陕西师範大學 SHAANXI NORMAL UNIVERSITY
化学化工学院 School of Chemistry & Chemical Engineering

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光子鼻与分子材料团队 简 报

Photonic Nose and Molecular Materials Group Newsletter

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房喻院士出席第二届陕西省科协年会并作主旨报告

Fang Yu delivers keynote report at 2nd Annual Conference of Shaanxi Science and Technology Association

2023 年 11 月 3 日，房喻院士出席由陕西省科协、榆林市政府主办，榆林市科协承办的第二届陕西省科学技术协会年会，榆林市委副书记、市长张胜利为房喻院士颁发了榆林市科技创新顾问聘书。

在主旨报告环节，房喻院士作了题为《构建新发展格局背景下教育与基础研究的作用》的报告，通过对比中外国家对教育和科技的重视程度，指出新发展阶段，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，必须重视教育、重视基础科学、重视基础研究。

在 11 月 2 日举行的年会重点活动院士专家与榆林市领导干部座谈会上，房喻院士发言，从材料化工领域角度展开分析，对前沿科技战略和未来科技发展趋势提出思考，对榆林科技发展把脉问诊，为榆林市高质量发展建言献策。

On November 3, 2023, Prof. Fang Yu attended the Second Annual Conference of Shaanxi Science and Technology Association, hosted by Shaanxi Provincial Science and Technology Association and Yulin Municipal Government.

Zhang Shengli, deputy secretary of the CPC Yulin Committee and mayor of Yulin city, presented Fang Yu with the appointment letter of Yulin Science and Technology Innovation Consultant.

In the keynote report session, Fang Yu delivered a report titled “The Role of Education and Basic Research in the Context of Building a New Development Pattern”. Comparing the importance given to education and science and technology at home and abroad, he maintained that in the new development stage we must attach great importance to education, basic science and basic research, so as to implement the new development concept, build a new development framework, promote sustainable development, and realize the great rejuvenation of the Chinese nation.

Fang Yu also spoke at the symposium of academicians, experts and Yulin officials, a key activity of the conference held on November 2, in which he analyzed from the perspective of the fields of materials and chemical engineering, put forward thoughts on the future development trend of science and technology strategy, examined the science and technology development of Yulin city, and offered suggestions for the high quality development of Yulin city.

房喻院士在 2023 全球硬科技创新大会开幕式上视频致辞

Fang Yu delivers video speech at opening ceremony of 2023 Global Key & Core Technology Conference

2023 年 11 月 3 日，以“硬科技·新质生产力”为主题的 2023 全球硬科技创新大会在西安高新国际会议中心开幕，房喻院士在开幕式上以视频形式发表寄语致辞。

房喻院士讲到：“陕西是科技大省，也是高等教育大省，这些优质资源主要集中在西安地区。在当前贯彻新发展理念、构建新发展格局背景下，西安市一定可以大有作为。因为科技资源、教育资源在贯彻新发展理念过程中将会发挥越来越重要的作用。作为新概念传感器和分子材料研究工作者，我和我的团队也将自觉融入到西安的发展过程中，也愿意为西安市的创新发展作出我们自己应有的贡献。”

大会由科技部、中国科学院、国家知识产权局、陕西省政府指导，西安市委、市政府、省科技厅、省知识产权局、省科协主办，突出西安综合性国家科学中心和科技创新中心建设，全方位展示硬科技创新发展典型案例、项目和成果，聚焦西安市发展，探讨交流创新发展之道。

On November 3, 2023, Prof. Fang Yu delivered a video message at the opening ceremony of the 2023 Global Key & Core Technology Conference, which is themed “Key & Core Technology - New Productivity Boosters” and held in Xi’an High-tech International Conference Center.

Fang Yu said: “Shaanxi is a big province of science and technology, as well as a big province of higher education, and these high-quality resources are mainly concentrated in Xi’an. Under the current background of implementing the new development concept and building a new development framework, Xi’an can certainly make great achievements. Because scientific and technological resources and educational resources will play an increasingly important role in the process of implementing the new development concept. As researchers of new concept sensors and molecular materials, my team and I will consciously integrate into the development process of Xi’an, and we are willing to make our due contributions to the innovation and development of Xi’an.”

Directed by the Ministry of Science and Technology, Chinese Academy of Sciences, State Intellectual Property Office and Shaanxi Provincial Government, and hosted by Xi’an Municipal Party Committee, Municipal Government, Provincial Department of Science and Technology, Provincial Intellectual Property Office and Provincial Association for Science and Technology, the conference highlights the construction of Xi’an Comprehensive National Science Center and Science and Technology Innovation Center, comprehensively showcases typical cases, projects and achievements of key and core science and technology innovation and development, focuses on the development of Xi’an, and explores ways to promote development through exchanges and innovation.

房喻院士获聘应用表面与胶体化学教育部重点实验室荣誉主任

Fang Yu appointed honorary director of MOE Key Laboratory of Applied Surface and Colloid Chemistry

2023 年 11 月 5 日，应用表面与胶体化学教育部重点实验室第三届学术委员会第二次全体会议在陕西师范大学长安校区致知楼召开。鉴于房喻院士多年来对实验室建设的辛勤付出和卓越贡献，重点实验室聘请房喻院士为实验室荣誉主任，陈新兵副校长为房喻院士颁发了聘书。

学术委员会主任韩布兴院士、副主任高子伟教授，委员谢素原院士、李广涛教授、黄建滨教授、吴立新教授、黄飞鹤教授、张晓兵教授、黄飞教授、梁永民教授、郝京诚教授、朱为宏教授、栾新军教授、孔杰教授、丁立平教授出席了会议。

实验室学术骨干马佳妮教授作了题目为“有机分子光化学反应机制研究”的学术汇报。

On November 5, 2023, the second plenary meeting of the third Academic Committee of the Key Laboratory of Applied Surface and Colloid Chemistry of the Ministry of Education was held in Zhizhi Building, Chang'an Campus, Shaanxi Normal University. In view of his hard work and outstanding contributions to the construction of the laboratory over the years, Prof. Fang Yu was appointed as the honorary director of the Laboratory, and was presented the letter of appointment by SNNU vice presidentChen Xinbing.

Committee chairman Academician Han Buxing, vicechairman Prof. Gao Ziwei, Academician Xie Suyuan, Prof. Li Guangtao, Prof. Huang Jianbin, Prof. Wu Lixin, Prof. Huang Feihe, Prof. Zhang Xiaobing, Prof. Huang Fei, Prof. Liang Yongmin, Prof. Hao Jingcheng, Prof. Zhu Weihong, Prof. Luan Xinjun, Prof. Kong Jie and Prof. Ding Liping attended the meeting.

Prof. Ma Jiani, one of the key members of the laboratory, presented a report titled “Research on the photochemical reaction mechanism of organic molecules”.

刘太宏副教授应邀参加防化前沿技术研讨会并作报告

Liu Taihong invited to present at Seminar on Chemical Defense Technology

2023 年 11 月 4 至 5 日，防化前沿技术研讨会暨《防化研究》编委 2023 年度工作会议在重庆召开，团队刘太宏副教授应邀参会并作题为“薄膜荧光传感器设计与毒剂检测应用”的主题报告。

团队硕士研究生赵佳音为第一作者身份撰写的“用于神经性毒剂检测的薄膜荧光传感器研究进展”论文获《防化研究》年度优秀论文。

From November 4 to 5, 2023, the Seminar on the Frontiers of Chemical Defense Technology and the 2023 annual work meeting of the editorial board of “Chemical Defense Studies” was held in Chongqing, and Assoc. Prof. Liu Taihong was invited to present a report titled “Design of film-based fluorescence sensor and application of toxicant detection”.

The paper “Research progress of film-based fluorescence sensor for nerve agent detection” first-authored by Zhao Jiayin, a master's student of the Photonic Nose and Molecular Materials Group, was awarded the annual ex-cellent paper of “Chemical Defense Studies”.

房喻院士出席国家重点研发计划“纳米前沿”重点专项项目启动会暨实施方案论证会

Fang Yu attends kickoff meeting for Nano Frontier special project of National Key R&D Program

2023 年 11 月 10 日，国家重点研发计划“纳米前沿”重点专项“超高灵敏检测痕量危险有害化学物质的纳米材料与技术”项目启动会暨实施方案论证会在乌鲁木齐召开，房喻院士、丁立平教授、彭浩南教授、刘太宏副教授及陕西师范大学科技处副处长屈新运等出席了会议。

丁立平教授作为课题负责人分别对课题的实施方案、最新进展以及存在问题进行了介绍。项目咨询专家组就项目研究内容、组织实施计划、考核指标等方面进行了讨论，并提出建设性意见。房喻院士作为项目团队成员对专家组的建议和意见表示感谢，表示受到很大启发，并希望项目各参与单位能够认真思考如何攻关，协同合力，共同做出有显示度的工作。

此重点专项由中国科学院新疆理化技术研究所牵头，联合陕西师范大学、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、深圳砺剑防卫技术有限公司等单位共同承担。

项目咨询专家组、中国科学院前沿局、新疆维吾尔自治区科技厅、自治区公安厅和项目各承担单位负责人以及项目部分科研骨干近 40 人参加了会议。

On November 10, 2023, the kickoff meeting and implementation plan discussion meeting of the Nano Frontier key special project of the National Key Research and Development Plan - “Nanomaterials and Technologies for Ultra-sensitive Detection of Trace Hazardous Chemicals” - was held in Urumqi. Prof. Fang Yu, Prof. Ding Liping, Prof. Peng Haonan, Assoc. Prof. Liu Taihong and Shaanxi Normal University Science and Technology Department vice director Qu Xinyun attended the meeting.

Ding Liping, as the leader of the project, reported the implementation plan, latest progress and existing problems of the project. The project advisory expert group discussed the research content, organization and implementation plan, assessment indicators and other aspects of the project, and put forward constructive opinions. Fang Yu, as a member of the project team, expressed his gratitude for the suggestions and opinions of the expert group, saying that he was greatly inspired, and hoped that the participating units could seriously think about how to tackle the key problems, work together and jointly do a more visible work.

The project is led by Xinjiang Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, and jointly undertaken by Shaanxi Normal University, CAS Institute of Chemistry, Chemical Defense Research Institute of PLA Academy of Military Sciences, Anti-drug Information Technology Center of Ministry of Public Security, and Shenzhen SRED Security and Surveillance Technology Co., Ltd.

Nearly 40 people from the project advisory expert group, CAS Frontier Bureau, Department of Science and Technology and Public Security Department of Xinjiang Uygur Autonomous Region, heads of project undertaking units and key researchers of the project attended the meeting.

团队老师参加全国超快化学青年研讨会

Fang Group participate in National Youth Symposium on Ultrafast Chemistry

2023 年 11 月 10 至 12 日，由国家自然科学基金委化学部科技活动专项资助、北京邮电大学和北京师范大学联合承办的“超快化学面临的挑战和新机遇论坛暨全国超快化学青年研讨会”在北京举行，房喻院士应邀作为嘉宾出席了本次会议，团队教师刘静教授、边红涛教授、马佳妮教授参加了会议。

From November 10 to 12, 2023, Prof. Fang Yu was invited as an honored guest to attend the “Forum on Challenges and Opportunities in Ultrafast Chemistry” and the “National Youth Symposium on Ultrafast Chemistry” in Beijing, which was sponsored by the Science and Technology Activities Special Program of the Chemistry Department of the National Natural Science Foundation of China and co-organized by Beijing University of Posts and Telecommunications and Beijing Normal University. Photonic Nose and Molecular Materials Group teachers Prof. Liu Jing, Prof. Bian Hongtao and Prof. Ma Jiani attended the meeting.

团队博士生丁南南参加第三届“唐敖庆”博士生学术论坛并作报告

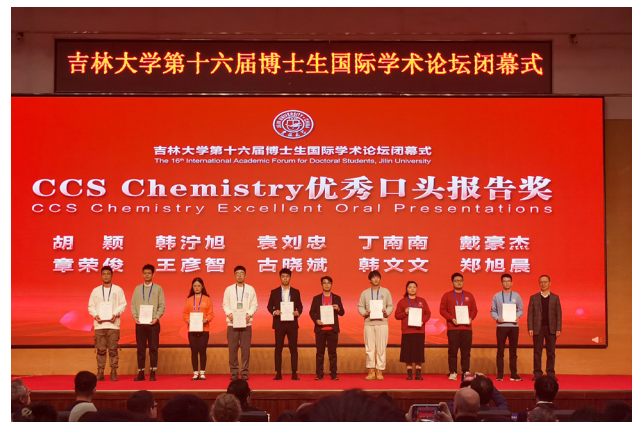
PhD student Ding Nannan presents at Third “Tang Aoqing” Doctoral Academic Forum

2023 年 11 月 16 至 17 日，第三届“唐敖庆”博士生学术论坛暨吉林大学第十六届博士生国际学术论坛分论坛于在吉林大学中心校区举办，团队博士研究生丁南南受邀参加 CCS Chemistry 论坛，作题为“邻碳硼烷 – 苝单酰亚胺多重发光体系的光物理性质及应用研究”的口头报告，并获 CCS Chemistry 优秀口头报告奖。

本届论坛以“交流合作赋能化学学科高层次人才培养”为主题，设置 CCS Chemistry、材料化学、能源化学、合成与催化、化学测量学与化学生物学以及未来科学交叉研究六个分会场。

From November 16 to 17, 2023, the third “Tang Aoqing” Doctoral Academic Forum and the sub-forum of the 16th Jilin University Doctoral International Academic Forum were held in the central campus of Jilin University. Ding Nannan, a doctoral student of the Photonic Nose and Molecular Materials Group, presented an oral report titled “*o*-Carborane-Perylene Monoimide-based Multiple Luminescence: Photophysical Behaviors and Applications” at the CCS Chemistry Forum and won the CCS Chemistry Excellent Oral Presentation Award.

Themed “Exchange and Cooperation to Empower Cultivation of High-level Talents in Chemistry”, the forum set up six sub-sessions of CCS Chemistry, Materials Chemistry, Energy Chemistry, Synthesis and Catalysis, Chemometrics and Chemicobiology, and Cross-research of Future Science.



房喻院士出席西北大学化学学科创建 100 周年庆典大会并致辞

Fang Yu speaks at 100th anniversary celebration of Chemistry discipline of Northwest University

2023 年 11 月 19 日上午，房喻院士在西北大学长安校区出席西北大学化学学科创建 100 周年庆典大会。在致辞中，房喻院士表示，西北大学化学学科为陕西的化学学科发展、为陕西的地方发展、为学校发展作出了卓越贡献，希望今后西北大学给予化学等基础学科更多的支持，推动化学学科取得更好、更丰硕的发展成果。

On November 19, 2023, Prof. Fang Yu attended the 100th anniversary celebration of the establishment of the Chemistry discipline of Northwest University. In his speech, Fang Yu said that the chemistry discipline of Northwest University has made outstanding contributions to the development of the chemistry discipline of Shaanxi Province, the local development of Shaanxi Province and the development of the university, and he hoped that Northwestern University would give more support to chemistry and other basic disciplines in the future, and promote chemistry to achieve better and more fruitful development results.

房喻院士、刘太宏副教授参加中国感光学会光学传感与诊疗专委会成立大会

Fang Yu and Liu Taihong attend inaugural meeting of CSIST Committee on Optical Sensing and Diagnosis and Treatment

2023 年 11 月 17 日至 20 日，中国感光学会光学传感与诊疗专委会成立大会暨第一届光学传感与诊疗学术研讨会在北京举行，房喻院士应邀作题为“薄膜荧光传感器——从基础研究到产业应用”的大会邀请报告，刘太宏副教授作题为“近红外双光子荧光探针创制及应用探索”的分会邀请报告。

本次会议以“‘健康中国’国家战略背景下光学成像助力生命健康”为主题，由中国感光学会光学传感与诊疗专业委员会主办，北京理工大学承办。

From November 17 to 20, 2023, Prof. Fang Yu and Assoc. Prof. Liu Taihong attended the inaugural meeting of the Special Committee on Optical Sensing and Diagnosis and Treatment of the Chinese Society for Imaging Science and Technology (CSIST) and the first Seminar on Optical Sensing and Diagnosis and Treatment held in Beijing.

Fang Yu presented an invited report titled “Film-based Fluorescence Sensor - From Basic Research to Industrial Application” to the conference and Liu Taihong presented an

invited report titled “Creation and application of near infrared two-photon excited fluorescence probes” at a parallel session.

Themed “Optical imaging enhances health in the context of ‘Healthy China’ national strategy”, the event was sponsored by CSIST Optical Sensing and Diagnosis and Treatment Committee and organized by Beijing Institute of Technology.

西安墙体材料研究设计院唐玉娇总经理一行来访

Xi'an Research and Design Institute of Wall and Roof Materials visitors received

2023 年 11 月 3 日，西安墙体材料研究设计院有限公司党委副书记、总经理唐玉娇、技术中心主任陈媛媛和工程中心副主任童蕊花到访、参观了新概念传感器与分子材料研究院，并与房喻院士进行了会谈交流。

On November 3, 2023, Prof. Fang Yu met and talked with visitors from Xi'an Research and Design Institute of Wall and Roof Materials Co., Ltd.--- deputy Party Committee secretary and general manager Tang Yujiao, Technology Center director Chen Yuanyuan, and Engineering Center deputy director Tong Ruihua, and showed them in a tour of the Institute of New Concept Sensors and Molecular Materials.

陕西斯瑞新材料王文斌董事长一行来访

Shaanxi Sirui New Materials visitors received

2023 年 11 月 5 日，陕西斯瑞新材料股份有限公司董事长王文斌、董事武旭红到访、参观了新概念传感器与分子材料研究院，并与房喻院士进行了会谈交流。

On November 5, 2023, Prof. Fang Yu met and talked with Shaanxi Sirui New Materials Co., Ltd. chairman Wang Wenbin and Sirui board director Wu Xuhong, and showed them in a tour of the Institute of New Concept Sensors and Molecular Materials.

深圳校友分会李秉谦会长来访

SNNU Shenzhen Alumni Branch director Li Bingqian received

2023 年 11 月 22 日，陕西师范大学深圳校友分会李秉谦会长在校友总会秘书处刘洪超秘书长的陪同下，到访、参观了新概念传感器与分子材料研究院，并与房喻院士进行了会谈交流。

李秉谦系陕西师范大学 1986 级文学系校友，现为深圳市新世纪浪潮文化发展有限公司董事长。

On November 22, 2023, Prof. Fang Yu met and talked with Li Bingqian, director of Shenzhen Alumni Branch of Shaanxi Normal University, and showed him in a tour of the Institute of New Concept Sensors and Molecular Materials.

Li Bingqian is a Class of 1990 alumnus of SNNU's Literature Department, and is currently the chairman of Shenzhen New Century Wave Cultural Development Co., Ltd. Liu Hongchao, secretary-general of the Secretariat of SNNU Alumni Association accompanied Li during the visit.

教育部网站刊载房喻院士《强化实验教学 培育实践学习生态》一文

Fang Yu's article on Experimental Teaching published on Ministry of Education website

2023 年 11 月 24 日，教育部网站刊载了房喻院士撰写的《强化实验教学 培育实践学习生态》一文，作为《中小学实验教学基本目录（2023 年版）》解读文章之一。

（网址为 http://www.moe.gov.cn/jyb_xwfb/moe_2082/2023/2023_zl24/202311/t20231123_1091842.html，全文已刊载于本简报 2023 年第 8 期）

On November 24, 2023, the website of the Ministry of Education published the article "Strengthening Experimental Teaching and Cultivating an Experiential Learning Ecology" written by Prof. Fang Yu, as one of the interpretation articles of the Basic Catalog for Experimental Teaching in Primary and Secondary Schools (2023 Edition).

(Link: http://www.moe.gov.cn/jyb_xwfb/moe_2082/2023/2023_zl24/202311/t20231123_1091842.html, the full text has been published in issue 8, 2023 of this Newsletter)

Contents lists available at ScienceDirect

Sensors and Actuators: B. Chemical

journal homepage: www.elsevier.com/locate/snb

Diminishable solvatochromic emission of a phenothiazine-derived triad for high-performance detection of ClO_2

Xinyu Gou, Zhaolong Wang, Ke Liu, Qiyuan Shi, Xue Gu, Taihong Liu*, Yu Fang*

吩噻嗪三分体的溶剂变色性质及高性能二氧化氯检测

二氧化氯（ClO_2）作为一种绿色消毒剂，由于其优异的性能、副产物为无害的氯离子而不是典型消毒剂（NaClO）形成的致癌三氯甲烷而被广泛使用。通常，用于水处理的 ClO_2 浓度水平在 0.1–5 mg/L 之间，因此，开发一种简单、灵敏、高选择性的液相 ClO_2 检测方法非常重要。在过去的几十年里，气－质联用法、紫外－可见分光光度法、电化学法、半导体传感器和共振散射技术已经被开发出来。这些方法能够满足对 ClO_2 检测浓度、精度等方面的需求，但是操作复杂、耗时长、功耗高，而荧光技术具有灵敏度高、响应快、可设计性强等优点，因此我们期望开发一种新的荧光分子，实现对 ClO_2 原位、在线、比率型检测。

吩噻嗪（PTZ）具有很强的给电子能力，常被用作 D–A 体系中的荧光活性发色团，PTZ 的硫原子（+2）可以被氧化成亚砜（+4）或砜（+6），伴随着 d–pπ 键引入，减少了电子在整个共轭骨架的离域，使 PTZ 从强给体变为弱受体从而带来光电性质的剧烈改变。基于此，本文设计了具有分子内电荷转移（ICT）性质的 PTZ 三分体（HDPP–PTZ），该化合物在溶液中的双发射性质归结于 LE 和 ICT 发射。将 PTZ 单元中的硫原子氧化为亚砜后，HDPP–PTZ 荧光团极性敏感的 ICT 发射完全消失。受此现象启发，建立了一种快速、灵敏的 ClO_2 比率型荧光检测方法。在 THF/ 水体系中 ClO_2 的检出限（DL）为 0.052 mg/L，满足 WHO 规定的检出限标准（1.0 mg/L），反应时间小于 20 s 且没有明显的干扰。利用显著的荧光变化，进一步将真实样品可视化并通过 RGB 分析进行评估且制备了试纸条进一步用于原位和实时检测气相和液相 ClO_2。本工作为研究 PTZ 衍生物氧化态性质提供了重要的认识，并为指导开发用于特定分析物的荧光探针提供了思路。

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Chlorine dioxide (ClO_2), as a green disinfectant, is widely used due to outstanding performance and the resultant of chloride ions, not the carcinogenic trihalomethanes formed by the typical disinfectants (NaClO). Typically, ClO_2 is used at a concentration level between 0.1 and 5 mg/L for water treatment, therefore, development of simple, sensitive, and selective identification method of ClO_2 used in solution phase is important.

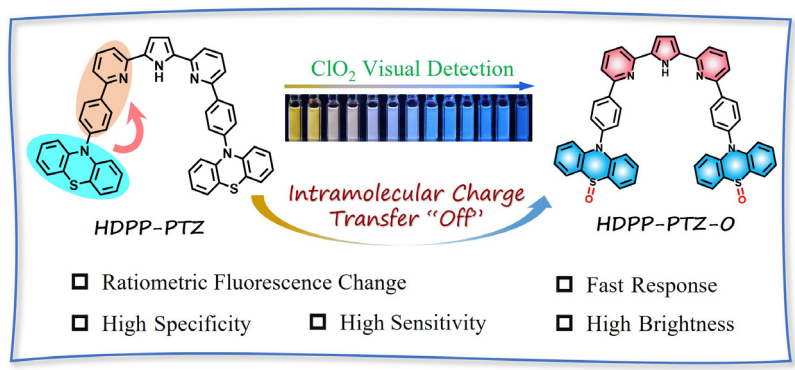

图 1. HDPP–PTZ 在 THF/ 水体系中随着不同浓度 ClO_2 加入的照片变化及机理。
Figure 1. Photographs of HDPP-PTZ toward various concentrations of ClO_2 in THF/water (1/1, v/v) and the possible sensing mechanism.

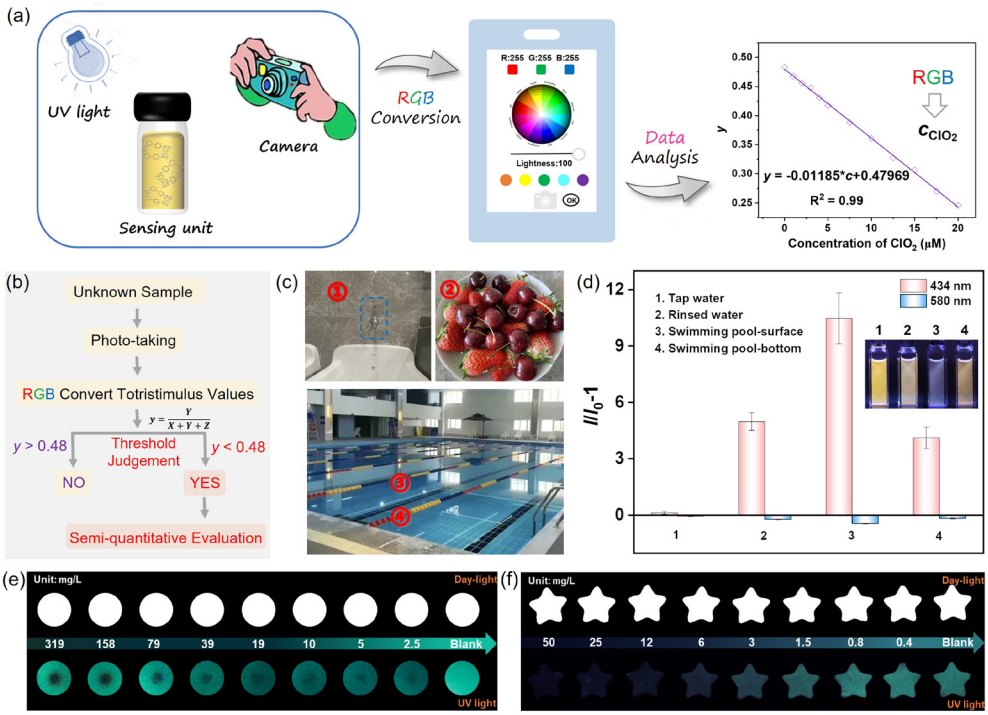

图 2.（a）根据校准方程进行 RGB 分析以评估 ClO_2 含量的示意图。（b）实际应用时样品评估过程的示意图。（c）模拟场景中 ClO_2 的检测图片。（d）荧光探针对于不同样品在 434 nm 和 580 nm 处的传感性能，插图为荧光探针 HDPP−PTZ 与实际样品反应后的图片。（e,f）HDPP−PTZ 试纸条在日光（上）和紫外灯（下）下检测水相和气相 ClO_2 的照片。

Figure 3. (a) Schematic illustration of RGB analysis to evaluate the content of ClO_2 using the established calibration equation. (b) Schematic illustration of the processes of sample evaluation in field applications. (c) Pictures of the ClO_2 detection in the simulation scenes. (d) Representative sensing performance of the fluorescence probe at 434 and 580 nm, each error bar was calculated from three parallel tests. Inset showed the pictures of the fluorescence probe HDPP-PTZ reacted with real samples. Photographs of HDPP-PTZ coated strips toward detecting aqueous and gaseous ClO_2 (e, f) under day-light (upper) and UV light (lower)..

Over the past few decades, GC-MS, UV-vis spectrophotometry, electrochemical methods, semiconductor sensors, and resonance scattering techniques have been developed. The approaches, however, may suffer from some shortcomings, such as complicated operation, time-consuming, and high-power consumption, etc. In contrast, fluorescence techniques feature the merits of high sensitivity, fast response, and great designability. Therefore, we hope to develop new agent for high-performance fluorescence detection of ClO_2 in situ and real-time.

Phenothiazine (PTZ) as a strong electron-donating is often used as an active fluorescence component in push-pull chromophores. The sulfur atom (+2) of PTZ can be oxidized to sulfoxide (+4) or sulfoxide (+6), which not only introduces d-pπ bonds to diminish the electron delocalization throughout the conjugation skeleton, but also results in drastic change in the photo-electronic properties of PTZ from a strong donor to a weak acceptor. Herein, we designed the PTZ triad (HDPP-PTZ) with the properties of intramolecular charge transfer (ICT). Dual emission of the compound in solution assigned as LE and ICT emission. The polarity sensitive ICT emission of HDPP-PTZ fluorophore totally disappeared upon oxidizing the sulfur atom in PTZ unit into sulfoxide. Inspired by the discovery, a highly selective, sensitive and rapid detection method for a widely used disinfectant chlorine dioxide (ClO_2) is established. The detection limit (DL) of ClO_2 in THF/water is < 0.052 mg/L, satisfying the setting limit by WHO (1.0 mg/L), the response time is less than 20 s and no significant interference. Taking advantage of the remarkable fluorescence changes, real samples are visualized and evaluated by RGB analysis. Testing strips are further fabricated for in-situ and at real-time detection of ClO_2 both in aqueous solution and gas states. Present study provides significant understanding of the oxidation states of the PTZ derivatives and guides development of fluorescent probes for specific analyte.

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Fast and Selective Luminescent Sensing by Langmuir-Schaeffer Films Based on Controlled Assembly of Perylene Bisimide Modified with A Cyclometalated Au(III) Complex

Jing Zhang, Zhiwei Shi, Ke Liu, Qiyuan Shi, Liang Yi, Junjie Wang, Lingya Peng, Taihong Liu, Miao Ma, Yu Fang

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荧光薄膜的可控制备及对新精神活性物质的高性能检测

薄膜荧光传感器（FFSs）以其优越的传感性能、灵活的可设计性，被IUPAC评为2022年化学领域十大新兴技术之一。FFSs的性能主要依赖于新型传感单元的设计和高效活性层的构建，传感单元决定了响应性，活性层则主要决定信噪比、可逆性等传感性能。然而在制备的薄膜中，传感单元的堆积方式即活性层的结构，对传感性能的影响尚未深入探究。

作者将金配合物通过炔键连接在苝二酰亚胺的邻位，设计合成了新型分子ortho-PBI-Au。XRD分析显示，分子呈平面构型，在Au–H键和C–H···π的弱相互作用下，两个单体以“边对面”方式排列形成二聚体，在C–H···π相互作用下进一步组装成方形四聚体，并沿着c轴方向形成双螺旋结构。这种独特的T型堆积避免了聚集诱导猝灭的发生，同时，这一给受体对形成分子内电荷转移态，增加了微环境敏感性。将单体分散在水面上时，烷基链朝向空气一侧，苝二酰亚胺芯结构靠近界面，在恒速压缩下得到π–A曲线。当表面压力达到5.0 mN/m时，单体以近乎平展的方式排列在水面上，分子与法线间的夹角约为87.13°，薄膜厚度与单体高度基本一致；随着压力的增大分子逐渐直立，最终形成稳定的固态膜，单分子极限面积与计算值吻合。吸收光谱和荧光光谱进一步证明了压缩过程中分子堆积结构的变化。采集不同堆积结构的薄膜对苯乙

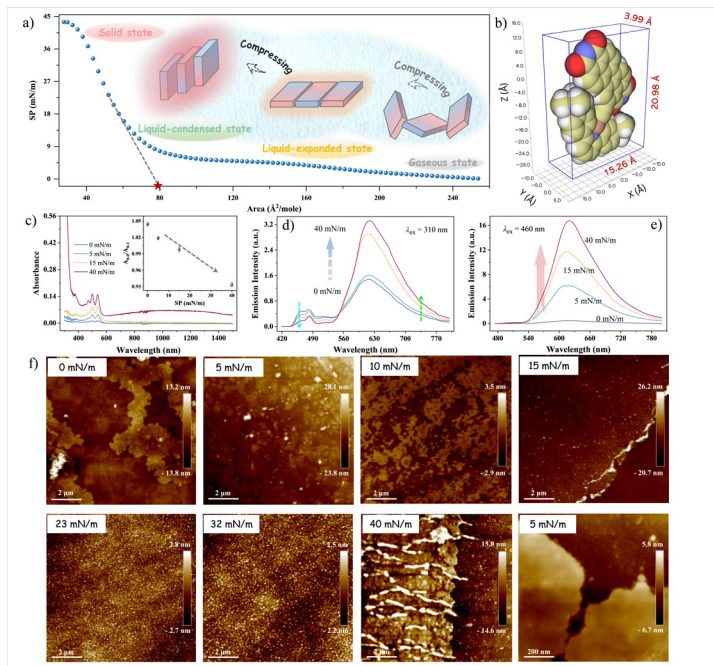

图1. LS薄膜的π–A曲线及光谱、形貌表征。

Figure 1. The π-A isotherm, spectral and morphological characterization of LS films.

胺进行检测，使用 GRA 法对影响因素进行分析。结果显示，薄膜的厚度和孔隙率是最重要的影响因素，这也证实了为什么厚度适宜、堆积松散、分子平展排列的 5 mN/m 薄膜具有最佳的响应性能。该薄膜对 PEA 的检出限低至 4 ppb，响应时间小于 1 秒，恢复时间少于 5 秒，大多数日用品和毒品对检测没有明显干扰。

这项研究揭示了设计具有精确可控堆积结构的新型传感单元是提升传感性能的核心策略，为未来 FFSs 的设计方向提供了重要指引，并为新精神活性物质的便携式、快速筛查奠定了基础。

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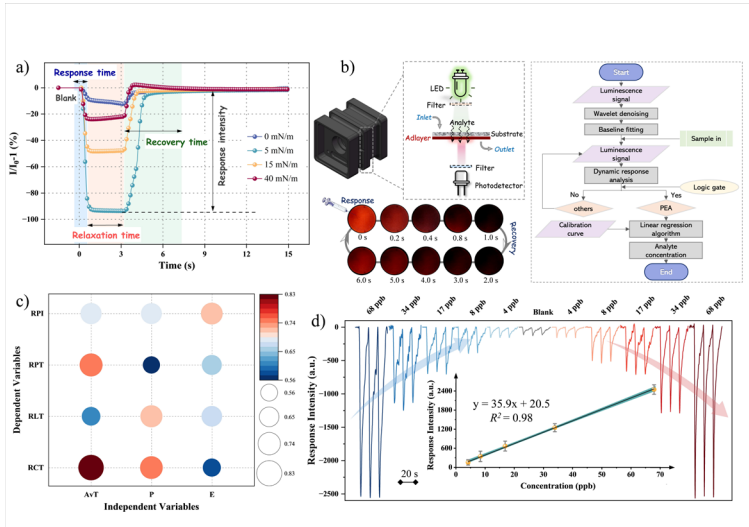

图 2. 透过式叠层传感器对苯乙胺的响应性能。
Figure 2. Sensing performance of penetrable layered sensor to PEA.

Film-based fluorescent sensors (FFSs), owing to their superior sensing performance, flexible design, and easy integration, have been recognized as one of the top 10 emerging technologies in chemistry in 2022 by the IUPAC. The performance of FFSs relies on designing innovative sensing luminophores and fabricating efficient adlayers. The sensing luminophores determine the responsiveness, while the adlayers mainly determine the signal-to-noise ratio, reversibility, and other sensing performances. However, in the film, the impact of the packing models of luminophores, i.e., the structure of adlayers, on the sensing performance has not yet been thoroughly explored.

The ortho-PBI-Au was synthesized by introducing a cyclometalated Au(III) complex into the ortho-site of PBI linked by a flexible alkyne bond. XRD analysis illustrated that the monomer has a planar configuration. The crystal contained a dimer-like structure in which the monomers were packed in an “edge-to-face” manner. The packing structure comprised two Au-H bonds and C-H···π weak interaction. These dimers further assembled into a square tetramer via C-H···π interactions. The isotropic tetramers formed an infinite helical chain along the c-axis. The unique T-type aggregation prevented the aggregation-caused quenching phenomenon. Additionally, this donor-acceptor facilitated intramolecular charge transfer, enhancing the sensitivity to the microenvironment. At the air-water interface, the hydrophobic alkyl chains invariably oriented towards the air, while the PBI-Au core might be close to the water surface, then π-A isotherm was obtained under constant-rate compression. When the surface pressure reached ~5.0 mN/m, the luminophores were gradually packed in a “one-by-one” tiled model. The calculated tilting angle via polarized UV-vis absorption spectra, between the luminophores and the normal has been determined to be about 87.13°, providing support for this. As the pressure increases, the luminophores gradually stood upright, eventually forming a stable solid film, with the monolayer limiting area matching the calculated value. Absorption and luminescence spectra further confirmed the changes in the molecular packing models during the compression process. Films with different packing models were collected to detect phenethylamine, and the Grey Relational Analysis method was used to analyze the influencing factors. The results showed that the thickness and porosity of the film were the most important factors, which also confirmed why the 5 mN/m film with appropriate thickness and tiled arrangement has the best response performance. The detection limit, response time, and recovery time were < 4 ppb, < 1 s, and < 5 s, respectively, surpassing the performance of the PEA sensors known thus far, and most daily necessities and illicit drugs causing no significant.

This research reveals that designing novel sensing luminophores with precisely controllable packing models is a core strategy to enhance sensing performance. It provides important guidance for the future design direction of FFSs, and lays the foundation for the portable and rapid screening of new psychoactive substances.

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Acceleration Mechanism of Triethanolamine in Electroless Bath for Pure Cobalt Deposition

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三乙醇胺在纯钴化学镀液中的加速机理

在芯片封装技术中，窄制程芯片间的互联可采用导电性更强的金属钴材料。采用化学镀钴往往采用次磷酸钠、硼氢化钠、二甲基氨硼烷等为还原剂，导致镀膜中存在硼、磷杂质，严重影响其电导率。为此，我们采用了水合肼作为还原剂，避免了杂质的引入。然而，水合肼的还原能力有限，其化学镀沉积速率较低，无法满足规模化制备要求。为此，本研究在化学钴镀液中加入三乙醇胺（TEA）作为加速剂，可以将化学镀钴的沉积速率提高五倍左右（从 1.0 μm·h^{-1} 到 5.0 μm·h^{-1}），并可拓展应用于 10 nm 以下的芯片钴互连线微孔填充技术。

研究表明，TEA 的加速机理可以解释为：强配位的 TEA 加入后取代了 $[Co(C_6H_5O_7)(H_2O)]_2^{2-}$ 络合物中的 H_2O 的位点，形成了 $[Co(C_6H_5O_7)(TEA)_2]_2^{2-}$ 络合物（图 1）。通过 TEA 本身的三条连式结构的强空间位阻效应，可有效避免钴中心离子被氧化，由此显著增强了钴离子的还原效率。

同时，我们还对镀液体系进行了系统优化，进一步调整了镀液中钴离子、络合物的浓度、镀液的 pH 参数、退火温度等，最终获得了质密、平整、结晶度高钴镀膜，其电阻率仅为 12.1 μΩ·cm。

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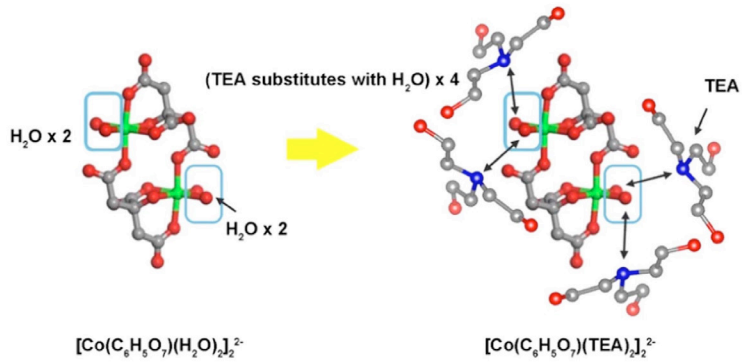

In chip packaging technology, the interconnection between narrow process chips can use cobalt metal materials with stronger conductivity. Conventionally, sodium hypophosphate, sodium borohydride, dimethylaminoborane, etc. are widely used as the reductive reagents for electroless cobalt plating while the impurities such as boron or phosphorus are inevitably introduced during codeposition process, which leads to an increase in the resistivity of the cobalt metal film. Alternatively, hydrazine is found to be a useful reductant to get rid of the impurity contamination. However, the deposition rate is relatively low for the weak reduction ability of hydrazine, which cannot meet the requirements of efficient scale-up process. In this study, adding triethanolamine (TEA) as an accelerator to the electroless cobalt plating can significantly increase the electroless deposition rate of cobalt plating by five times (from 1.0 μm·h^{-1} to 5.0 μm·h^{-1}), and can be extended to apply to through-silicon vias (TSVs) below 10 nm.

It is also found that the acceleration mechanism of TEA can be explained by the addition of strongly coordinated TEA, which replaces H_2O on $[Co(C_6H_5O_7)(H_2O)]_2^{2-}$ complex, forming $[Co(C_6H_5O_7)(TEA)_2]_2^{2-}$ due to TEA's stronger coordination capability (Fig.1). Since TEA molecule has three long chains, the resultant strong steric-hindrance protects the central Co^{2+} from passivation so as to accelerate the reduction reaction of Co^{2+} citrate complex.

Additionally, we also systematically optimized the plating bath, further adjusting the concentration of cobalt ions and complexes in the plating solution, pH value, annealing temperature, etc., and obtained a dense, flat, and highly crystallized cobalt film with a resistivity of only 12.1 μΩ· cm.

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国际商学院毕超副教授应邀作报告

International Business School's Bi Chao invited to give a presentation

2023 年 11 月 6 日下午，光子鼻与分子材料团队邀请陕西师范大学国际商学院毕超副教授在新概念传感器与分子材料研究院报告厅作了题为“技术成熟度评价理论、方法与应用”的报告。报告由研究院办公室主任杨小刚老师主持，研究院教师和全体专职科研助理参加了报告会。

毕超老师介绍了技术成熟度评价理论的国内外发展及应用情况，围绕技术成熟度等级和技术创新成熟度等级的级别划分、通用定义、举证要素及其量表分类架构进一步展开，并讲解了技术成熟度评价的四类方法以及评价实施步骤与应用。

房喻院士在总结讲话中指出毕超老师的报告能帮助研究院科研工作者用技术成熟度理论促进工作，并要求科研助理借此次交流学习对所负责项目进行梳理及汇总。

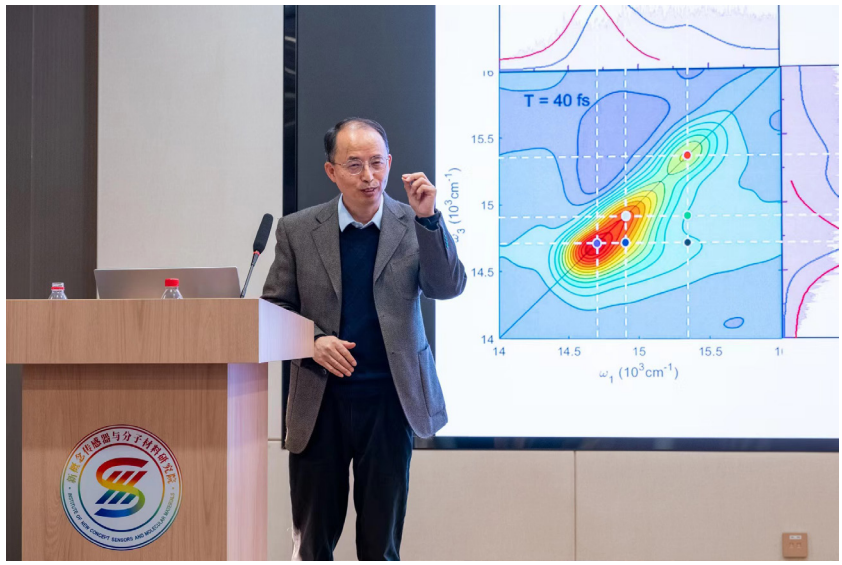
On November 6, 2023, the Photonic Nose and Molecular Materials Group invited Assoc. Prof. Bi Chao from the International Business School of Shaanxi Normal University to give a report titled “Theory, Method and Application of Technology Maturity Evaluation” in the lecture hall of the Institute of New Concept Sensors and Molecular Materials. The report was moderated by INCSMM Administrative Office director Mr. Yang Xiaogang, and teachers and full-time research assistants of the institute attended the report.

Bi Chao introduced the development and application of the technology maturity evaluation theory at home and abroad, further expanded it around the classification, general definition, evidential elements and scale classification structure of technology maturity level and technology innovation maturity level, and explained four types of technology maturity evaluation methods as well as evaluation implementation steps and application.

Prof. Fang Yu concluded that Bi Chao's report can help researchers in the institute to promote their work with the technology maturity theory, and asked research assistants to use what they have leanred from this report to sort out and summarize the projects they are responsible for.

中国科学院物理所翁羽翔研究员应邀作学术报告

Weng Yuxiang of CAS Institute of Physics invited to give a report



2023 年 11 月 18 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行学术交流会，中国科学院物理研究所翁羽翔研究员作了题为“超快时间分辨光谱方法发展及其应用研究”的学术报告。研究院部分教师和研究生参加了此次交流会，会议由边红涛教授主持。

翁羽翔老师介绍了课题组近些年在设备建设、研究方法、研究体系等方面的进展。目前已建立了单光子荧光非共线光参量放大飞秒时间分辨荧光光谱测量的新方法，发展了飞秒时间分辨二维电子光谱仪在相干态能量转移方面的测量，拓展了瞬态红外光谱在带隙中间能级的激发扫描方面的应用，研究了光合细菌捕光天线膜蛋白中的生物量子效应，研发脉冲升温－纳秒时间分辨瞬态中红外光谱技术。

报告结束后，翁羽翔老师与在场师生就相关问题进行了讨论，并与团队老师合影留念。

On November 18, 2023, the Photonic Nose and Molecular Materials Group held an academic seminar in the lecture hall of the Institute of New Concept Sensors and Molecular Materials, and Weng Yuxiang, a researcher from the Institute of Physics of the Chinese Academy of Sciences, presented a report titled “Development and Application of Ultrafast Time-resolved Spectroscopy”. Teachers and graduate students of the institute attended the seminar, which was moderated by Prof. Bian Hongtao.

Weng Yuxiang introduced the progress of his research group in equipment development, research methods and research systems in recent years. They have established a new method for measuring femtosecond time-resolved fluorescence spectra with single-photon fluorescence non-collinear optical parametric amplification, developed the measurement of coherent state energy transfer by femtosecond time-resolved two-dimensional electron spectrometer, expanded the application of transient infrared spectroscopy in the excitation scanning of intermediate energy levels in the band gap, studied the biological quantum effects in the membrane proteins of photosynthetic bacteria light-trapping antennas, and has been developing pulse temperature-nanosecond time-resolved transient mid-infrared spectroscopy.

After the report, Weng Yuxiang discussed relevant issues with the teachers and students present, and took a photo with the teachers.

刘新风研究员、陈缙泉教授、吴凯丰研究员应邀作学术报告

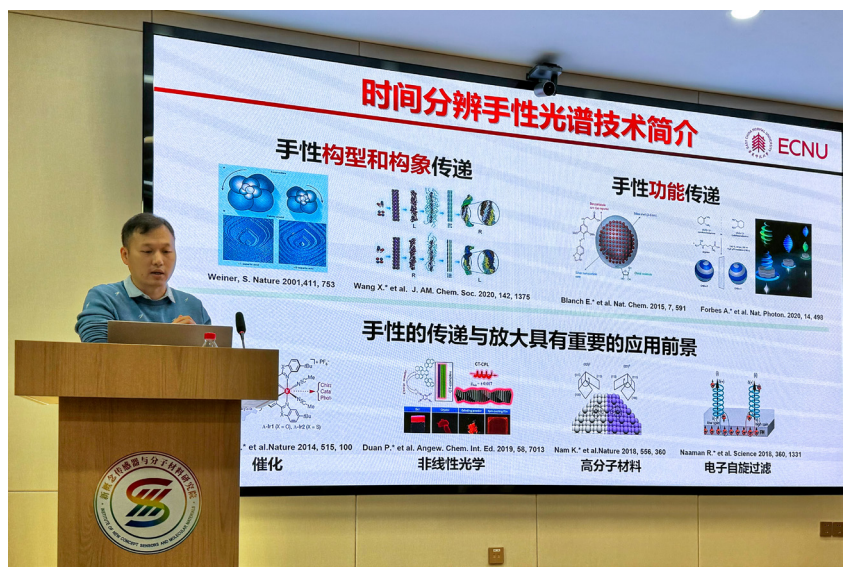
Liu Xinfeng, Chen Jinquan and Wu Kaifeng invited to give reports

2023 年 11 月 19 日上午，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行学术交流会，研究院部分教师和研究生参加了此次交流会，会议由边红涛教授主持。

中国科学院大学国家纳米科学中心刘新风研究员作了题为“微尺度超快光谱学及其应用”的学术报告。超快光谱是表征载流子的重要技术手段，在材料、信息、物理、化学等领域有着广泛的应用。刘新风研究员介绍了自主开发的具有空间、时间和动量分辨能力的微尺度稳态 / 瞬态 / 角分辨光谱测量系统，并将其应用到半导体材料系统中测试其载流子特性、电子声子耦合以及纳米级半导体材料的边缘诱导的光谱特性，为深入了解其光电特性和相关器件奠定基础。

华东师范大学陈缙泉教授作了题为“超快手性光谱技术在化学和生物体系中的应用”的报告。陈缙泉教授介绍了课题组自主研发了飞秒时间分辨圆二色吸收光谱（fs–TRCD）和飞秒–纳秒圆偏振发射光谱（TR–CPL）技术，实现了染料分子、轮烷分子及其衍生物体系的激发态手性产生和传递过程的精密测量。

中国科学院大连化学物理研究所吴凯丰研究员作了题为“量子点超快光物理与光化学”的学术交流报告。吴凯丰课题组在胶体量子点中观测到系综层面的激子自旋量子拍频，展示了温度可调的激子精细能级裂分及相干动力学。吴凯丰研究员通过超快界面电子转移，制备了室温长寿命的空穴自旋态，基于光学斯塔克效应率先实现了量子点自旋的室温相干操控，直接观测到量子点 – 有机分子杂化自由基对的自旋量子相干特性，实现了三线态光化学反应的高效磁场调控。



报告结束后，刘新风老师、陈缙泉老师、吴凯丰老师与在场师生就相关问题进行了讨论，并与团队老师合影留念。

On November 19, 2023, the Photonic Nose and Molecular Materials Group held an academic seminar in the lecture hall of the Institute of New Concept Sensors and Molecular Materials. Teachers and graduate students of the Institute attended the seminar, which was moderated by Prof. Bian Hongtao.

Liu Xinfeng, a researcher at the National Nanoscience Center of the University of Chinese Academy of Sciences, gave a report titled “Micro-scale Ultrafast Spectroscopy and Its

Applications". Ultrafast spectroscopy is an important technique to characterize charge carriers, which has been widely used in materials, information, physics, chemistry and other fields. He introduced a self-developed micro-scale steady-state/transient/angular resolution spectral measurement system with spatial, temporal and momentum resolution, which was applied to semiconductor material systems to test its carrier characteristics, electron phonon coupling and edge-induced spectral characteristics of nanoscale semiconductor materials, laying a foundation for in-depth understanding of its photoelectric characteristics and related devices.

Prof. Chen Jinquan from East China Normal University gave a report titled "Application of Ultrafast Chiral Spectroscopy in Chemical and Biological Systems". He introduced the femtosecond time-resolved circular dichroic absorption spectroscopy (fs-TRCD) and femtosecond-nanosecond circular polarization emission spectroscopy (TR-CPL) technologies independently developed by his research group, which realized the precise measurement of the excited state chirality generation and transfer process of dye molecules, rotaxane molecules and their derivative systems.

Wu Kaifeng, a researcher from the Dalian Institute of Chemical Physics, Chinese Academy of Sciences, gave a report titled "Quantum Dot Ultrafast Photophysics and Photochemistry". Wu's research group observed the exciton spin quantum beat frequency at the ensemble level in colloidal quantum dots, demonstrating the temperature-adjustable exciton fine energy level splitting and coherent dynamics. By means of ultrafine interfacial electron transfer, they prepared long-lived hole spin states at room temperature. Based on the optical Stark effect, he was the first to realize the coherent manipulation of the spin of quantum dots at room temperature, directly observed the spin quantum coherence characteristics of the hybrid free radical pairs of quantum dots and organic molecules, and realized the efficient magnetic field regulation of the three-wire photochemical reaction.

After the reports, Liu Xinfeng, Chen Jinquan and Wu Kaifeng discussed relevant issues with the teachers and students present, and took a photo with the teachers.

陕师大杨凌实验中学师生来院进行科普参观学习

Yangling Experimental Middle School visitors received for science popularization tour

2023 年 11 月 27 日上午，陕西师范大学杨凌实验中学老师带领高二年级 30 余名同学前来新概念传感器与分子材料研究院进行科普参观学习。刘太宏副教授带领来访师生参观了研究院成果展厅，介绍了研究院基本情况和发展理念，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。随后，刘凯强教授为师生们作了题为“神奇的凝胶材料”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 November 27, 2023, teachers and more than 30 sophomore students from Shaanxi Normal UniversityYangling Experimental Middle School visited the Institute of New Concept Sensors and Molecular Materials in a science popularization tour. Assoc. Prof. Liu Taihong showed the visitors the exhibition hall of the Institute, introduced the basic situation and development concept, and explained the products such as explosive and drug detectors developed from the research findings of Prof. Fang Yu’s group. Subsequently, Prof. Liu Kaiqiang gave a report titled “Magical Gel Materials” for the students, introducing the development status of gels at home and abroad and the research achievements of Prof. FangYu’s group in small molecule gel propellants, high energy density fuels, gel emulsions and high-strength and low-density materials.

扬州大学韩杰教授应邀作学术报告

Han Jie of Yangzhou University invited to give a report

2023 年 11 月 29 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行学术报告会，扬州大学韩杰教授作了题为“超分子自组装手性材料与不对称催化”的学术报告。研究院部分教师和研究生参加了此次交流会，会议由丁立平教授主持。

韩杰教授首先介绍了手性催化在过去几十年的相关研究进展，然后讲解了其团队围绕高品质单一镜像手性纳米催化剂的构建及在不对称催化中的应用这一课题，在超分子层面和材料层面开发的手性纳米催化剂的高效和普适的构筑策略，该策略应用于手性催化反应体系展现出较好的不对称催化性能。

报告结束后，韩杰教授与在场师生就相关问题进行了讨论，并与团队老师合影留念。

On November 29, 2023, the Photonic Nose and Molecular Materials Group held an academic seminar in the lecture hall of the Institute of New Concept Sensors and Molecular Materials, and Prof. Han Jie of Yangzhou University presented a report titled “Supramolecular self-assembly chiral materials and asymmetric catalysis”. Teachers and graduate students of the institute attended the seminar, which was moderated by Prof. Ding Liping.

Han Jie first introduced the relevant research progress of chiral catalysis in the past few decades, and then explained the efficient and universal construction strategy of chiral nanocatalites developed by his group at the supramolecular and material levels, focusing on the construction of high quality single mirror chiral nanocatalites and their application in asymmetric catalysis. It is also applied to the chiral catalytic reaction system and shows better asymmetric catalytic performance.

After the report, Han Jie discussed relevant issues with the teachers and students present, and took a photo with the teachers.

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