 Ru/NC 纳米纤维、Ru/TiO_2 纳米纤维和商用 Pt/C。本研究强调了异质结载体在提高 HER 活性方面的关键作用，这种策略可扩展到构建其他类型的载体用于电催化反应中。

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The sluggish kinetics and complex reaction pathway associated with water dissociation during the alkaline hydrogen evolution reaction (HER) result in high energy barriers and low efficiency of energy utilization, which is not conductive to the application of alkaline water splitting. To address the above problems, highly active HER electrocatalysts are usually required to speed reaction kinetics and minimize energy consumption. By virtue of its relatively low price with respect to Pt, Ru has been recognized as an appealing alternative for Pt based HER electrocatalyst. However, the HER activity of this catalyst, particularly in an alkaline solution, remains inadequate as a result of the formidable metal–hydrogen bonding and sluggish kinetics of water dissociation. To address these challenges effectively, one of the efficacious approaches is to fabricate heterostructures through designing appropriate supports. The ideal electrocatalyst support should not only regulate the local electronic environment of Ru to expedite water dissociation and optimize *H adsorption but also possess excellent electronic conductivity to enhance electron transport.

In such a context, Ru/TiO_2/N-doped carbon (Ru/TiO_2/NC) nanofiber was constructed as highly efficient HER electrocatalyst through electrospinning and subsequent pyrolysis treatment. A series of physiochemical characterizations including tests on hydrogen binding energy, experiments on hydrogen radical quenching and theoretical calculations reveal that TiO_2/NC nanofiber as a support material can more effectively promote water dissociation as well as optimize the adsorption of *H compared to NC and TiO_2, thus leading to significantly improved HER activity of Ru. The optimal Ru/TiO_2/NC nanofiber in 1 M KOH only demands an overpotential of 18 mV to achieve 10 mA cm^{-2}, outperforming Ru/NC nanofiber, Ru/TiO_2 nanofiber and commercial Pt/C. The present work highlights the crucial role played by hybrid supports in enhancing HER activity, and this strategy can be extended to fabricate other types of supports for various electrocatalytic applications.

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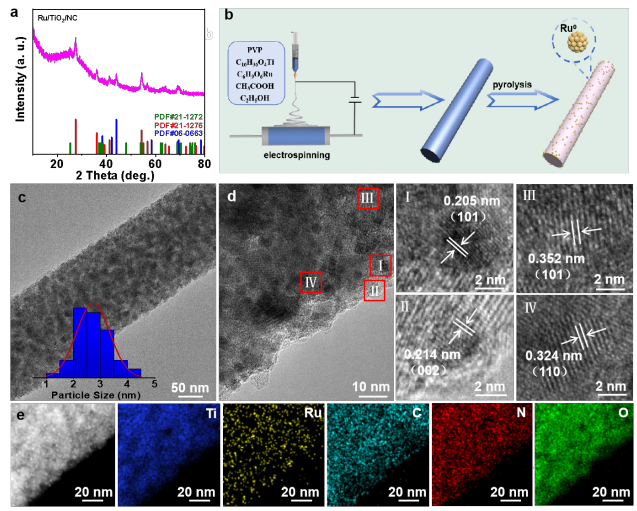

图 1. Ru/TiO_2/NC 的 (a) XRD；(b) 制备流程图；(c) 低分辨 (d) 高分辨 TEM 图像；(e) HAADF−STEM 以及 EDS 映射图像

Figure 1. Ru/TiO_2/NC (a) XRD patterns, (b) schematic illustration for the fabrication, (c) TEM image, (d) HRTEM images, (e) HAADF-STEM image and corresponding EDS mapping.

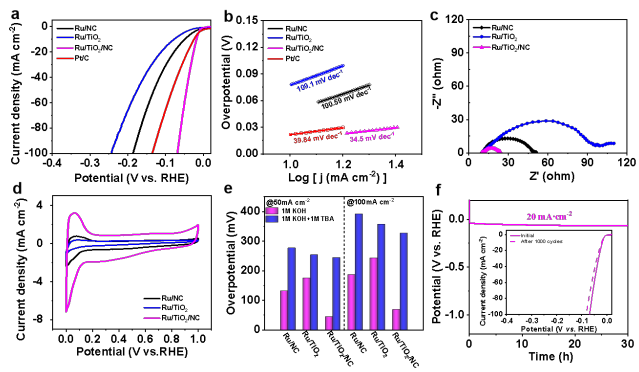

图 2. Ru/TiO_2/NC 纳米纤维和对比样品在 1.0 M KOH 中的 HER 性能。(a) LSV 图，b) Tafel 斜率图，(c) EIS 图，(d) CV 图，(e) 添加和不添加 1.0 M TBA 在 50 和 100 mA cm^{-2} 处的过电位，(f) 稳定性测试图

Figure 2. HER performance of the Ru/TiO_2/NC nanofiber and contrast samples in 1.0 M KOH. a) LSV plots, (b) Tafel plots, (c)EIS plots, (d) CV plots (e) the overpotentials at 50 and 100 mA cm^{-2} with and without 1.0 m TBA, (f) chronopotentiometry plots.

秦创原（国际）路演中心来访

Qinchuangyuan (International) Roadshow Center visitors received

2024年3月13日，秦创原（国际）路演中心总经理李涛一行到访新概念传感器与分子材料研究院，与房喻院士进行了座谈交流，陕西师范大学校友工作办公室主任刘洪超陪同。

房喻院士介绍了研究院的发展历程、建院理念、人才培养、创新成果，以及成果产业化路径等经验，强调了基础研究的重要性，指出科研工作者应坚持做最重要的事情、国家最需要的事情，要把个人理想与国家重大需求结合起来，希望高校与产业届建立更多的合作，实现资源共享与优势互补，促进新质生产力及经济高质量发展。

李涛介绍了路演中心的成立背景以及业务体系，并表示将发挥平台牵引作用，助力科创资源与产业、资本有效对接，为加快科技成果转化落地发展，推动区域产业能级不断发展提升。

On March 13, 2024, Institute of New Concept Sensors and Molecular Materials dean Prof. Fang Yu met and talked with visitors headed by from Qinchuangyuan (International) Roadshow Center manager Li Tao, who were accompanied by Liu Hongchao, director of Alumni Office of Shaanxi Normal University.

Fang Yu briefed guests about the history and concept of the Institute, the talent training, innovation achievements, and industrialization of achievements. He stressed the importance of basic research, argued that research workers should do the most important things and the most needed things of the country, combining personal ideals with the major needs of the country, and hoped that universities and industries to establish more cooperation, so as to share resources and complement each other's strengths and promote new productivity and high-quality economic development.

Li Tao introduced the establishment background and business system of the Roadshow Center, and said that it will play a leading traction role to help the effective docking of science and technology resources with industry and capital, in order to accelerate the transformation and development of research achievements, and promote the continuous development of regional industrial levels.

全省高校推动发展新质生产力教育培训团来访

Shaanxi colleges and universities education and training group for promoting new productive forces received

2024年3月21日，陕西省委教育工委、陕西省教育厅举办了全省高校推动发展新质生产力教育培训暨校际观摩交流活动启动仪式和首场活动，45所高校党委书记、校长出席了启动仪式，并分组参加校际观摩交流活动。第二组高校党委书记、校长来到陕西师范大学参观了新概念传感器与分子材料研究院，丁立平副院长陪同参观并讲解。

On March 21, 2024, Shaanxi Provincial Party Committee on

Educational Work and Shaanxi Provincial Department of Education held the launch ceremony and the first event of the provincial colleges and universities education and training for promoting new productive forces and inter-school observation and exchange activities. Party secretaries and presidents of 45 colleges and universities attended the launch ceremony and participated in the inter-school observation and exchange activities in groups. The secretaries and presidents of the second group came to Shaanxi Normal University and visited the Institute of New Concept Sensors and Molecular Materials, where INCSMM vice dean Prof. Ding Liping accompanied and explained for the visitors.

西湖大学吕久安教授应邀作学术报告

Prof. Lyu Jiu'an of Westlake University invited to give a report

2024 年 3 月 22 日下午，西湖大学吕久安教授应邀在陕西师范大学长安校区致知楼作了题为“高性能柔性人工肌肉材料组装新技术”的学术报告。报告由马佳妮教授主持，化学化工学院部分师生参加了本次会议。

吕久安教授在报告中介绍了刺激性响应形变液晶高分子的设计、功能器件的开发及应用。在介绍了发展背景后，他从刺激性响应形变液晶高分子材料的响应机理出发，从象鼻等几个仿生学的例子展开，最后介绍了材料的设计以及应用。报告结束后，吕久安教授与在场师生进行了讨论，并解答了师生提出的问题。

On March 22, 2024, Prof. Lyu Jiu'an of Westlake University was invited to give an academic report titled “New Technology for Assembly of High Performance Flexible Artificial Muscle Materials” at Zhizhi Building on Shaanxi Normal University's Chang'an campus. The report was chaired by Prof. Ma Jiani, and attended by teachers and students of

the School of Chemistry and Chemical Engineering.

In his presentation, Prof. Lu Jiu'an introduced the design of stimulus responsive deformable liquid crystal polymers, and the development and application of functional devices. After introducing the development background, he started from the esponse mechanism of stimulus responsive liquid crystal polymer materials, and presented several biomimetic examples such as elephant trunks and finally, introduced the design and application of the materials. After the presentation, Prof. Lyu discussed with the teachers and students present and answered their questions.

雁塔区第二中学师生来院进行科普参观学习

Yanta District No. 2 Middle School visitors received for science popularization tour

2024 年 3 月 26 日下午，西安市雁塔区第二中学高二年级 110 余名同学在老师带领下前来新概念传感器与分子材料研究院进行科普参观学习。

刘太宏副教授向同学们介绍了研究院基本情况和发展理念，带领他们参观了研究院成果展厅，讲解了房喻院士团队研发的爆炸物探测仪、毒品探测仪等科研成果转化产品。

刘凯强教授为师生们作了题为“凝胶材料的前世今生”的科普报告，介绍了国际国内凝胶的发展现状及房喻院士团队在小分子凝胶推进剂、高能量密度燃料、凝胶乳液及其高强低密度材料等方面取得的成果。

On March 26, 2024, teachers and more than 110 sophomore students from Xi'an Yanta District No. 2 Middle School visited the Institute of New Concept Sensors and Molecular Materials in a science popularization tour.

Assoc. Prof. Liu Taihong introduced the basic situation and development concept of the Institute, showed the visitors the exhibition hall, and explained the products such as explosive and drug detectors developed from the research findings of Prof. Fang Yu's group.

Prof. Liu Kaiqiang gave a report titled “The Past and Present of Gel Materials” for the students, introducing the development status of gels at home and abroad and the research achievements of Prof. Fang Yu's group in small molecule gel propellants, high energy density fuels, gel emulsions and high-strength and low-density materials.

我的科研寻梦游记

My Dream Journey in Scientific Research

文 / 雷海瑞 by Lei Hairui

转眼间，结束了长达十二年的研究生和博士后科研求学之路，自己也开始独立开展科研工作。在快乐追寻科研梦的路上，有些许科研学习经历和感悟在此与同学们分享一下。

顺利入门

在高中和大学的时候，从未想过自己会从事科研工作，直至 2011 年 12 月进入“光子鼻与分子材料研究团队”攻读研究生学位期间改变了自己的想法。自己在做实验过程中能够很专注且能感觉到快乐，每当自己解决一个实验小问题就能开心一周，接着就继续解决下一个问题，也许这就是兴趣。同时，我经常问自己“为什么要读研究生？”既然自己选择做科研，那就要将其做到极致，正如《朱子语类》中说：“人之为事，必先立志以为本，志不立则不能为得事。”因此在攻读博士学位期间，一直游荡在实验过程和实验问题的探寻中，寄希望自己能够在超分子发光材料领域贡献自己的微薄之力。

我是在刘静老师悉心指导下取得了博士学位的，刘老师很支持我发散思维，阅读各个领域的相关文献以及鼓励我自主设计实验并进行验证，这也催生我对镧系金属、有机荧光染料和过渡金属配合物等发光材料的设计合成并研究其发光性质及应用，这对我后期交叉课题的研究有很大帮助。同时，团队首席教授房喻院士每年暑期都会邀请全球顶尖级科学家作学术报告和讲授专题课程，拓展了我的学术视野。记得房老师在我博士毕业的时候，告诉我“天道酬勤”，这也许是我后期科研工作中一直坚持的原因之一吧。感谢老师们在我科研路上的引导和鼓励。

我博士毕业的时候，自己心里还有些许从事科研的念头，所以选择从事博士后研究，也许是由于 2016 年诺贝尔化学奖授予了“分子机器的设计与合成”领域的三位科学家。给国外超分子领域科学家寄出不计其数的博士后求职信都石沉大海，此时我问自己“以后想要做什么样的科研？”纵观科学史，做好科研的一些科学家都有共性：一种为头脑风暴，即新颖超前 idea 超级多；另一种将科学问题研究到极致，即可入教科书式的研究；第三种为前两种的结合，即头脑风暴和研究极致，通常第三种科学家凤毛麟角。此前，自己对镧系金属、有机荧光染料和过渡金属配合物的发光材料都有所了解，唯独对随尺寸变化而发光不同的量子点未接触，同时好奇量子点为什么会表现出如此独特的性质？很庆幸自己博士后期间进入了量子点的研究领域，而 2023 年诺贝尔化学奖也授予了在量子点发现和合成领域作出贡献的三位科学家。

艰难前行

记得去浙江大学化学系彭笑刚教授课题组进行博士后面试时，秦海燕老师问我：“为什么选择彭老师课题组”，我回答：“我对量子点比较感兴趣”。秦老师继续问：“做量子点的课题组那么多，为什么不去其他课题组”，我回答：“在量子点领域我只知道彭老师”。在很多人看来似乎有些恭维，但是在量子点相关领域，我当时的确只知道彭老师，也并不知道彭老师在量子点领域有着举足轻重的地位，只知道彭老师是头脑风暴和研究极致相结合的科学家代表。

进入彭老师课题组后，我首先从事量子点光谱学的研究，和自己硕博期间的研究完全脱钩，需要去学习半导体物理、光谱学以及搭建光路等基础知识。博士后前两年异常艰难，有时觉得很窒息，偶然间看到叶剑英元帅的至理名言“攻城不怕坚，攻书莫畏难。科学有险阻，苦战能过关。”让自己重拾坚持的信心。博士后第三年，自己发现了半导体纳米晶对晶面依赖的表面缺陷态，也有了相应的成

果并发表。此时彭老师找我谈话，说“海瑞，你更适合做合成化学”，由于自己化学研究背景，我回答彭老师“自己光物理基础比较差，所以开始的研究课题选择了光谱学，后续基于光谱学的认知想去做一些量子点合成化学，我认为这样与纯粹做合成化学的思维不一样，即导向性更强”，彭老师很赞成我的想法。同时，他建议我要继续拓宽自己的知识面和阅读文献量，最终形成自己的科研特色。同年，我回到光子鼻课题组，房老师也建议我将合成化学和光谱学相结合去做一些特色的工作，两位老师的不谋而合的建议让我开始思考自己今后的研究特色。

快速成长

博士后研究工作进行了三年，我决定继续在彭老师课题组开展新发现的课题，一次偶然的实验，我解决了困扰量子点合成领域四十年的一个难题——“量子点人造分子的合成”，这次新发现让我和彭老师均感觉到很兴奋，但是中间一年的时间实验重复不出来或者产率较低，经过不断地尝试和思考，最终制备了多种单分散性且表现出分子量子态特征的人造分子。这让我更加坚定继续从事该领域的研究，以特殊光谱学性质为导向，合成化学为基础实现制备具有特殊功能的半导体纳米晶材料，这也许是自己今后科研方向的一大特色吧。

在浙江大学从事博士后研究期间认识了很多优秀的老师和同学们，正如共生效应“与优秀的人在一起，让自己也变得更优秀。”这让我了解到顶尖科学实验室的学生是如何思考、如何学习、如何设计实验。虽然博士后研究过程比较艰难和坎坷，但是也让自己进入一个全新且更多未知的领域，希望可以在所从事的科学领域可以不断发明和制造对人类更有用的新物质。

自己三生有幸在科研寻梦进程中遇到的良师们，为自己前进的方向指点迷津。现如今自己也为人师，该思考“如何做一名在学生科研成长路程中的引路人”，以及“如何做有品位和有价值的科学研究”。

雷海瑞是内蒙古大学研究员，博士生导师。2017 年于陕西师范大学获得理学博士学位，导师为刘静教授。2017-2023 年在浙江大学化学系从事博士后研究，导师为彭笑刚教授。2023 年加入内蒙古大学能源材料化学研究院。近年来，主要从事胶体半导体纳米晶的精准合成与表面化学以及单分子光谱学。在 Acc. Chem. Res., J. Am. Chem. Soc., ACS Nano 等期刊发表论文 18 篇，授权国家发明专利 4 项。

After completing twelve years of postgraduate and postdoctoral studies, I have now begun to conduct independent scientific research. I would like to share my research experiences and reflections as I pursue my dream of scientific exploration.

Getting Started

Throughout my time in high school and college, I never envisioned a career in scientific research until December 2011, when I joined the Photonic Nose and Molecular Materials Group to pursue a graduate degree. I find great joy and focus in conducting experiments and solving problems. This passion drives me forward, pushing me to constantly seek new challenges. Despite occasional moments of doubt about my pursuit of a postgraduate degree, I am fully committed to doing my best effort in the field of research. As Zhuzi Yulei once said, “If a man wishes to accomplish something, he must first establish his will as the foundation; without this will, he cannot achieve anything.” During my doctoral program, I have dedicated myself to the experimental processes and exploration of research questions, with the goal of making a meaningful contribution to the field of supramolecular luminescent materials.

I completed my PhD under the supervision of Prof. Liu Jing, who supported me to think creatively, explore diverse literature in various fields, and encouraged me in the design and validate my experiments. This experience led me to develop and synthesize luminescent materials such as lanthanide complexes, organic fluorescent dyes, and transition metal complexes, and to study their luminescent properties and applications. Such interdisciplinary work has been beneficial to my subsequent research. Additionally, Prof. Fang Yu, the chief scientist of the group, regularly invited renowned scholars worldwide to give academic lectures and special courses during the summers, which broadened my academic horizons. Upon my graduation, Prof. Fang’s words “God rewards the diligent” resonated with me and motivated me to continue my dedication to research. I am grateful for the guidance and support throughout my scientific research journey.

When I graduated from my doctoral program, I harbored a lingering interest in conducting scientific research, leading me to engage in postdoctoral research, and this is perhaps because of that the 2016 Nobel Prize in Chemistry was awarded to three scientists in the field of “Design and Synthesis of Molecular Machines”. But when I sent countless postdoctoral cover letters to foreign scientists in the field of supramolecular research, they all came to nothing. So I asked myself, “What kind of research do you want to do in the future?” Throughout the annals of scientific history, exceptional scientists share certain traits: One is brainstorming, a propensity for generating a multitude of innovative and forward-looking ideas; another is a tendency to push scientific boundaries to the point of being textbook-worthy; the third is a rare ability to combine both of the above. While my previous knowledge encompassed lanthanide complexes, organic fluorescent dyes, and transition metal complexes of luminescent materials, I had yet to delve into the realm of quantum dots with varying sizes and distinct luminescent

properties. This curiosity was fueled by a desire to understand the unique properties of quantum dots. I am grateful for the opportunity to enter the field of quantum dots research during my postdoctoral period, and the 2023 Nobel Prize in Chemistry was bestowed upon three scientists for their contributions to the discovery and synthesis of quantum dots.

Carrying On

During my postdoctoral interview with Prof. Peng Xiaogang's group in the Department of Chemistry at Zhejiang University, Assoc. Prof. Qin Haiyan asked me "Why did you choose Prof. Peng's group?", and I replied "I am more interested in quantum dots". She continued to ask that "There are so many groups working on quantum dots, why don't you go to other groups?", and I answered, "I only know Prof. Peng in the field of quantum dots". It seems to be a bit complimentary to many people, but in the field of quantum dots, I only knew Prof. Peng at that time. Despite I didn't aware of Prof. Peng's significant reputation in the field of quantum dots, I know that his approach to excellence in scientific research and brainstorming inspires.

After joining Prof. Peng's group, I was initially engaged in quantum dot spectroscopy, which was completely unrelated to the research I had done during my master's and doctoral programs, and I had to learn the basics of semiconductor physics, spectroscopy, and the construction of optical circuits. The first two years of my postdoctoral career were extremely difficult, and I sometimes felt suffocated. I happened to read the wise words of Marshal Ye Jianying, "A fortress is not to be feared, a book is not to be feared. Science has its dangers and obstacles, but hard work can get us through." It made me regain the confidence to carry on. In the third year after my PhD program, I discovered the surface defect states of semiconductor nanocrystals dependent on the crystal surface, and the corresponding results were published. Meanwhile, Prof. Peng suggested that my experimental skills were more suited to synthetic chemistry. Due to my background in chemistry, I replied to Prof. Peng, "I have a poor foundation in photophysics, so I chose spectroscopy as my first research topic, and then based on the knowledge of spectroscopy, I would like to do some oriented synthetic chemistry of quantum dots, which is different from purely doing synthetic chemistry." Prof. Peng agreed with my opinion. At the same time, he suggested that I should continue to broaden my knowledge and read more literature in interdisciplinary fields, and eventually develop my own research characteristics. In the same year, I returned to the Photonic Nose Group, and Prof. Fang also suggested that I should combine synthetic chemistry and spectroscopy to do some special research works. The coincidental suggestions of the two teachers made me start to think about the characteristics of my future research.

Growing and Advancing

After three years of postdoctoral research, I made the decision to delve deeper into the new topics discovered in Prof. Peng's research group. Through a serendipitous experiment, I successfully tackled a forty-year longstanding challenge in the field of quantum dots synthesis --- "Synthesis of artificial molecules of colloidal quantum dots". This breakthrough brought great excitement to both Prof. Peng and myself. Despite initial difficulties in reproducing the results or achieving high yields over the course of a year, persistent efforts and reflections eventually led to the successful preparation of various monodispersed artificial molecules showcasing quantum states characteristics. This has reinforced my commitment to further exploring this research area, using unique spectroscopic properties as a guide and synthetic chemistry as a foundation for developing semiconductor nanocrystal materials with specialized properties. This may become a prominent focus of my future research endeavors.

During my postdoctoral research at Zhejiang University, I had the privilege of interacting with exceptional teachers and fellow students, just as the symbiotic effect of "Being with good people makes you better too". This experience provided valuable insights into the mindset, learning strategies, and experimental design techniques prevalent in top scientific laboratories. Although the postdoctoral research journey was challenging and filled with obstacles, it also opened doors to uncharted fields, fueling my desire to innovate and develop novel substances that can benefit humanity in my scientific research.

I have been fortunate to have met mentors in the process of searching for my dreams in scientific research, who have guided me in the direction of my own advancement. As I now transition into a teaching role, I am compelled to contemplate how I can serve as a guide for students on their research journeys and how I can conduct meaningful and impactful scientific investigations.

About the Author: Lei Hairui is a senior researcher and a doctoral supervisor at Inner Mongolia University.He received his PhD degree in Science from Shaanxi Normal University in 2017 under the supervision of Prof. Liu Jing. He was a postdoctoral researcher at the Department of Chemistry of Zhejiang University from 2017-2023 under the supervision of Prof. Peng Xiaogang. He joined the College of Energy Material and Chemistry of Inner Mongolia University in 2023. In recent years, he is mainly engaged in the precise synthesis and surface chemistry of colloidal semiconductor nanocrystals and single-molecule spectroscopy. He has published 18 papers in Acc. Chem. Res., J. Am. Chem. Soc. and ACS Nano, and has been authorized 4 Chinese invention patents.

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