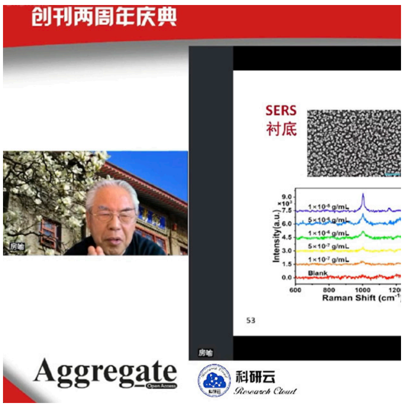
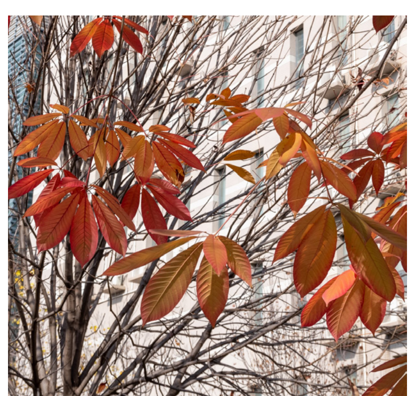
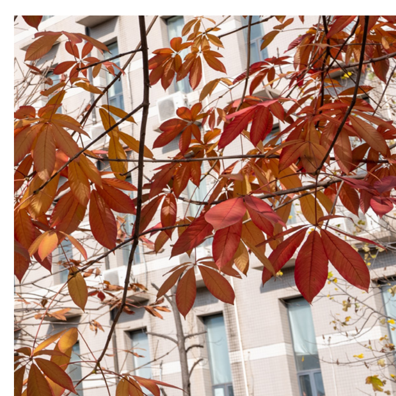
新概念传感器和分子材料研究院简报

Newsletter of Institute of New Concept Sensors and Molecular Materials

12 / 2022







国家重点研发计划纳米专项进行答辩并获通过

National Key R&D Nano Special Program defense passed

2022 年 12 月 7 日，新概念传感器与分子材料研究院副院长丁立平教授和化学化工学院副院长翟全国教授作为课题负责人，并由房喻院士参与的国家重点研发计划“纳米前沿”重点专项进行了答辩，并获通过。

此次答辩的组织评审单位为科技部高技术中心，答辩题目为“超高灵敏检测痕量危险有害化学物质的纳米材料与技术”。

此项目由中国科学院新疆理化技术研究所作为项目负责单位牵头，陕西师范大学、中国科学院化学研究所、中国人民解放军军事科学院防化研究院、公安部禁毒情报技术中心和深圳砺剑防卫技术有限公司参与共同申报。项目设有四个课题，课题负责人分别为翟全国、丁立平、窦新存和孔景林。

“纳米前沿”重点专项的总体目标是围绕物质在纳米尺度（1–100 纳米）上呈现出的新奇物理、化学和生物特性，开展单纳米尺度效应和机理、新型纳米材料和器件制备方法、纳米尺度表征新技术等方面的基础前沿探索和关键技术研究，催生更多新思想、新理论、新方法和新技术等重大原创成果。同时，开展纳米科技与信息、能源、生物、医药、环境等领域的交叉研究，提升纳米科技对经济社会发展重点领域的支撑作用。

On December 7, 2022, Prof. Ding Liping, vice dean of the Institute of New Concept Sensors and Molecular Materials, and Prof. Zhai Quanguo, vice dean of the School of Chemistry and Chemical Engineering, as the project leaders, joined by Prof. Fang Yu, participated in and passed the project defense of the Nano Frontier special key project of the National Key R&D Program.

The organization and evaluation unit of this defense is the High-tech Center of the Ministry of Science and Technology, and the project in defense is nanomaterials and technologies for ultra-high sensitivity detection of trace dangerous and hazardous chemicals.

The project was led by the Xinjiang Institute of Physical and Chemical Technology of the Chinese Academy of Sciences, and jointed by Shaanxi Normal University, the CAS's Institute of Chemistry, the Institute of Chemical Defense of the Academy of Military Sciences of the Chinese People's Liberation Army, the Anti-Narcotics Intelligence Technology Center of the Ministry of Public Security and Shenzhen SRED Security and Surveillance Technology Co., Ltd. The project has four sub-projects, which leaders are Zhai Quanguo, Ding Liping, Dou Xincun and Kong Jinglin.

The overall goal of the Nano Frontier special key project is to carry out basic frontier exploration and key technology research on the novel physical, chemical and biological properties of matter at the nanoscale (1-100 nm), such as the effects and mechanisms of single nanoscale, the preparation methods of new nanomaterials and devices, and the new technology of nanoscale characterization, so as to give birth to more major original achievements such as new ideas, new theories, new methods and technologies; and at the same time, carry out interdisciplinary research on nanotechnology and information, energy, biology, medicine, environment and other fields to enhance the supporting role of nanotechnology in key areas of economic and social development.

团队举行研究生工作汇报与感悟分享会

Postgraduate work report and reflection sharing session held

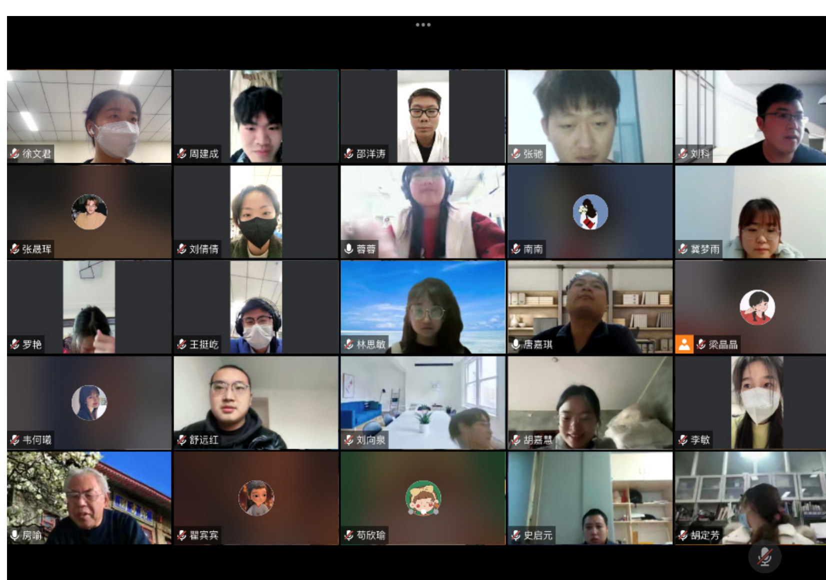
2022年12月18日下午，光子鼻与分子材料团队线上举行研究生近期工作汇报与感悟分享会，邀请博士毕业生唐嘉琪、博士生丁南南、硕士研究生胡定芳和梁晶晶进行工作的汇报和分享。

会议由黄蓉蓉同学主持，房喻教授以及组内的博士后、博士和硕士研究生出席。

在会上，丁南南同学、胡定芳同学、梁晶晶同学分享了自己近期工作的进展以及所遇到的一些挫折。

唐嘉琪同学从自己的研究工作出发，介绍了自己的科研工作进展、未来规划，以及在学习和实验过程中遇到的问题，建议低年级同学要多读文献，多与他人交流讨论，切勿单打独斗，同时树立积极向上的心态。

最后，房喻教授在总结讲话中感谢了同学们的汇报和分享，并对同学们的工作与生活表达了关心，叮嘱同学们近期不仅要专心做好科研，更要做好防护，以更好的身体和心理状况来进行接下来的科研工作。



十二月大事记 Events in December, 2022

On December 18, 2022, the Photonic Nose and Molecular Materials Group held an online work progress report and reflection sharing meeting for graduate students, inviting doctoral graduate Tang Jiaqi, doctoral student Ding Nannan, and master's students Hu Dingfang and Liang Jingjing to report and share their works and reflections.

The meeting was chaired by Huang Rongrong, and attended by Prof. Fang Yu and postdoc, doctoral and master's students in the group.

At the meeting, Ding Nannan, Hu Dingfang and Liang Jingjing shared their recent work progress and some setbacks.

Starting from his own research work, Tang Jiaqi reported his research progress, future research plan, and problems encountered in the process of learning and experiment, and suggested that younger students should read more literature, communicate and discuss with others, do not try to work alone, and establish a positive attitude.

In the end, Prof. Fang Yu thanked the students for their report and sharing, and expressed concern for the work and life of the students, and advised the students not only to concentrate on research in the near future, but also to do a good job in self-protection, and carry out the following research work with better physical and psychological conditions.

简讯动态 News in Brief

· 2022 年 12 月 1 日，西安市科学技术协会党组书记、常务副主席耿占军一行四人来研究院对西安市科协第九届委员会主席（兼职）候选人建议人选房喻院士进行考察。

On December 1, 2022, Xi'an Science and Technology Association CPC Party Group Secretary and Executive Vice Chairman Geng Zhanjun came to the Institute of New Concept Sensors and Molecular Materials to screen Prof. Fang Yu, as a candidate recommended for the 9th Committee Chairman (part-time) of Xi'an Science and Technology Association.

· 2022 年 12 月 8 日，房喻院士、丁立平教授担任中国化学会胶体与界面化学专业委员会委员。

On December 8, 2022, Prof. Fang Yu and Prof. Ding Liping were appointed as members of the Colloidal and Interface Chemistry Professional Committee of the Chinese Chemical Society.

简讯动态 News in Brief

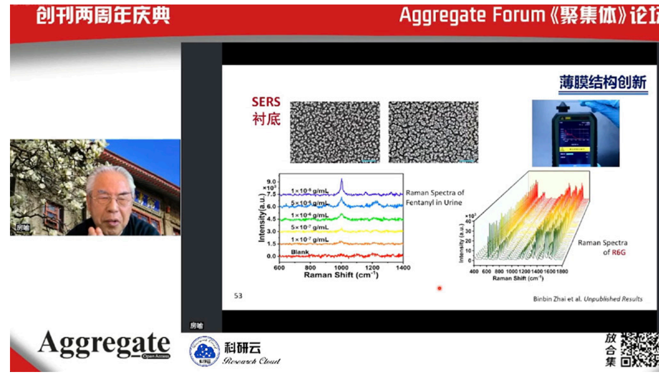
· 2022年12月17日，房喻院士在线参加复旦大学高分子学科发展研讨会，并作题为“薄膜荧光传感器——从基础研究到产业应用”的报告。

On December 17, 2022, Prof. Fang Yu participated in the Polymer Discipline Development Seminar of Fudan University online and gave a report titled Film-based Fluorescent Sensors - From Basic Research to Industrial Application.

· 2022年12月18日，房喻院士在线参加在京召开的中国化学会第十二次全国会员代表大会。中国化学会第三十届理事会领导班子、第一届监事会监事和来自全国各地的会员代表等共计320余人参加会议。

On December 18, 2022, Prof. Fang Yu participated online in the 12th National Member Congress of the Chinese Chemical Society held in Beijing. More than 320 people attended the meeting, including the leadership team of CCS’s 30th Council, the supervisors of the first CCS board of supervisors and CCS members from all over the country.

· 2022年12月19日，由房喻院士、刘忠山副研究员负责的光子鼻与分子材料团队2022年年度科研成果汇编编制完成，并提交至化学与化工学院。汇编汇总了团队在2022年取得的主要工作与成绩，包括主要研究进展介绍、发表科研论文（45篇）、在研科研项目（27项）、授权专利（12项），以及参加国际、国内会议和社会兼职、荣誉情况、人才培养情况和其他重要事件。



On December 19, 2022, the compilation of the 2022 Annual Research Achievements of the Photonic Nose and Molecular Materials Group led by Prof. Fang Yu and Dr. Liu Zhongshan was completed and submitted to the School of Chemistry and Chemical Engineering. The compilation summarizes the main work and achievements carried out by the group in 2022, including the introduction of major research progress, the publication of research papers (45), ongoing research projects (27), authorized patents (12), as well as participation in international and domestic conferences and social appointments, honors and awards, talent cultivation and other important events.

· 2022年12月21日，房喻院士在Aggregate Forum《聚集体》创刊两周年庆典作“薄膜荧光传感器研制中的传感物质创新”主题的线上邀请报告。

On December 21, 2022, Prof. Fang Yu was invited to give an online report on the theme of Innovation of Sensing Substances in the Development of Film-based Fluorescent Sensors at the Aggregate Forum commemorating the second anniversary of the journal Aggregate.

· 2022年12月31日，房喻教授课题组举行第三次线上工作汇报会。博士研究生徐文君、硕士研究生刘倩倩分别汇报了近一个月研究工作的进展和未来研究工作的计划。

On December 31, 2022, Prof. Fang Yu’s group held the third online work report meeting. Doctoral student Xu Wenjun and master’s student Liu Qianqian reported on the progress of their research work in the past month and plans for future research.

NANO · MICRO small

Research Article | Full Access

Shape-Controlled Synthesis of Covalent Organic Frameworks Enabled by Polymerization-Induced Phase Separation

Lin Zhu, Yajiao Su, Zhongshan Liu, Yu Fang

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共价有机框架材料成型新策略

共价有机框架（COFs）材料的比表面积大、孔道高度有序，是一种理想的吸附分离材料。然而，COFs 材料多以粉末态存在，很难二次加工成特定的形状和形貌，以满足高性能的实际应用需求。

基于我们的前期研究基础，发现 COFs 难以成型的根本原因在于传统溶剂热合成方法中的相分离（决定成型、通孔结构、骨架尺寸）和晶化（决定结晶度、有序孔道、比表面积）的条件不兼容。目前，大多数研究最关心的问题往往是结晶控制，很难兼顾甚至忽略了材料的 COFs 形貌和结构调控。

为解决上述问题， 我们报道了基于相分离和晶化过程控制的两步法制备成型 COFs 材料。通过深入研究反应体系中多元醛

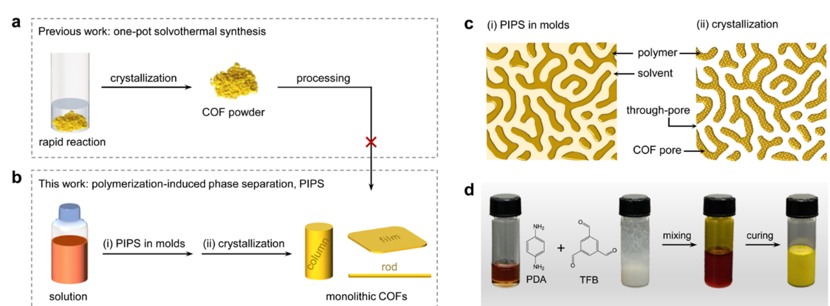

图 1.（a）传统溶剂热法制备 COFs 粉末；（b）基于聚合诱导相分离的 COF 成型方法；（c）聚合诱导相分离和晶化对形貌的影响示意图；（d）TFB–PDA 无定形聚合物的制备示意图。

Figure 1. Schematic depictions of (a) one-pot solvothermal synthesis of COF powders, and (b) separated PIPS and crystallization processes for shape-controlled synthesis of COF monoliths. (c) Schematic illustrations of continuous nanostructure generated by controlling PIPS process, and COF formation via crystallization. (d) Photographs of monomer solutions, prepolymerization mixture, and cured TFB-PDA polymeric monolith in 4-mL vials.

与多元胺的聚合诱导相分离过程，并优化无定形聚合物到晶态 COFs 的晶化条件，成功将 COFs 制备成柱、棒、膜等形状。通过优化致孔溶剂获得了具有多级孔结构的 COFs 整体材料，该整体材料无裂纹、不掉粉、压缩模量高达 214 MPa。COFs 整体材料的多级孔结构使其具有较好的通透性和较高的比表面积，作为吸附剂和固相萃取介质，在高流速下表现出优异的吸附容量（204 mg/g，罗丹明）、去除率（100%，罗丹明）和回收率（98%，双酚

A）。以上结果表明，相分离和晶化过程独立控制的两步法实现了通孔结构、材料形状和尺寸均可控的 COFs 整体材料，是一种制备成型 COFs 的普适性策略，对推动 COFs 材料的实际应用具有重要研究意义。

第一作者：陕西师范大学硕士研究生朱淋
通讯作者：陕西师范大学刘忠山副研究员
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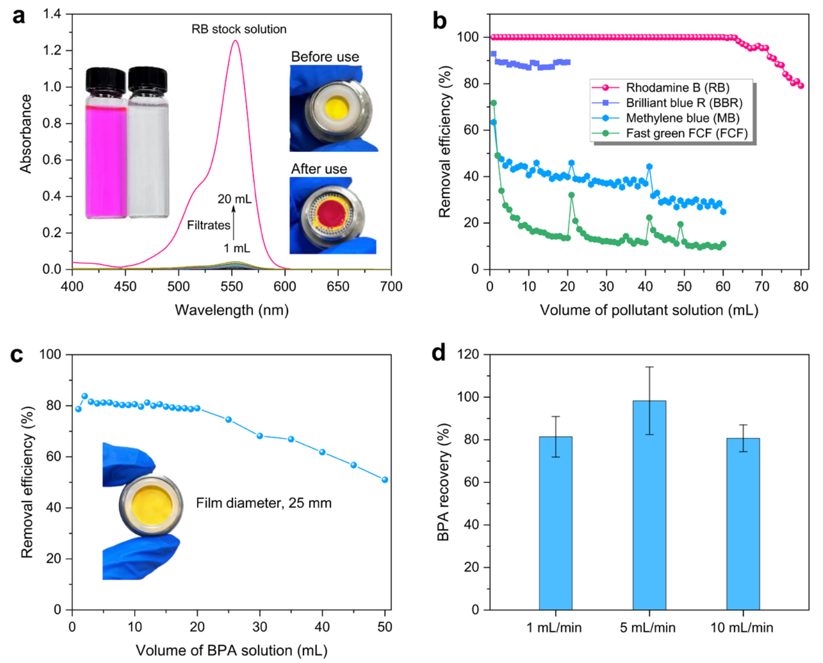

图 2.（a）TAPB–TPA 膜对罗丹明溶液吸附前后的 UV–vis 光谱和实物图；COF 膜在不同流动体积下对（b）四种污染物和（c）双酚 A 的去除率；（d）COF 膜在不同流速下对双酚 A 的回收率。

Figure 2. Flow-through adsorption applications. (a) UV-vis spectra of RB stock solution and filtrates. (b) Removal efficiency of each pollutant obtained by flowing pollutant solution through a 13 mm TAPB-TPA COF film filter. (c) Removal efficiency of BPA upon flowing solution through a 25 mm TAPB-TPA COF film filter. (d) Recovery of BPA at varied flow rates.

Covalent organic frameworks (COFs), which have ordered porous channels and high surface areas, are ideal adsorption and separation materials. However, the shape and morphology modulations of COFs are extremely difficult because COFs are usually insoluble powders. This hinders their high-performance and practical applications.

Based on experimental phenomena, we found that the abovementioned difficulty was attributed to the contradiction between the condensation and crystallization processes. The rapid condensation of monomers in solvents determines shapes and morphologies (e.g., through-pore, skeleton size), while slow crystallization process generates high crystallinity, ordered pores, and high surface areas. However, most researches have been focused on optimizing crystallization conditions to achieve COFs, but failed to control shapes and morphologies concurrently.

To address this problem, we report a two-step method that separates the phase separation and crystallization processes for the shape-controlled synthesis of COFs. The insight into the polymerization-induced phase separation allows for the flexible shaping of COFs into the column, rod, film and others. The optimized porogenic solvents generate hierarchically porous structure. The as-synthesized COF monoliths are crack-free, no powder detaching, and show 214 MPa of compressive modulus. The resulting good permeability and mechanical flexibility enable COF films to apply for flow-through adsorption and extraction of pollutants at high flow rates. In short, our work offers a promising tool to produce COF monoliths with controlled through-pores, desired shapes and sizes, laying the foundation for realizing practical applications of COF materials.

First Author: Master’s candidate Zhu Lin, Shaanxi Normal University
Corresponding Author: Dr. Liu Zhongshan, Shaanxi Normal University
Full Text Link: https://onlinelibrary.wiley.com/doi/10.1002/smll.202205501

Non-negligible Axial Ligand Effect on Electrocatalytic CO_2 Reduction with Iron Porphyrin Complexes

Jiancong Zheng, Dexia Zhou, Jinxiu Han, Jing Liu, Rui Cao, Haitao Lei*, Hongtao Bian*, and Yu Fang

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The Journal of Physical Chemistry Letters

铁卟啉轴向配体对其电催化还原二氧化碳的影响

化石燃料的消耗导致大气层中二氧化碳的含量急剧增加，进而造成一系列环境问题，为实现二氧化碳的资源化利用，科学家们开发出许多催化剂用于电催化二氧化碳还原。铁卟啉类均相催化剂因具有较高的二氧化碳电催化还原效率和稳定性而受到广泛关注，且其结构易被修饰，可调控电催化活性大小。然而，轴向配体对铁卟啉电催化还原二氧化碳的影响机制研究很少，由于铁卟啉电催化还原反应中心是 Fe^{I} 或者是 Fe^{0}，故普遍认为轴向配体对其电催化还原二氧化碳影响很小，反应时轴向配体会从复合物金属中心掉落。然而，由于实验技术手段的受限，复合物轴向配体原位结构及其动力学行为没有得到很好地认识，而对铁卟啉轴向配体在电催化过程中结构动力学的基本理解可以从分子的层次上来阐明电催化还原二氧化碳的潜在机理。

本工作通过阴离子交换法将 FeTPP–Cl 的配体 Cl 替换成 SCN，通过核磁、单晶 X 射线衍射、紫外的手段对其进行表征，这些数据表明，铁卟啉的电子结构不受硫氰酸根抗衡阴离子的影响。CV 曲线表明，在氩气条件下，由于两种铁卟啉轴向配体不同，所以 Fe^{III}/Fe^{II} 还原电位不同，而 Fe^{II}/Fe^{I} 和 Fe^{I}/Fe^{0} 电位不受轴向配体种类的影响。但是通过在 DMF 溶液中的电催化性能表征，轴向配体由 Cl 替换成 SCN 极大地抑制了铁卟啉电催化还原二氧化碳的活性，所以轴向配体对铁卟啉电催化还原二氧化碳的影响机制十分重要。本工作利用 SCN 轴向配体作为傅里叶红外变换光谱以及非线性红外光谱的探针来直接揭示卟啉复合物的结构动力学信息，通过红外光谱表明，FeTPP–SCN 中的 SCN 在 DMF 溶液中有两个峰，分别位于 2055 cm^{-1} 和 2033 cm^{-1}，这表明 SCN 在 DMF 溶液中有两种存在形式。结合 DFT 计算和对照实验，我们将 2055 cm^{-1} 归属为“自由”的 SCN，将 2033 cm^{-1} 归属为 N 与 Fe 结合的 SCN。超快红外光谱测试进一步表明，两种 SCN 在能量分布上比在硫氰酸钠在 DMF 溶液中的 SCN 快 3–5 倍，这表明这两种 SCN 配体均受到铁卟啉复合物中静电相互作用的影响，转动各向异性表明 SCN 配体被强烈地受限在金属中心周围。为了进一步证明轴向配体在催化过程中的影响，我们测试了 FeTPP–SCN 在 DMF 溶液中不同电压下的红外光谱，再次表明轴向配体会影响 Fe^{III}/Fe^{II} 的还原过程，而不是从复合物金属中心脱落。

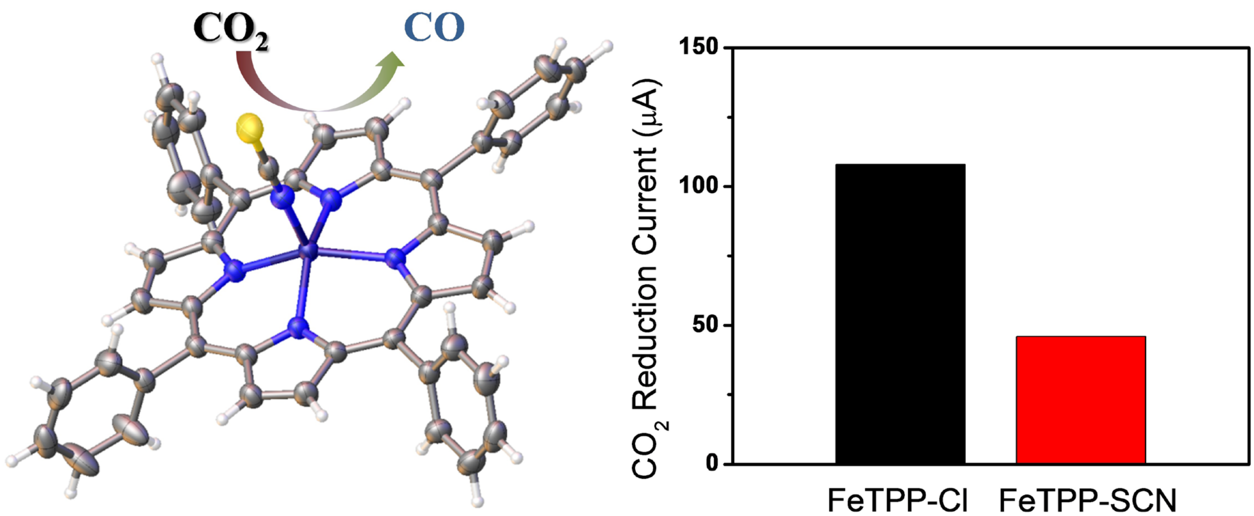

图 1. FeTPP−Cl 与 FeTPP−SCN 电催化还原二氧化碳性能对比
Figure 1. Comparison of FeTPP-Cl and FeTPP-SCN electrocatalytic reduction of carbon dioxide.

本实验结合电化学测试以及超快振动光谱测试，阐明了轴向配体对铁卟啉电催化还原二氧化碳有着不可忽略的影响，且电催化活性可以通过复合物轴向配体和金属中心之间微妙的静电相互作用来调节。

第一作者：陕西师范大学硕士研究生郑建聪
通讯作者：陕西师范大学边红涛教授、雷海涛副研究员
全文链接：https://pubs.acs.org/doi/abs/10.1021/acs.jpclett.2c03235

Consumption of fossil fuels leads to a sharp increase of CO_2 concentration in the atmosphere, which causes a series of environmental problems. In order to utilize CO_2, scientists have developed many catalysis for CO_2 electrocatalytic reduction (CO_2RR). Iron porphyrin homogeneous catalysts have been widely concerned because of their high efficiency and stability, and their structures are easy to be modified, which can regulate the activity of electrocatalysis. However, the mechanism of axial ligands on the electrocatalytic reduction of carbon dioxide by iron porphyrins is very limited, this is mainly based on the fact that the reaction center is Fe^0 or Fe^I, where the axial ligand should be dissociated from the reaction center of the complex. However, the in situ structure and dynamics of the axial ligands in the complex are not fully understood due to the limitations of experimental techniques. The fundamental understanding of structural dynamics of the axial ligands, especially during the electrocatalytic process, would elucidate the underlying mechanism of the electrocatalytic reduction of CO_2 at the molecular level.

In this work, the iron(III) tetraphenylporphyrin thiocyanate (FeTPP-SCN) is synthesized from the iron(III) tetraphenylporphyrin chloride (FeTPP-Cl) by counteranion exchanging reaction, and it was characterized by ^{1}H NMR, XRD and UV-vis, and all the measurements revealed that the subtle electrostatic interaction between the axial ligands and metal center in the complex can have non-negligible effect on the electrocatalytic CO_2 reduction. The CV data in DMF under Ar indicate that the potential difference observed for the first redox wave is generally attributed to the difference of axial ligands, and the Fe^{II}/Fe^{I} (−1.52 V) and Fe^{I}/Fe^{0} (−2.15 V) redox couples were not affected by the type

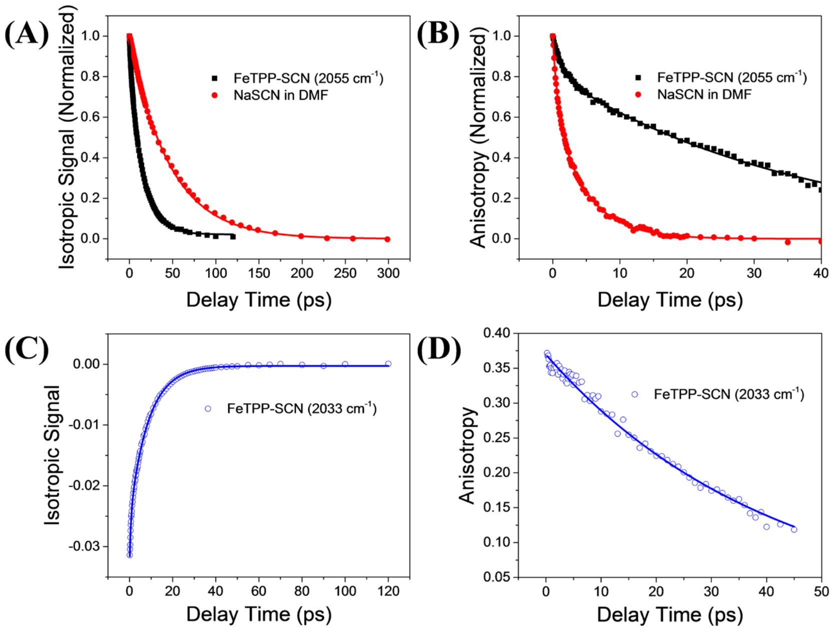

图 2. 铁卟啉复合物和硫氰酸钠在 DMF 溶液中 SCN 的振动布居弛豫动力学及其各向异性衰减曲线。
Figure 2. Vibrational population relaxation dynamics and anisotropy decay for the SCN in the iron porphyrin complex and NaSCN dissolving in DMF solution.

of axial ligands. However, the replacement of axial ligands from Cl to SCN can noticeably suppress the electrocatalytic CO_2 reduction reaction activity. Therefore, it is important to investigate the structure and dynamics of the axial ligands in the porphyrin complex dissolved in the DMF solutions. Here, the SCN ligands can serve as the vibrational reporter to reveal the structural dynamics in the porphyrin complex by FTIR and nonlinear IR spectroscopies, and there are two absorption peaks in the CN stretching region for FeTPP-SCN in DMF solution, indicating there are two different types of SCN species in the solution. Combining DFT calculations and control experiments, we attribute 2055 cm^{-1} as "free" SCN and 2033 cm^{-1} as the bound SCN, where the N atom in SCN ligand should interact with the metal center in the complex. Ultrafast IR spectroscopic measurements demonstrated that both the “free” and bound SCN ligands displayed 3–5 times faster energy redistribution than free SCN of sodium thiocyanate in DMF, suggesting that the SCN ligands should be affected by the electrostatic interaction in the FeTPP complex. Rotational anisotropy measurements indicate that the ligands are strongly confined and restricted by the global networks formed in the vicinity of metal center. To further elucidate the role of axial ligand in the metal complex during the catalytic activity process, the IR spectra of FeTPP-SCN in DMF solutions under different potentials were measured. This result confirmed our assumption that the axial ligands of SCN can still be affected during the Fe^{III}/Fe^{II} redox process, rather than dissociated away from the metal center in the complex.

From the electrochemical measurements combined with linear and ultrafast vibrational spectroscopic studies, it was demonstrated that the axial ligands can have a non-negligible effect on the electrocatalytic CO_2 reduction, and the electrochemical catalytic activity can be mediated by the subtle electrostatic interaction between the axial ligands and metal center in the complex.

First Author: Master’s candidate Zheng Jiancong, Shaanxi Normal University
Corresponding Authors: Prof. Bian Hongtao and Assoc. Prof. Lei Haitao, Shaanxi Normal University
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很多美好都是在学习和研究过程中伴随发生的

A lot of good things happen along with the learning and research process

文 / 刘小燕 by Liu Xiaoyan

转眼间已经结束瑞典的交流学习一段时间了，借此机会分享一下两年多在隆德大学物理化学系的研究和在隆德的生活经历。

时隔四年，2019 年我再次回到了瑞典。隆德大学物理化学系早就有了解，之前也跟这个系的老师有过合作或者在会议上见过面，不过想到要开始新的研究课题还是有很多期待和兴奋。第一天上班先跟合作导师开会讨论课题怎么开展，之后安排了一下办公室和实验室以及完成实验安全相关的测试，我在物理化学系的研究工作就正式开始了。

研究工作主要围绕几个要回答的问题展开，涉及到了一个对我来说全新的研究内容模型细胞膜和一个熟悉的研究内容微凝胶。我开始学习之前没有接触过的仪器，比如小角 X 射线散射（SAXS）。工作有序进展，我很快适应了课题组和系里的工作模式。系里日常事务会议每个月一次，最长 20 分钟，主要是告知大家接下来系里要开展的重要的事件，包括博士生、硕士生学位论文答辩，实验室安全，学术报告，学术会议这几项。我的研究工作前几个月整体算是顺利，但是也遇到了一些挑战。其中一个就是在利用激光共聚焦显微镜研究微凝胶与细胞膜相互作用的时候，微凝胶的荧光信号太弱。经过几次讨论和实验观察，最终在跟其他课题组的合作下解决了这个难题。研究中遇到挑战是很常见的，除了自己查阅文献和思考之外，也可以通过与导师讨论，或者与其他课题组进行合作来解决问题。这段时间每周最少有三天要全天呆在激光共聚焦显微镜的实验室里拍照片和视频，一周工作后最期待的是周末会留出时间去隆德周边的森林徒步，对我来说这是最让我放松和享受的休息方式。回想 2019 年的秋冬是高效和安静的。

2020 年三月新冠疫情来到了隆德，跟很多人一样开始我也是有恐慌和担心的。开始居家工作，为了避免感染我一般安排周六周日两个整天去学校做实验。

在这段时间里，有趣的实验现象和接下来的思考和提出问题可以说是对抗疫情负面情绪最有效的药剂。投入到具体的工作学习里也是一种面对疫情的方式，除了工作和实验上的调整，也要调整和适应新的节奏，关注自己的健康状况同工作和学习同样重要。

记得很清楚的一个时间转折点是 2022 年一月初，在瑞典非常有限的对新冠的限制性政策下，身边几乎所有的同事朋友都在这个时候感染了新冠，学校关闭了办公室和实验室，自己也进入完全居家的工作模式。直到四月份学校才安排分批回校工作，很好的是接下来的时间里再没有大规模的疫情发生，可以全身心的投入到研究工作中。回国之前同事们组织了一次非常温暖也是我非常喜欢的徒步活动为我送行。那天天气很好景色很美，是一个美好的时刻。

两年多的研究工作和生活故事很长，难以一一概括。这段时间里有过困难和疑惑，但是很幸运从事了一份自己热爱的工作，这份工作里有很大比例的时间是在学习和研究。我的感受是有时间和条件去学习和做研究是幸运的，除了自身发展，在这个过程中我遇到了新同学，现在他们是我的好朋友和同事。我的博士导师现在见面和讨论问题时常会说“很开心在你毕业之后还能有机会一起做研究”。完成博士后研究后，我到了现在的工作岗位，房老师和课题组的老师们给了我很多的帮助，非常感谢！在隆德学习交流的这段时间里，在做一个对照实验的时候发现了一个很有趣的实验现象，跟合作导师还有她的导师一起进行讨论，然后做了其它的补充实验和理论计算，最终这个实验现象作为一个独立工作发表了论文。

科学研究的过程总是让我感到兴奋和享受。我时常给课题组的研究生说要珍惜能学习的时间，投入到学习和实验当中去，在这个过程里会遇到良师益友、会获得自信。这些美好都是在学习和做研究的过程中伴随发生的。

In the blink of an eye, it has been a while since my postdoc program in Sweden completed, so I would like to take this opportunity to share my research and life experience for more than two years at the Department of Physical Chemistry of Lund University and in the city of Lund.

After four years, I returned to Sweden in 2019. I have known about the Department of Physical Chemistry at Lund University for a long time, and I have collaborated with teachers from this department or met at conferences before, but I still have a lot of anticipation and excitement to start my new research project. On the first day of work, I had a meeting with my supervisor to discuss how to carry out the project, and then I sorted out the office and laboratory arrangements and completed the experimental safety-related tests, and my research work in the Department of Physical Chemistry officially began.

My research work mainly revolves around a few questions to be answered, involving a new research content model cell membrane and a familiar research content microgel. I started learning about instruments I hadn’t touched before, such as small-angle X-ray scattering (SAXS). The work progressed orderly, and I quickly adapted to the working mode of the research group and the department. The daily affairs meeting of the department is held once a month, which is up to 20 minutes and mainly informs everyone of the important events to be carried out in the department, including doctoral and master’s students’ defense, laboratory safety, academic reports and conferences. In the first few months my research went well generally, but there were some challenges. One of them was that the fluorescence signal of microgels was too weak when I used laser confocal microscopy to study the interaction between microgels and cell membranes. After several discussions and experimental observations, this problem was finally solved with the cooperation of other research groups. It is common to encounter challenges in research, and in addition to consulting the literature and thinking on your own, you can also solve them by discussing with your supervisor or collaborating with other research groups. During this time, I spent at least three days a week in the laser confocal microscope laboratory to take photos and videos, and after a week of work, I looked forward to setting aside time for hiking in the forests around Lund, which was the most relaxing and enjoyable way for me. Looking back, I found the autumn and winter of 2019 was efficient and quiet.

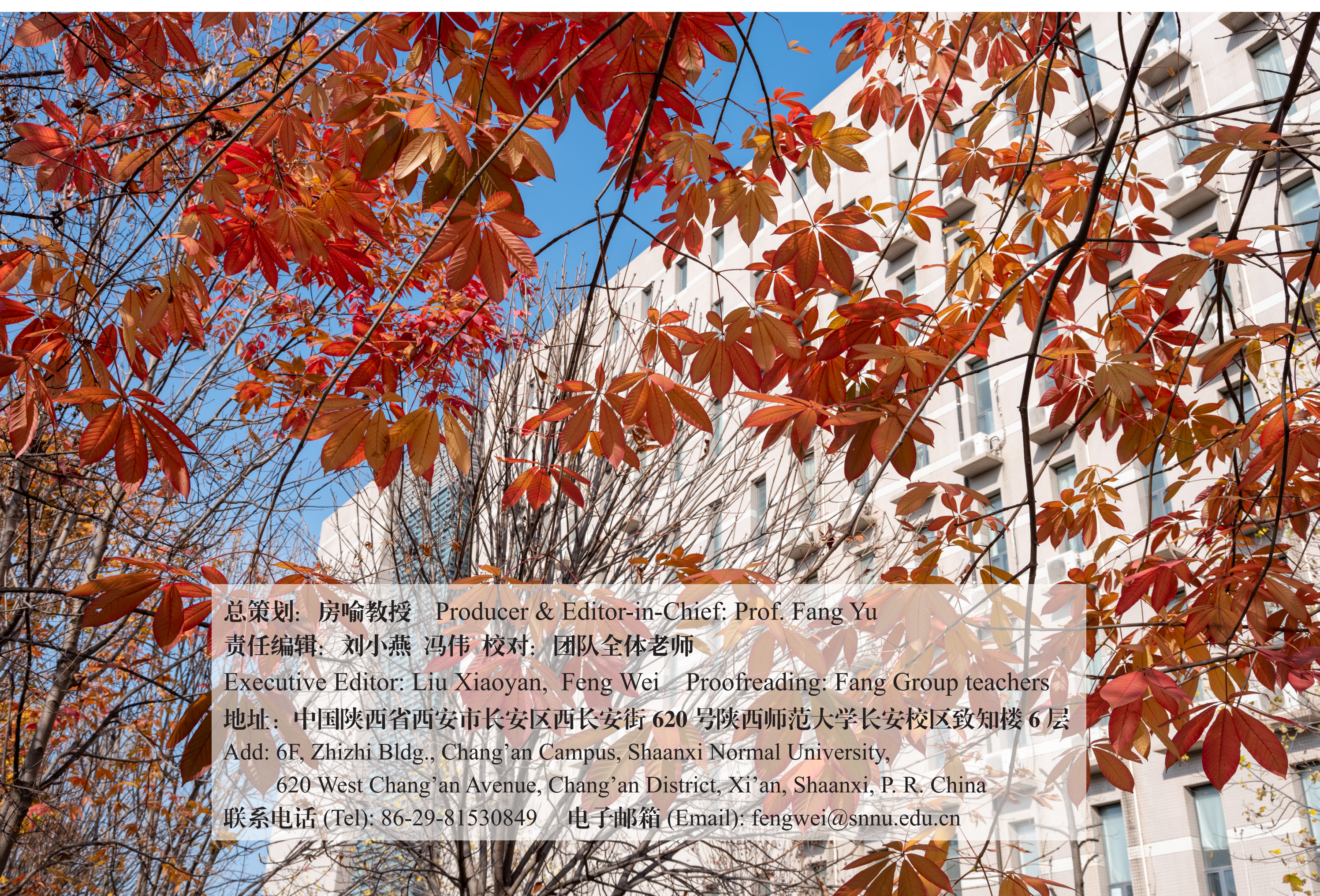
When the COVID-19 pandemic came to Lund in March 2020, like many people, I was panicked and worried at first. After starting to work from home, in order to avoid infection, I generally arrange to go to school for experiments on Saturday and Sunday. During this time, interesting experimental phenomena and the follow-up thinking and asking questions can be said to be the most effective medicine against the negative emotions of the epidemic. Investing in specific work and study is also a way to face the epidemic, and in addition to work and experimental adjustments, you should also adjust and adapt to the new rhythm, as paying attention to your own health is just as important as working and studying.

I clearly remember the turning point was in early January 2022, when under Sweden's very limited restrictive COVID policy, almost all colleagues and friends around me were infected. The school closed offices and laboratories, and I also entered a complete home work mode. It was not until April that the school arranged to return to work in batches, and it is good that there were no large-scale outbreaks in the following time, so I could devote myself to research. Before returning home, my colleagues organized a very heart-warming

hike to see me off, which I liked so much. The weather was lovely that day and the view was beautiful. It was such a wonderful moment.

More than two years of research, work and life stories are too long to summarize. During this time, there were difficulties and doubts, but I was lucky to work in a job that I loved, and a large proportion of my time was spent studying and researching. My reflection is that I am lucky to have the time and conditions to study and do research, and in addition to my own development, in the process I met new classmates, who are now my good friends and colleagues. My PhD supervisor often says this when he meets and discusses problems with me, "I'm so happy to have the opportunity to do research together after you have graduated." After completing my postdoctoral research, I came to my current job, and Prof. Fang and the colleagues in the group gave me a lot of help. Thank you very much! During the period of study and exchange in Lund, while doing a control experiment, I found an interesting experimental phenomenon, discussed it with my supervisor and her supervisor, and then did other supplementary experiments and theoretical calculations, and finally published a paper on this experimental phenomenon as an independent work.

The process of scientific research always excites me and makes me enjoy it. I often tell the graduate students in my research group to cherish the time they can study, devote themselves in learning and experimenting, and in the process they will meet good mentors and friends and gain self-confidence. All of these good things are something that happen in the process of learning and doing research.



总策划：房喻教授　Producer & Editor-in-Chief: Prof. Fang Yu
责任编辑：刘小燕　冯伟　校对：团队全体老师
Executive Editor: Liu Xiaoyan, Feng Wei　Proofreading: Fang Group teachers
地址：中国陕西省西安市长安区西长安街 620 号陕西师范大学长安校区致知楼 6 层
Add: 6F, Zhizhi Bldg., Chang'an Campus, Shaanxi Normal University,
620 West Chang'an Avenue, Chang'an District, Xi'an, Shaanxi, P. R. China
联系电话 (Tel): 86-29-81530849　电子邮箱 (Email): fengwei@snnu.edu.cn