



陕西师范大学
SHAANXI NORMAL UNIVERSITY



化学化工学院
School of Chemistry & Chemical Engineering

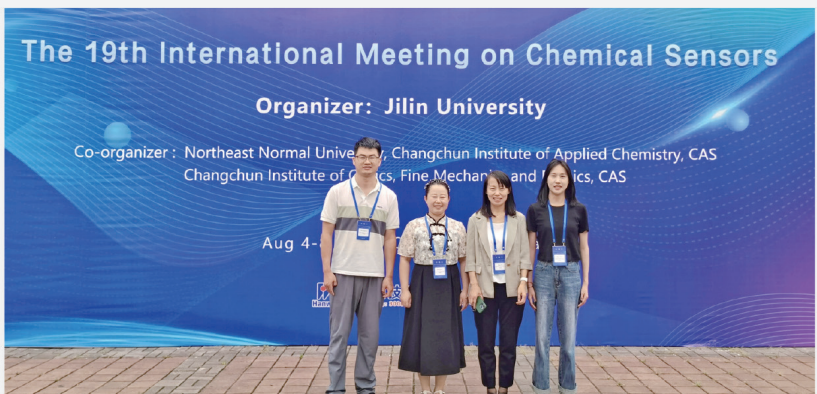
08 / 2023

光子鼻与分子材料团队

Photonic Nose and Molecular Materials Group

简报

Newsletter



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基础科学的 ——以化学学科

房喻

E-mail: yfang@snnu.edu.cn

Website: <http://yfang.snnu.edu.cn>

全国科学教育



房喻院士在“全国科学教育暑期学校”西安会场作报告 Fang Yu speaks at National Summer School on Science Education (Xi'an)

2023年8月5日,房喻院士在“全国科学教育暑期学校”中小学教师培训(西安会场)为来自河南、山西和陕西的103名科学教师作报告。

此次中小学教师培训于8月1至6日在陕西师范大学开班,邀请舒德干、段宝岩、房喻三位院士和8位科学课程教学论专家共同授课,组织3次学术沙龙和案例研讨,4次科研院所现场教学,帮助中小学教师加深对

科学课程标准的理解,学习科学家精神,提升科学教育教学能力。

On August 5, 2023, Prof. Fang Yu gave a lecture to 103 science teachers from Henan, Shanxi and Shaanxi provinces at the National Summer School on Science Education (Xi'an) for Primary and Secondary School Teacher Training.

The training, held from August 1 to 6 at Shaanxi Normal University, invited three CAS academicians Shu

Degan, Duan Baoyan and Fang Yu, and eight experts in science curriculum pedagogy to give lectures, and organized three academic salons and case study discussions, and four on-site teaching sessions at research institutes, in an effort to help the primary and secondary school teachers deepen their understanding of the science curriculum standards, learn from the spirit of scientists, and improve their ability of science education and teaching.

房喻院士参加中国化学会第十八届全国光化学学术讨论会并作报告

Fang Yu speaks at 18th National Photochemistry Symposium of Chinese Chemical Society



2023年8月3至6日,中国化学会第十八届全国光化学学术讨论会在长春举行,房喻院士、丁立平教授、刘静教授应邀参加会议并作报告。

房喻院士的大会报告题目为“薄膜荧光传感器-从敏感材料创新到硬件结构研制”,丁立平教授的邀请报告题目为“交互动应性荧光传感体系的构建及其区分识别性能研究”,刘

静教授的邀请报告题目为“组装态荧光小分子的激发态调控及对气相污染物的高效传感”。

会议以“超分子光化学”为主题,由中国化学会光化学专业委员会和吉林大学联合主办、吉林大学物理学院承办,来自全国120多家单位的600余位学者,包括8位院士,40余位杰青等国家高层次人才,50余位“四青”人才参加了会议。

Changchun.

Fang Yu's plenary report was titled "Film-based Fluorescent Sensors - From the Innovation of Sensitive Materials to the Development of Hardware Structure", Prof. Ding Liping's invited report was titled "Construction of Interactive Responsive Fluorescent Sensing System and Its Differentiation and Recognition Performance", Prof. Liu Jing's invited report was titled "Excited State Regulation of Assembled Fluorescent Small Molecules and Efficient Sensing of Gas-Phase Pollutants".

From August 3 to 6, 2023, Prof. Fang Yu, Prof. Ding Liping, and Prof. Liu Jing participated in and presented at the 18th National Photochemistry Symposium of the Chinese Chemical Society held in

With the theme of "Supramolecular Photochemistry", the conference was co-sponsored by the Photochemistry Committee of the Chinese Chemical Society and Jilin University, and organized by the School of Physics of Jilin University, which was attended by more than 600 scholars from more than 120 organizations in China, including eight CAS academicians and more than 40 other national high-level talents.



团队举办外出参会学习经验分享会

Sharing session on conference and workshop experiences held

2023年8月12日，光子鼻与分子材料团队在新概念传感器与分子材料研究院报告厅举办了外出学习参会经验心得分享会，黄蓉蓉博士、舒远红博士后、博士研究生翟宾宾和刘向泉进行了汇报和分享。

在会上，黄蓉蓉分享了参加中国化学会第十八届全国光化学学术讨论会的情况及感悟。舒远红分享了参加中国化学会第十二届有机固体电子过程暨华人有机光电功能材料学术讨论会中的相关情况。翟宾宾和刘向泉分别分享了参加吉林大学暑期讲习班所学习到的内容和所见所想。

最后，房喻教授在总结讲话中感谢了同学们的工作汇报和分享，同时希望同学们可以刻苦努力，潜心学习，铆足干劲迎接接下来的科研工作。

On August 12, 2023, the Photonic Nose and Molecular Materials Group held a sharing session on the experiences of attending conferences and participating in workshop in the Lecture Hall of the Institute of New Concept Sensors and Molecular Materials. Dr. Huang Rongrong, Postdoctoral Fellow Shu Yuanhong, and PhD students Zhai Binbin and Liu Xiangquan shared their experiences and reflections.

Huang Rongrong shared what she learned from participating in the 18th National Photochemistry Symposium of the Chinese Chemical Society. Shu Yuanhong shared his experience of participating in the 12th Organic Solid State Electronic Processes and CCS's Chinese Organic Photovoltaic Functional Materials Symposium of the Chinese Chemical Society. Zhai Binbin and Liu Xiangquan shared what they had learned, seen and thought during the summer workshop at Jilin University.

In the end, Prof. Fang Yu thanked the students for their presentations, and hoped that they could work hard, study hard, and be energetic to meet the next research work.



Science,
Mathematics and
Technology



陕西师范大学
SHAANXI NORMAL UNIVERSITY

Coffee Break

Aug. 12, 2023
Rongrong Huang



中国化学会第十二届有机固体电子过程暨华人有机光电功能材料学术讨论会

- 有机/聚合物发光材料与器件
- 新型共振分子和聚合物材料的设计与合成
- 有机/聚合物场效应晶体管材料与器件
- 杂化/钙钛矿光伏材料与器件
- 碳材料、有机热电材料与器件
- 有机固体前沿方向

3

2023

超分子化学与自组装

吉林大学暑期讲习班分享

汇报人：刘向泉

研究院举办年中学术活动 INCSMM mid-year academic activity held



2023年8月14日上午，新概念传感器与分子材料研究院在研究院报告厅举办了年中学术活动。活动由丁立平副院长主持，房喻院士、团队老师和学生，计算机科学学院副院长马苗教授及国家毒品实验室陕西分中心杨春研究员参加了此次活动。

团队的新成员彭灵雅老师作了题为“有机金属配合物的光催化和发光机制的理论研究”的学术报告。彭老师介绍了她博士期间的工作，也分享了她来到新团队之后对未来工作的思

考，并就在场师生提出的问题进行了交流。

杨春研究员的报告从四个方面展开，依次是分中心实验室简介、主要研究方向和内容、毒品种类介绍和禁毒案例介绍。报告结束后，在场师生和杨春研究员进行了问答交流。

房喻院士对陕西分中心提出了一些发展期望和合作建议。最后，房喻院士还对学生们提出了培养坚韧性格的期望。

接下来在研究院会议室进行的分

享会上，刘静教授和刘凯强教授分别介绍了本学期参加学术会议的情况，分享了他们对学术研究和学术交流的心得。

彭军霞副教授介绍了她作为指导教师带领学生团队参加大学生创新创业大赛并获得省级金奖的情况，以及经验和心得。

最后，马佳妮教授介绍了她的专业成长历程，分析了不同院校在科研管理和激励措施等方面的差异，分享了自己的心路历程。





On August 14, 2023, the Institute of New Concept Sensors and Molecular Materials held a mid-year academic activity in its lecture hall. The event was hosted by vice dean Liping Ding and attended by Prof. Fang Yu, INCSMM faculty members and students, and Prof. Ma Miao, vice dean of the School of Computer Science, and researcher Yang Chun of the Shaanxi Regional Center of

her PhD and shared her thoughts about future work after she joined INCSMM, and exchanged views with students and faculty members in the audience.

Yang Chun presented her report from four aspects, namely, introduction of the Shaanxi center, its main research direction and contents, drug types and anti-drug cases. After the presentation, teachers and students present had a Q&A

session with Yang Chun.

Ms. Peng Lingya, a new member of INCSMM, gave a lecture titled Theoretical Study of Photocatalysis and Luminescence Mechanism of Organometallic Complexes. Ms. Peng introduced her work during

session with Yang Chun.

Prof. Fang Yu put forward some development expectations and cooperation suggestions to the Shaanxi center. Finally, Fang Yu also put forward the expectation for students to cultivate tough character.

In the following sharing session held in the conference room, Prof. Liu Jing and Prof. Liu Kaiqiang briefed about their participation in academic conferences this semester and shared their insights on academic research and academic communication.

Dr. Peng Junxia introduced her experience and insights as an instructor who led a student team to participate in the Innovation and Entrepreneurship Competition for College Students and won the provincial gold medal.

Finally, Prof. Ma Jiani introduced her professional growth history, analyzed the differences in research management and incentives in different institutions, and shared her thoughts and reflections.



马佳妮教授受聘《中国化学快报》青年编委

Ma Jiani appointed as Young Editorial Board member of Chinese Chemical Letters

近日，光子鼻与分子材料团队/新概念传感器与分子材料研究院马佳妮教授受聘担任《中国化学快报》青年编委会委员，聘期自2023年1月至2024年6月。

《中国化学快报》1990年创刊，由中国化学会/中国医学科学院药物研究所主办、中国医学科学院药物研究所承办，是一本国内外公开发行的化学综合性英文通讯类学术期刊。1996年起被SCI收录，2022年影响因子目标10左右，总被引频次超过22000次，2012至2021年连续10届获得“中国最具国际影响力科技期刊”，居国内化学类期刊前列。

Recently, Prof. Ma Jiani of the Photonic Nose and Molecular Materials Group / Institute of New Concept Sensors and Molecular Materials has been appointed as a member of the Young Editorial Board of Chinese Chemical Letters, and her period of appointment is from January 2023 to June 2024.

Founded in 1990, Chinese Chemical Letters, sponsored by the Chinese Chemical Society/Chinese Academy of Medical Sciences Institute of Pharmaceutical Sciences, and undertaken by the latter, is a comprehensive



English-language academic journal of chemistry for domestic and international circulation. It has been included in SCI since 1996, with an impact factor of about 10 in 2022, and a total of more than 22,000 citations. From 2012 to 2021, it has been awarded one of the China's Most Internationally Influential Science and Technology Journals for 10 consecutive years, ranking the forefront of chemistry journals in China.

研究院老师和博士后获批国家自然科学基金资助

INCSMM teachers and postdocs awarded NSFC grants

近日，国家自然科学基金委员会公布了2023年国家自然科学基金集中接收申请项目评审结果，新概念传感器与分子材料研究院马佳妮教授、刘忠山副教授和舒远红博士后、郭燕博士后申报的项目获批资助。

马佳妮申报的“有机分子光化学反应机制”项目获批优秀青年科学基金资助，资助经费200万元。刘忠山的项目“晶态填料研制中的相分离和晶化机制”获批面上基金，资助经费50万元。舒远红的项目“力致变色动态共价界面膜形成及力学响应机制”获批青年基金，资助经费20万元。郭

燕的项目“光致生成醌甲基化合物反应机制研究”获批青年科学基金，资助经费20万元。

Recently, the National Natural Science Foundation Committee announced its 2023 evaluation results, and the projects submitted Prof. Ma Jiani, Assoc. Prof. Liu Zhongshan and Postdoctoral Fellows Shu Yuanhong and Guo Yan of the Institute of New Concept Sensors and Molecular Materials were awarded grants.

Ma Jiani's project Mechanisms of Photochemical Reactions of Organic Molecules was awarded the Outstanding

Youth Fund with a funding of CNY 2 million yuan. Liu Zhongshan's project Insight into the Phase Separation and Crystallization Toward Developing Crystalline Separation Materials was granted CNY 500,000 yuan by the General Fund. Shu Yuanhong's project Formation and Mechanical Response Mechanism of the Mechanochromism Dynamic Covalent Interfacial Film was granted CNY 200,000 yuan by the Youth Fund. Guo Yan's project Unraveling the Reaction Mechanisms of Photogenerated Quinone Methide Compounds was granted CNY 200,000 yuan by the Youth Science Fund.



房喻院士出席河西学院首届丝路论坛并作大会报告

Fang Yu speaks at first Silk Road Forum of Hexi University

2023年8月28日，房喻院士出席在甘肃省张掖市河西学院举办的首届丝路论坛，并作了题为“薄膜荧光传感器——从敏感材料创新到硬件结构研制”的大会报告。

报告会由河西学院名誉校长、大连化学物理研究所李灿院士主持，与会专家、领导和河西学院师生代表900余人出席。

On August 28, 2023, Prof. Fang Yu attended the first Silk Road Forum held in Hexi University in Zhangye City, Gansu Province, and gave a report titled Film-based Fluorescence Sensor - From sensitive material innovation to hardware structure development.

The report was presided over by Prof. Li Can of Dalian Institute of Chemical Physics, a CAS academician and the honorary president of Hexi



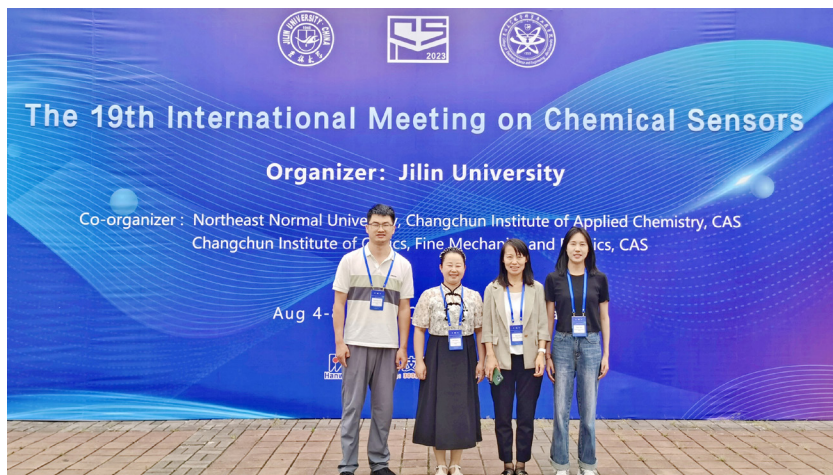
University and attended by more than 900 people, including experts, officials

participating the forum and Hexi University teachers and students.

刘静教授参加第十九届化学传感器国际会议并作报告 Liu Jing presents at 19th International Meeting on Chemical Sensors

2023年8月4至7日，光子鼻与分子材料团队刘静教授、博士后乔敏、博士生崔凯翔、闫珍参加了由吉林大学承办、在吉林省长春市召开的第十九届化学传感器国际会议，刘静教授作了题为“荧光组装膜的创建与传感性能研究”的口头报告。

From August 4 to 7, 2023, Prof. Jing Liu, Postdoctoral Fellow Qiao Min, PhD students Cui Kaixiang and Yan Zhen of the Photonic Nose and Molecular Materials Group attended the 19th International Meeting on Chemical Sensors hosted by Jilin University in Changchun, Jilin Province, where Prof.



Liu Jing gave an oral presentation titled "Studies of Fluorescent Assembled Films. Construction and Sensing Property".

房喻院士出席西北工业大学化学学科博士学位授权点 自评估评审会

Fang Yu attends NPU self-evaluation meeting of Chemistry doctoral program

2023年8月11日，西北工业大学化学学科博士学位授权点自评估评审会在西北工业大学长安校区召开，房喻院士作为评审专家参加了评审，并与其他评审专家在听取报告、质询

与讨论后，给出了合格通过的评估意见。

On August 11, 2023, the self-evaluation review meeting of the doctoral degree program of Chemistry of Northwestern Polytechnical University

was held in NPU's Chang'an Campus. Prof. Fang Yu participated in the review as an expert, and gave a qualified evaluation opinion after listening to the report, questioning and discussion with other review experts.

房喻院士出席陕西基础科学研究院 2023 年度专家委员会会议 并作报告

Fang Yu appointed Expert Committee member of Shaanxi Institute of Basic Sciences

2023年8月23日至24日，陕西基础科学（化学、生物学）研究院2023年度专家委员会会议暨学术研讨会在西北大学召开，房喻院士获颁首届专家委员会委员聘书，并在随后举

行的学术研讨会主论坛上做了学术报告。

From August 23 to 24, 2023, the Expert Committee meeting and academic seminar of Shaanxi Institute of Basic

Sciences (Chemistry, Biology) was held in Northwest University. After being presented the appointment letter as the first Expert Committee member at the meeting, Prof. Fang Yu gave a report at the main forum of the seminar held later.

Tunable Non-Kasha Behaviors and Excited-State Dynamics of Quadrupolar Squaraine Aggregates

Nan Zhang, Lu Liu, Haixia Chang, Ke Liu, Taihong Liu,* Liping Ding, and Yu Fang

四偶极方酸菁聚集体的 Non-Kasha 堆积行为和激发态动力学研究

分子堆积是单个分子通过分子间非共价键相互作用构筑分子聚集态结构的重要过程。近年来，多偶极共轭荧光分子及聚集体的堆积方式与光物理性质之间的关系受到了广泛关注。目前较多发现的分子堆积方式为具有较高能态、特征光谱蓝移、辐射跃迁禁阻特征的 H- 聚集，具有较低能态、特征光谱红移、辐射跃迁允许特征的 J- 聚集以及 Davydov 分裂等。结合 Coulomb 聚集和 Frenkel 激子理论，新型聚集态理论比如红移 H- 聚集、丰富的 HH/Hj/hJ/JJ 聚集、能级或结构无序性以及 X- 聚集等均用于解释茈二酰亚胺、方酸菁等衍生物体系较为特殊的聚集行为（图 1）。因此，设计开发新颖研究体系和开展复杂聚集体的光电性质研究对于深化人们对多偶极共轭荧光分子发光特性理解具有重要意义。

本工作设计合成了一种 Donor-Acceptor-Donor 型四偶极方酸菁衍生物 SQC6，基于该类分子堆积的环境敏感特性，其在三氟乙酸 TFA 共存的不同溶剂中表现出包括 H- 聚集、J- 聚集和 hJ- 聚集的差异化聚集行为。在 hJ- 聚集类型中，聚集决定因素分别源自于 Coulomb 堆积和电荷转移 CT

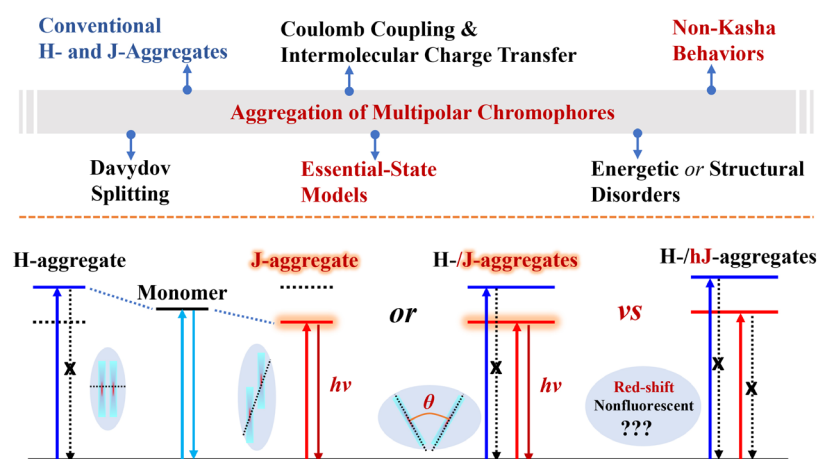


图 1. 多偶极共轭荧光分子及聚集体的堆积方式与其光物理性质变化。

Figure 1. Diverse theories and representative energy transitions on understanding the aggregation phenomena of multipolar chromophores.

作用的强弱。具体而言，在 SQC6 的甲苯和甲醇体系中加入 TFA，光谱变化伴随着 702 nm 处单体吸收峰强度的降低，在短波长 632 nm 和 574 nm 处分别出现二聚体和 H- 聚集特征峰。在二氯甲烷体系中，光谱出现 569 nm H- 聚集特征峰和不发荧光的 800 nm 的波谱裂分，后者归属于 hJ- 聚集光谱。在三氯甲烷和四氯化碳体系中，光谱变化仅出现不发荧光的红移 hJ 特征峰。大量对比验证测试同时表明，

溶剂特性和反离子的细微变化会显著影响 SQC6 的聚集行为，方便实现其光学性质的精细调控。理论研究认为氢键、 $\pi-\pi$ 和静电相互作用引发了相邻分子间的强激子耦合，Essential-state Model (ESM) 模型较好地解释了单体、二聚体的消失和非荧光发射的红移 hJ- 聚集体的产生（图 2）。此外，超快 fs-TA 光谱研究证实了不同聚集体系激发态动力学的显著差异和激发态快速弛豫过程与电子激发态 CT 机制

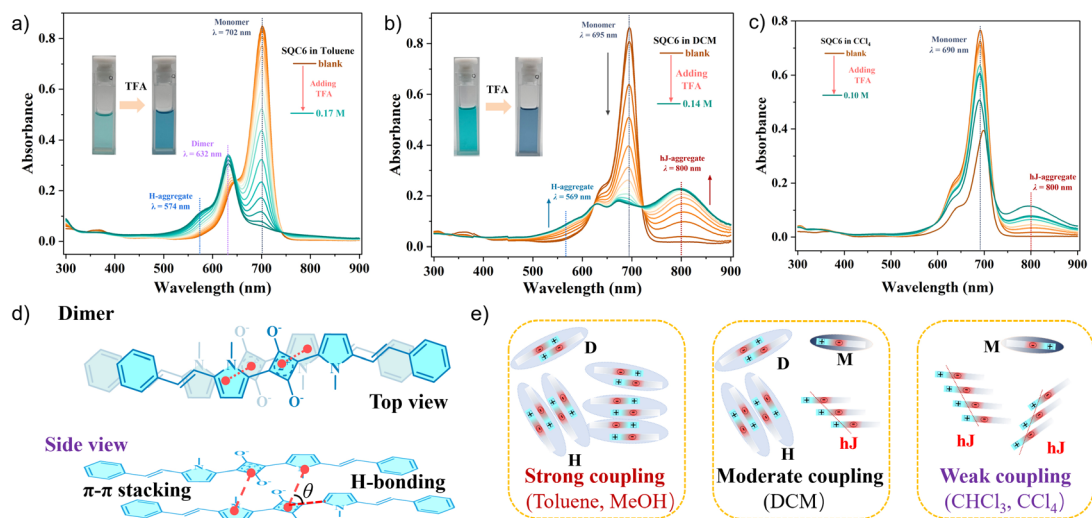


图 2. 向 SQC6 的甲苯溶液 (a)、DCM 溶液 (b) 和 CCl_4 溶液 (c) 中逐步加入不同浓度 TFA 的紫外可见吸收光谱变化情况。插图为加入 TFA 前后的相关溶液颜色变化。(d) SQC6 二聚体不种角度观察效果图。(e) TFA 协同作用下不同溶剂中 SQC6 不同强度的聚集行为。

Figure 2. Absorption spectra changes of SQC6 in (a) toluene, (b) DCM, and (c) CCl_4 in the presence of various concentrations of TFA. The inset showed the solution color changes before and after adding TFA. (d) Schematic illustration of the two views of dimer fragments. (e) Distinct aggregation of SQC6 cooperated by TFA in different media with diverse coupling strength.

的相关性。宽波长范围的双光子吸收 2PA 表征和最大 2PA 吸收波长的特征分析表现出方酸菁衍生物固有的共振增强 2PA 特性。该工作有助于理解特定分子间相互作用本质，并为构建可调控堆积模型和独特非线性光学性质的聚集体开辟了新视角。

第一作者：陕西师范大学硕士研究生张楠

通讯作者：陕西师范大学刘太宏副教授

全文链接：<https://pubs.acs.org/doi/full/10.1021/acs.jpcllett.3c02029>

Multipolar chromophores and corresponding aggregates have gained ever-expanding attention owing to the feasibility of charge delocalization and energy level engineering. Complicated theories based on the Frenkel exciton theory and Kasha model have been developed on understanding the aggregation of polarizable chromophores whereby modular molecular entities are integrated in different distances and orientations. Unconventional non-Kasha behaviors have been observed where Frenkel excitons can strongly couple to

intermolecular excitons and in certain packing morphologies give rise to distinct aggregates. Besides, a richer array of aggregate types as HJ, HH, JH, and JJ were denoted, where the first letter and the second one indicates the influence of Coulomb coupling and charge transfer (CT)-mediated coupling, respectively. Although considerable discussion on photophysical dynamics of molecular aggregates are revitalized (Figure 1), in-depth studies of aggregates are still limited by the small family of suitable materials or infrequent packing arrangements.

Herein, distinct aggregates of SQC6 in the presence of TFA were comparatively demonstrated in different organic solvents. Subtle changes of solvent and ion pair influenced the aggregation of SQC6 and led to the significant variations in optical properties. The stabilization of dimer suggested strong exciton coupling with the adjacent molecules initiated by the π - π stacking and electronic interaction. Vanishment of dimer and generation of nonfluorescent red-shifted hJ-aggregate were elucidated well based on the ESM

model. Additionally, comparative fs-TA studies confirmed the notable differences in relaxation dynamics and the importance of CT state. Fast relaxation processes in the excited state might be associated with the CT processes upon electronic excitation. Broadband 2PA and the maxima 2PA cross section manifested the intrinsic resonance-enhanced characteristics of squaraine derivatives. Strength of excitonic coupling directly addressed the position of absorption bands and thus pronounced excitonic interactions could favor noticeable enhancement of 2PA efficiency. Present results contribute to understand the nature of specific intermolecular interactions and open new perspectives in constructing tunable aggregates with unusual packing models and unique optical properties.

First Author: Zhang Nan, Master's candidate, Shaanxi Normal University

Correspondence Author: Assoc. Prof. Liu Taihong, Shaanxi Normal University

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中国科学院大连化物所李先锋副所长一行来访

Meeting held with CAS Dalian Institute of Chemical Physics visitors



2023年8月21日，中国科学院大连化学物理研究所李先锋副所长、榆林中科洁净能源创新研究院任晓光院长、陈维东副院长一行到访新概念传感器与分子材料研究院，并与房喻院士会面商谈合作事宜。

首先，房喻院士带领来访者一行参观了研究院成果展厅，介绍了研究院的基本情况、科研成果和成果转化情况。接下来，双方在会议室进行了座谈。李先锋副所长表达了此次来访的合作意愿，希望院士团队科研成果能在榆林市进行转化，支持榆林市的产业发展；陈维东副院长介绍了榆林中科洁净能源创新研究院的情况；任晓光院长与研究院老师探讨了开展合作的可能性，双方同意今后加强联系交流。

西安交通大学何刚教授，研究院副院长丁立平教授、彭军霞副教授、办公室主任杨小刚、办公室秘书左振男参加了会谈。

On August 21, 2023, Li Xianfeng, deputy director of Dalian Institute of

Chemical Physics, Chinese Academy of Sciences, Ren Xiaoguang and Chen Weidong, dean and vice dean of Yulin Zhongke Clean Energy Innovation Research Institute, visited the Institute of New Concept Sensors and Molecular Materials (INCSMM) and met with Prof. Fang Yu.

After showing the visitors INCSMM's exhibition room, Fang Yu briefed them about the institute, its research results and the commercial transformation. During the discussion held in the meeting room, Li Xianfeng expressed his willingness to cooperate with INCSMM and hoped that the research achievements could be transformed in Yulin in support of the industrial development of Yulin. Chen Weidong in-

troduced his institute and Ren Xiaoguang explored the possibilities of cooperation with INCSMM faculty members, and the two sides agreed to strengthen the contacts and exchanges in the future.

Prof. He Gang from Xi'an Jiaotong University, INCSMM vice dean Prof. Ding Liping, Dr. Peng Junxia, Administrative Office director Yang Xiaogang, and secretary Zuo Zhennan attended the meeting.





强化实验教学 培育实践学习生态

Strengthening Experimental Teaching and Cultivating an Experiential Learning Ecology

文 / 房喻 by Fang Yu

科技革命是人类文明发展的根本动力，每一次科技革命都极大地改变了人类命运，重塑了世界政治经济格局。当前，新一轮科技革命正加速演进，科技教育的战略价值日益突显。青少年是民族的未来，是国家现代化建设的后备军，加强青少年科学兴趣和动手能力培养对于“两个一百年”奋斗目标实现，对于中华民族伟大复兴意义重大，已经引起了党和政府的高度重视。习近平总书记在中共中央政治局第三次集体学习时强调“要在教育‘双减’中做好科学教育加法，激发青少年好奇心、想象力、探求欲，培育具备科学家潜质、愿意献身科学研究事业的青少年群体”“基础教育既要夯实学生的知识基础，也要激发学生崇尚科学、探索未知的兴趣，培养其探索性、创新性思维品质”。这是总书记从党和国家事业全局出发，着眼加快建设教育强国、实现高水平科技自立自强作出的重要指示。

青少年时期科学兴趣培养、动手能力历练对于一个人求实求真做事风格的形成和创新思维习惯的养成作用突出。这就是为什么习近平总书记强调“对科学兴趣的引导和培养要从娃娃抓起”。实验教学是学生获取知识，提升科学素养的重要途径，是学科教学的重要内容，是建构各学科理论体系的基础。为贯彻教育部《基础教育课程教学改革深化行动方案》，落实《关于加强和改进中小学实验教学的意见》要求，培养具有创新意识、实践能力、动手能力和复杂问题解决能力的创新

型人才，提升中小学科学教育质量，教育部教育技术与资源发展中心（中央电化教育馆）组织专家团队研制并发布了《中小学实验教学基本目录》（以下简称《基本目录》）。

《基本目录》的编制是落实新时代课程改革精神的关键之举，是推动中小学实验教学改革创新的重要举措。《基本目录》的编制以课标主题为主线，以课标内容为依据，以层层细化的大概念为脉络，将课程标准细化到实践教学中，有助于中小学制定具体的实践教学计划，规范实践教学实施，提升科学与技术类课程的教学质量；有助于师生开展基于大概念大单元的教学活动，将学生置身于真实情景中，为学生获取科学知识，理解科学本质，认识客观世界提供了重要的实践途径。这一努力无疑有助于更加全面地体现学科的育人价值，更加有力地促进新课程标准、新课程理念的落地生根。

《基本目录》的研制坚持依据国家课程标准，立足我国基础教育实践教学实际，注意参考各学科教学装备配备标准和教材，借鉴国内外先进经验，坚持素养为本和能力导向，尊重学生认知发展规律，同时充分考虑区域差异、学段衔接、课时安排等实际情况，使得最终形成的《基本目录》具备了鲜明的育人特点，较强的科学性、实操性和可行性。本次颁布的《基本目录》涵盖涉及小学、初中、高中各学科应该开展的900多项实践活动，进一步明确了新课程、新教改理念下

的实践教学内容，为实验教学视导、实验教学装备配置、实验教学经费投入和实验场地保障等提供了重要依据。

《基本目录》的出台充分体现了知识导向的科学教育向学生创造才能和创新素养培养方向的转变。《基本目录》编制过程中充分考虑了学科特征，关注了不同实验形式、实验内容与实验技术，倡导学生在实践中通过自主设计、实际操作、小组合作、实验探究和问题解决等环节加深对知识的理解，提升学习的主动性和参与度，培养团队合作和沟通能力，提高创新意识和创造力。通过丰富多样的实践活动，让学生充分感受科学之美，激发学生创造潜能。通过经历像科学家一样研究科学问题、像工程师一样解决工程实践问题，让学生学会科学研究的一般方法与范式，有效提升学生的科学素养。

《基本目录》的实施是强化实践教学的有效措施，将有效引导教学方法和学习方法的改进，进一步减轻盲目机械训练造成的过重学业负担。基本目录以层层细化的大概念为脉络，多样化进阶式的实验内容涵盖了技能实验、探究实验和应用实验等，搭建起了有血有肉、丰富充实的实验教学框架，可有效帮助学生增强对必备知识的理解，学科关键能力的养成。中小学校应以此为契机，合理规划课前、课中和课后时间，充分利用学校实验室、创客空间和校外科技馆、少年宫、天文馆、博物馆、实践基地等活动场所，有效对接科研院所、高校、高新技术

企业等社会机构, 指导学生开展观察、体验、测量、探究、考察、调查、编程、种植、养殖等基于真实情境的科学实践学习活动和跨学科项目式学习, 让科技教育回归其实践属性, 让新时代科学教育高质量发展更精准、更高效。

《基本目录》具有较好的基础性、普适性和前瞻性, 是加快推进教育现代化, 扎实推进新时代中小学科学教育的有力措施。为更好地发挥其引导教学的作用, 各地应积极地有选择地扩充实验内容, 使之更符合地方教育特色, 比如沿海城市可以加入更多的海洋资源实验内容, 农村地区可以增加现代农业相关实验内容。教师在实际应用中应根据学生的心理特征, 选择真实问题情景, 引发学生的好奇心和探究欲望, 使实验真正成为解决问题的工具和学习知识的载体, 引导学生有效开展自主学习和创造性学习。鼓励教师根据教学实际安排活动, 增加与生活、社会和科技密切联系的跨学科实践活动, 尽量减少重复学习与重复训练内容。实验教学管理部门应加大对实验教学研究力度, 发布实验教学指南, 开发实验教学精品课例, 推动实验教学高质量发展, 全面提升中小学科学教育质量, 助力创新型国家建设。

我相信, 《基本目录》的制定和发布将会极大地推动“在体验中探究, 在实践中学习”这一重要的, 当前还显得十分薄弱的第二学习生态的构建。

——此文是为教育部《中小学实验教学基本目录》所写的推荐语

Scientific and technological revolutions are the fundamental driving force behind the development of human civilization, and each of them has dramatically changed the destiny of mankind and reshaped the world's political and economic landscape. At present, a new round of scientific and technological revolution is accelerating, and the strategic value of science and technology education is becoming increasingly prominent.

Young people are the future of the nation and the reserve force of the national modernization construction. Strengthening young people's interest in science and hands-on training is of great significance to the realization of the goal of the “Two Centenary Goals” and the great rejuvenation of the Chinese nation, and has attracted great attention from the Party and the government. General Secretary Xi Jinping emphasized in the third collective study of the Political Bureau of the CPC Central Committee that “we should do a good job of adding science education to the ‘double reduction’ in education, to stimulate young people's curiosity, imagination, and desire to explore, and to cultivate groups of young people with the potential of scientists who are willing to dedicate themselves to the cause of scientific research”. “Basic education should not only strengthen students' knowledge foundation, but also stimulate their interest in science and exploring the unknown, and cultivate their exploratory and innovative thinking qualities”. This is an important instruction made by the General Secretary from the overall situation of the Party and the country, focusing on accelerating the construction of a country strong in education and realizing a high level of scientific and technological self-reliance and self-improvement.

Cultivation of scientific interest and hands-on experience in adolescence play a prominent role in the formation of a person's practical and realistic style of doing things and the development of innovative habits of thinking. This is why General Secretary Xi Jinping emphasized that “the guidance and cultivation of scientific interest should start from childhood”. Experimental teaching is an important way for students to acquire knowledge and improve their scientific literacy, an important part of subject teaching, and the basis for constructing the theoretical system of each subject. In order to implement the Ministry of Education's “Action Plan for Deepening the Basic Education

Curriculum and Teaching Reform”, implement the requirements of “Opinions on Strengthening and Improving Experimental Teaching in Primary and Secondary Schools”, cultivate innovative talents with innovative consciousness, practical ability, hands-on ability and complex problem solving ability, and improve the quality of science education in primary and secondary schools, the Center for Educational Technology and Resource Development of the Ministry of Education (National Center for Educational Technology) has organized a team of experts to develop and publish the Basic Catalog for Experimental Teaching in Primary and Secondary Schools (hereinafter referred to as the Basic Catalog).

The compilation of the Basic Catalog is a key move in the implementation of the spirit of curriculum reform in the new era, and an important initiative to promote reform and innovation in experimental teaching in primary and secondary schools. The compilation of the Basic Catalogue is based on the theme of the curriculum standard, threaded with the big concepts which are refined layer by layer and aligned with practical teaching, which helps primary and secondary schools to formulate specific practical teaching plans, standardize the implementation of practical teaching and improve the quality of the teaching of science and technology courses; it helps teachers and students to carry out teaching activities based on big concepts and big units, and puts the students in real situations, which provides important practical approaches for students to acquire scientific knowledge, understand the nature of science, and know the objective world. This effort will undoubtedly help reflect the educational value of the subject in a more comprehensive way, and promote the implementation of the new curriculum standards and concepts more vigorously.

The compilation of the Basic Catalogue is based on the national

curriculum standards, on the actual practice of teaching and learning in China's basic education, drawing reference to the standards of teaching equipment and teaching materials of various disciplines, drawing on the advanced experience at home and abroad, adhering to the principles of literacy-based and ability-oriented, respecting the law of cognitive development of the students, and at the same time, taking into full consideration of the actual situation of regional differences, the connection of the school phases, the class arrangement, etc., which makes the final version of the Basic Catalogue distinctively educational, strongly scientific, practical and feasible. The Basic Catalog covers more than 900 practical activities that should be carried out in each subject in elementary school, junior high schools and senior high schools, which further clarifies the content of practical teaching under the concept of the new curriculum and the new education reform, and provides an important basis for the supervision of experimental teaching, the configuration of experimental teaching equipment, the investment of funds for experimental teaching and the guarantee of experimental venues.

The introduction of the Basic Catalogue fully reflects the shift from knowledge-oriented science education to the cultivation of students' creative talents and innovative literacy. The preparation of the Basic Catalogue takes into full consideration of the characteristics of the discipline, pays attention to different forms of experiments, experimental contents and experimental techniques, and advocates that students deepen their understanding of knowledge through independent design, practical operation, group cooperation, experimental investigation and problem solving in practice, enhance their initiative and participation in learning, cultivate their teamwork and communication skills, and improve their sense of innovation and creativity. Through rich and diverse practical activities, students can fully experience

the beauty of science and stimulate their creative potential. Through experiencing researching scientific problems like scientists and solving engineering practice problems like engineers, students can learn the general methods and paradigms of scientific research and effectively enhance their scientific literacy.

The implementation of the Basic Catalog is an effective measure to strengthen practical teaching, which will effectively guide the improvement of teaching and learning methods and further reduce the excessive study burden caused by rote training. The Basic Catalog is based on the big concepts which have been refined layer by layer, and the diversified and progressive experimental content covers skill experiments, inquiry experiments and application experiments, etc. It builds up a flesh-and-blood, rich and full experimental teaching framework, which can effectively help students enhance their understanding of the necessary knowledge and the development of the key abilities of the discipline. Primary and secondary schools should take this as an opportunity to rationally plan the time before, during and after school, make full use of school laboratories, maker spaces and off-campus science and technology centers, juvenile palaces, planetariums, museums, practice bases and other activity venues, and effectively dock with scientific research institutes, colleges and universities, hi-tech enterprises and other social institutions, and guide students to carry out practical science learning activities and interdisciplinary project-based learning based on real situations, such as observations, experiences, measurements, explorations, expeditions, investigations, programming, planting, breeding and other science practical learning activities, so that science and technology education can return to its practical attributes and make the high-quality development of science education in the new era more accurate and efficient.

The Basic Catalogue is basic,

universal and forward-looking, and is a powerful measure for accelerating the modernization of education and solidly promoting science education in primary and secondary schools in the new era. In order to better play its role in guiding teaching, local schools should actively and selectively expand the experimental contents to make them more in line with local educational characteristics. For example, coastal cities can add more experimental contents on marine resources, and rural areas can increase the experimental contents related to modern agriculture. In actual application, teachers should choose the real problem scenarios based on the psychological characteristics of students, to trigger students' curiosity and desire to explore, so that the experiment really becomes a problem-solving tool and a carrier of learning knowledge, guiding students to effectively carry out independent learning and creative learning. Teachers are encouraged to arrange activities according to the actual teaching, increase interdisciplinary practical activities that are closely connected with life, society and science and technology, and minimize contents of repetitive learning and repetitive training. Laboratory teaching administrative departments should increase their research efforts on laboratory teaching, issue guidelines for laboratory teaching, develop fine examples of laboratory teaching, promote the high-quality development of laboratory teaching, comprehensively improve the quality of science education in primary and secondary schools, and contribute to the construction of an innovative country.

I believe that the development and release of the Basic Catalog will greatly promote the construction of the important second learning ecology of "Inquiry through experience and learning by doing", which is still very weak at present.

(This is a recommendation written for the Ministry of Education's *Basic Catalog for Experimental Teaching in Primary and Secondary Schools*)

参加经验分享组会的思考和感悟

Reflections and Insights from Experience Sharing Session

参加了8月12日课题组举办的外出参会学习分享会之后，团队的研究生们写下了自己的思考和感悟，这里刊发其中的五篇。

After attending the Fang Group sharing session on conference and workshop experiences held on August 12, some graduate students wrote down their reflections and insights, and five of which are published here.

李晶:

锲而舍之，朽木不折，锲而不舍，金石可镂。于我而言，这是对8月12日组会的最好总结。在这次组会上，各位汇报人对自己所参与的会议都进行了相关总结，有许多知识可以为自己的课题所用，也会有所启发。但所有内容中，最重要的应当是那些由经历所产生的经验，这些都是无法在网络上检索到的，我们应该铭记于心。

没有一帆风顺的科研工作，搞科研就是要遇见问题，解决问题，不被问题所困住，这也是我们一生中要面对的最平常的事。不怕困难，慢慢走，走好每一步，一定会比原地打转或不断摔倒更快到达终点。

留给我们做学生，专心搞科研的时间就那么多，应当珍惜每一分一秒。所有的困难都会使我们成长，应当积极的去面对。遇见本就不易，更应当感谢每一个人所给予我们的帮助。最后，想分享一句最喜欢的话给大家：Life is about feeding your soul.

Li Jing :

Chiseling a piece of rotten wood but giving it up does not break it; Carving with perseverance can work on metal and stone. For me, this is the best way to summarize the August 12 meeting. In this meeting, the presenters shared their experiences of participating in the

conferences, and many of the knowledge they shared can be used for my own research topic, which is inspiring. But of all the contents, the most important should be those lessons that come from the experience, which cannot be retrieved on the Internet, and we should keep them in mind.

There is no smooth sailing in scientific research. Doing research means meeting problems, solving problems, and not being trapped by problems, which are the most common things we have to face in our life. Do not be afraid of difficulties, go slowly and take every step well, and you will surely reach the finish line faster than spinning in the same place or falling down constantly.

There is only so much time left for us to be students and concentrate on research, so we should cherish every minute. Difficulties will make us grow, so we should face them positively. It's not easy to meet people, so we should be grateful for the help given to us by them. Finally, I would like to share a favorite saying with you: Life is about feeding your soul.

谷雪:

科研应时刻保持思考，以不断质疑的学术态度和坚持探索的学术精神去发现更多未知的可能。

“细节决定成败”。科研工作中要善于观察，认真对待每一次实验、每一次数据分析，仔细做好实验记录，帮助自己理清思路，客观、真实、详尽的记录是一笔宝贵的财富。此外，文献阅读是科研的基础，要广泛阅读高质量期刊论文，多加思考、善于总结、敢于创新。同时，要积极与老师、师兄师姐、同学进行有效沟通，及时反馈，倾听他人意见、吸收观点。科研一定要“坐冷板凳”，保持乐观的心态，积极迎接挑战。进步的道路永无止境，

没有任何一个成功是偶然的，需要长时间的准备和沉淀。

Gu Xue :

In scientific research, we should always keep thinking and discover more unknown possibilities with the academic attitude of constant questioning and the academic spirit of persistent exploration.

"The devil is in the details". In scientific research, we should be good at observation, seriously treat every experiment, every data analysis, carefully keep experimental records, so as to help ourselves clear thinking, for objective, true and detailed records are a valuable asset. In addition, literature reading is the foundation of research, so we should read more high-quality journal papers, think more and summarize well, and dare to innovate. At the same time, we should actively communicate with teachers, senior and fellow students, feedback timely, listen to others' opinions and absorb their ideas. In doing research, we must be patient, maintain an optimistic mindset, and actively meet the challenges. The road to progress is never-ending, and no success is accidental, which requires long preparation and precipitation.

张晶:

小小组会，大大收获。从研一懵懂到博二渐进，组会始终是一个宝贵的学习和成长平台，通过参加组会，可以听取伙伴们的经验分享，了解研究领域最新动态，逐步建立起自己的知识体系。组会也是一个锻炼沟通和表达能力的好机会，通过向他人介绍自己的研究进展，可以更好地理解和掌握自己的工作。望“珍惜组会时光，收获知识宝藏”。

点点积累，蔓蔓日茂。努力工

作和专心科研是实现成功的关键。只有通过不断的努力和专注，才能在科研领域中取得突破性的成果。每一次的失败都是一次宝贵的经验，只有不断地尝试和探索，才能发现新的知识和解决问题的方法。同时，要保持对科研的热情和信心，相信自己的能力和潜力，不断挑战自己，超越自己。只有这样，才能在科研道路上走得更远，取得更大的成就。望“博冠尽而约取，厚积终而薄发”。

芸芸众生，熠熠生辉。尽管都是平凡的个体，但这并不意味着我们不能过上充满激情与活力的生活。每个人都有自己的闪光点 and 价值，关键在于如何挖掘并发挥这些潜力，保持积极乐观的心态，这是我们在面对生活科研挑战时所需的强大动力。正视自己的平凡，但不甘于平庸，完成自己的科研，体验生活之精彩。望“保持一份热爱，奔赴一场山海”。

Zhang Jing :

Small group meeting, big gain. From my first year as a master's candidate to the second year of my doctoral program, the group meeting has always been a valuable platform for learning and growth. By participating in the meeting, we can listen to the experience sharing of fellow students, understand the latest development of the research field, and gradually build up our own knowledge system. The group meeting is also a good opportunity for us to exercise our communication and expression skills, and we can better understand and master our own work by presenting the progress of our own research to others. I hope that we will "cherish the time of group meeting and harvest the treasure of knowledge".

Accumulation little by little grows into a luxuriant tree. Hard work and dedication to research is the key to achieving success. Only through continuous efforts and concentration can we achieve breakthrough results in scientific research. Every failure is a

valuable experience, and only through continuous trial and exploration can we discover new knowledge and solutions to problems. At the same time, keep your enthusiasm and confidence in research, believe in our own abilities and potentials, and constantly challenge ourselves to surpass ourselves. Only in this way can we go farther on the road of research and make greater achievements. Only in this way can we go farther on the road of scientific research and achieve greater success. I hope that we will "acquire knowledge broadly, take its essence well, accumulate learning abundantly, and utilize knowledge prudently".

All people shine. Although we are ordinary individuals, it does not mean that we can not live a life full of passion and vitality. Everyone has their own shining point and value, and the key lies in how to tap and play these potentials and maintain a positive and optimistic mindset, which is a powerful motivation we need to face the challenges of life and research. Facing our own mediocrity, but not willing to be mediocre, we will complete our own research and experience the splendor of life. I hope that we will "keep up the passion, go face the next challenge".

刘倩倩 :

暑期收假后的第一次组会，由出去开会的师兄师姐们分享自己的参会所见所闻以及所思所想，使我受益匪浅。黄蓉蓉师姐向大家分享了自己开会时遇到的人和事，认识了一些与自己志同道合的朋友们，一起交谈分享自己的科研。此外，她选择了一些与自己课题相关的学术报告分享给大家。最后还给大家介绍了一个 AI 润色论文的软件，启发我们要合理借用外力来帮助自己。

接下来舒远红师兄与大家分享了有机光电功能材料会议的内容。尽管和我们课题组研究方向相关性不大，但是师兄分享了一些我们可能用到的化学反应，为我们打开了新世界的大

门。

最后刘向泉师兄和翟宾宾师兄分享了他们在吉林大学参加超分子自组装集训课的情况。

这次特殊的组会汇报让我收获了很多。谨记翟宾宾师兄送给大家的一段话：期望落空，总在众望所归之处；希望常现，总在心灰意冷之时。

最后，非常感谢房老师给我们提供这么好的交流平台，为我们拓宽知识，开阔眼界打下的基础。

Liu Qianqian :

At the first meeting after the summer vacation, I benefited a lot from the senior students and graduates who attended conferences and shared what they had seen, heard and thought. Dr. Huang Rongrong shared with us the people and events she met during the conference, where she met some friends with the same interests as her, talking and sharing their research works together. In addition, she shared with us some academic reports related to her research topic. Finally, she introduced a software for AI embellishing manuscript, which inspired us to reasonably borrow external tool to help ourselves.

Next, Dr. Shu Yuanhong shared with us the content of the conference on Organic Optoelectronic Functional Materials. Although it is not very relevant to the research direction of our group, he shared some chemical reactions that we may use, which opened the door to a new world for us.

Finally, Liu Xiangquan and Zhai Binbin shared their participation in the Supramolecular Self-Assembly Intensive Training Course at Jilin University.

I have gained a lot from this special group Meeting. I would like to share the words by Zhai Binbin: Expectations are always dashed when they are most desired whereas hope is always there when we are disillusioned.

Finally, I am very grateful to Prof. Fang for providing us with such a good communication platform and laying the foundation for us to broaden our

knowledge and expand our horizon.

胡定芳:

在这次的分享会中,我有幸听取了黄蓉蓉师姐、舒远红师兄、刘向泉师兄以及翟宾宾师兄假期参加学术会议的经验分享,他们介绍了在会议中所了解到的跟我们的研究工作密切相关的报告,以及从学术会议中获得的一些感悟,让我受益匪浅。

学术会议作为一个汇聚全国学者的平台,为我们提供了与同领域顶尖专家交流的机会,并有机会了解到该领域最新的研究成果和发现,从而对领域内的热点问题有更深刻的理解,这也为我们今后的研究方向提供了一定的参考价值。

此外,蓉蓉师姐还提到了在会议中建立人脉关系的重要性。通过与专家、同行的交流,我们有机会建立合作机会,为未来的研究合作奠定基础。同时,与其他参会者的互动也能够激发新的研究思路,促使我们的研

究工作走向更高水平。

总的来说,这次分享会让我深刻认识到学术会议在研究生学习和科研中的重要作用。它不仅是获取知识的平台,还是拓展视野、建立人脉、了解前沿科学的重要途径。

Hu Dingfang :

In this sharing session, I had the honor to listen to Dr. Huang Rongrong, Dr. Shu Yuanhong, Dr. Liu Xiangquan, and Dr. Zhai Binbin's sharing about their experiences of attending academic conferences during the summer vacation. They briefed us about the presentations that were closely related to our research works and the insights they gained from the presentations, which were of great benefit to me.

As a platform that brings together scholars from all over the country, the academic conferences provide us with the opportunity to communicate with the top-notch experts in the same field and have the chance to learn about the

latest research results and discoveries in the field, so that we can have a deeper understanding of the hot issues in the field, which will also provide some reference for our future research direction.

In addition, Rongrong mentioned the importance of networking at the conference. By interacting with experts and peers, we have the opportunity to establish collaborative opportunities and lay the foundation for future research collaborations. At the same time, interactions with other attendees can also stimulate new research ideas and drive our research to a higher level.

Overall, this sharing session made me deeply realize the important role of academic conferences in postgraduate study and research. It is not only a platform for acquiring knowledge, but also an important way to expand your horizons, build up your network, and learn about cutting-edge science.

总策划: 房喻教授

Producer & Editor-in-Chief: Prof. Fang Yu

责任编辑: 刘小燕 冯伟

Executive Editors: Liu Xiaoyan, Feng Wei

翻译: 冯伟

Translator: Feng Wei

校对: 团队全体教师

Proofreading: Fang Group teachers

装帧设计: 长乐央吉 | 泛象空间

Designed by Changle Yangji, FanForm Art Space

地址: 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

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): 86-29-81530726

电子邮箱 (Email): incsmm@snnu.edu.cn