



江西师范大学高等研究院
Institute of Advanced Scientific Research (IASR)
Jiangxi Normal University



2021年瑶湖功能材料论坛 暨中德合作交流项目双边论坛

程 序 册

承办单位

江西师范大学高等研究院
功能有机小分子教育部重点实验室

江西·南昌

2021. 03. 26-28

温馨提示

请各位代表注意以下几点：

- 1、会议期间外出活动应提高安全意识，积极防范各类人身伤害，确保您的安全。如您希望单独活动，请提前告知并留下联系方式，以便我们及时联系到您。
- 2、会议日程、与会代表名单等详见本手册。
- 3、会议住宿酒店：南昌绿地华邑酒店（高新区紫阳大道3333号）。
- 4、会议期间，南昌气温在 14 °C-28 °C 之间，需注意昼夜温差，做好防寒保暖，代表身体如有不适症状，请立即联系工作人员（廖勋凡15070899638 蒋平18270885611）。



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一、会议主旨 (Theme of the forum)

绿色化学与功能材料是当今新能源及绿色催化领域的研究前沿和热点之一。为促进化学和材料科学与其他学科交叉融合，推动相关领域原始创新，加强国际交流与合作，共享全球新材料研究的最新成果，由江西师范大学高等研究院和功能有机小分子教育部重点实验室主办的 **2021年瑶湖功能材料论坛暨中德合作交流项目双边论坛** 将于2021年3月26-28日在江西南昌举行。

Green chemistry and functional materials are currently one of the frontiers and hotspots in the field of new energy and green catalysis. In order to promote the cross integration of chemistry and materials science with other disciplines, promote original innovation in related fields, strengthen international exchanges and cooperation, and share the latest results of global new materials research, the **2021 Yaohu Lake Functional Materials Forum/Sino-German Mobility Program Bilateral Forum** hosted by the Institute of Advanced Scientific Research (iASR) of Jiangxi Normal University/Key Laboratory of Functional Small Molecules for Ministry of Education will be held in Nanchang, China from March 26-28, 2021.

二、会议日程 (Forum schedule)

- March 26: 报到 (Check in)
- March 27: 学术报告 (Academic report)
- March 28: 企业考察交流 (Enterprise inspection and exchange)

三、会议地点 (Forum address)

江西师范大学瑶湖校区高等研究院 (方荫楼一区三楼)

Institute of Advanced Scientific Research (iASR) of Jiangxi Normal University,
(Fangyin Building, District 1, 3rd Floor)

Online Video: <https://meeting.tencent.com/s/Stm12qhc8tNv>

Meeting-ID: 158 994 709

四、会务联系人 (Contact)

- ① 廖勋凡 (Xunfan Liao) (Tel: 15070899638; Email: xfliao@jxnu.edu.cn)
- ① 蒋 平 (Ping Jiang) (Tel: 18270885611; Email: pjiang0912@163.com)

会议日程 (Schedule)

时间 (Time)	报告题目 (Title)	报告人 (Speaker)	所在单位 (Institute)	主持人 (Host)
08:30-08:35	开幕式致辞 (Opening ceremony)			
08:35-08:45	合影 (Photo session)			
08:45-09:10	有机光电功能材料的研究进展 (Research Progress in Organic Functional Materials for Optoelectronics)	张 晓 宏 教 授 (Prof. Xiaohong Zhang)	苏州大学 (Soochow University)	王 双 印 教 授 (Prof. Shuangying Wang)
09:10-09:35	难溶有机共轭半导体的溶液加工及热电性能研究 (Research on solution processing of insoluble organic conjugated semiconductors and their application in thermoelectrics)	马 於 光 教 授 (Prof. Yuguang Ma)	华南理工大学 (South China University of Technology)	
09:35-10:00	高效率、低成本非稠环电子受体光伏材料 (High efficiency low-cost non-fused ring electron acceptors)	薄 志 山 教 授 (Prof. Zhishan Bo)	北京师范大学 (Beijing Normal University)	
10:00-10:25	固态发光探针与原位成像 (Solid-state fluorochrome-based molecular probes for in situ imaging)	张 晓 兵 教 授 (Prof. Xiaobing Zhang)	湖南大学 (Hunan University)	
10:25-10:35	茶歇 (Coffee Break)			
10:35-11:00	高效被动辐射冷却聚合物薄膜材料设计 (The design of highly efficient passive radiation cooling polymer film materials)	武 利 民 教 授 (Prof. Limin Wu)	复旦大学 (Fudan University)	薄志山教授 (Prof. Zhishan Bo)
11:00-11:25	有机分子电催化转化 (Electrocatalytic Conversion of Organic Molecules)	王 双 印 教 授 (Prof. Shuangying Wang)	湖南大学 (Hunan University)	
11:25-11:50	Wiley 材料科学期刊论文发表 (Publishing in Wiley Materials Science Journals)	袁 吉 培 编 辑 (Edit. Jipei Yuan)	Wiley-VCH Verlag	
11:50-13:45	午餐 (Lunch): 白鹿会馆			

会议日程 (Schedule)

时间 (Time)	报告题目 (Title)	报告人 (Speaker)	所在单位 (Institute)	主持人 (Host)
13:45-14:10	自组装 超粒子: 构建, 光学活性及催化应用 (Self- assembled superparticles: construction, optical activity and catalytic applications)	唐 智 勇 教 授 (Prof. Zhiyong Tang)	国家纳米科学中心 (National Center for Nanoscience and Technology)	章明秋教授 (Prof. Qiuming Zhang)
14:10-14:35	光致形变液晶高分子及光控微流体芯片 (Photo-deformable Liquid Crystal Polymers and All-optical Microfluidic Chips)	俞 燕 蕾 教 授 (Prof. Yanlei Yu)	复旦大学 (Fudan University)	
14:35-15:00	拓扑异构高分子网络 (Topology isomerizable network)	谢 涛 教 授 (Prof. Tao Xie)	浙江大学 (Zhejiang University)	
15:00-15:10	茶歇 (Coffee Break)			
15:10-15:35	水下自愈合聚合物 (Underwater Self-healing of Polymers)	章 明 秋 教 授 (Prof. Mingqiu Zhang)	中山大学 (Sun Yat-sen University)	谢涛教授 (Prof. Tao Xie)
15:35-16:00	全固态锂电池: 制备与挑战 (All-solid-State Li Battery: the Fabrication and Challenges)	Dr. Chih-Long Tsai	Forschungszentrum Jülich GmbH	
16:00~16:15	纳米器件界面修复与增韧 (Interfacial repair and toughness for nano-devices)	谈 利 承 教 授 (Prof. Licheng Tan)	南昌大学 (Nanchang University)	
16:15-16:30	含氮杂环非富勒烯受体材料分子构筑及其光伏性能研究 (Molecular construction of N-heteroacenes based nonfullerene acceptors and studying their photovoltaic properties)	廖勋凡 特聘教授 (Prof. Xunfan Liao)	江西师范大学 (Jiangxi Normal University)	

有机光电功能材料的研究进展

Research Progress in Organic Functional Materials for Optoelectronics

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有机光电功能材料是一类新型功能材料，基于该类材料的光电器件，如有机电致发光器件、薄膜晶体管、光伏器件等，具有器件制备简便、性能优良等特点，是新一代光电技术研究领域的前沿方向。针对限制该类器件效率的瓶颈问题，如载流子的高效平衡注入和传输、激发态性质的精确调控等，张晓宏教授围绕有机光电分子及分子有序聚集体两个材料结构层次开展系统性研究工作，取得了系列重要创新性成果，主要科学发现如下：

1. 高效光/电转换有机材料分子结构：提出了通过材料氧化还原电势、三重态能级预测激基复合物生成及能级位置，以及构筑多个逆向系间窜越上转换通道设计高效激基复合物第三代OLED材料的普适性策略，发明了接近理论极限的高效材料体系。

2. 高效光/电转换有机材料聚集体结构：提出了一维有机单晶光电微纳结构控制生长，以及利用界面及图案化衬底诱导制备较大面积（晶圆级）有机单晶光电微纳材料定向及图案化结构的普适性策略，实现了该类高性能材料大面积制备的重要突破。

3. 高效光/电转换有机/微纳复合结构：发展了金属离子刻蚀控制制备一维硅微纳有序阵列结构，以及温和条件高效制备有机/硅微纳复合径向p/n结有序结构的策略，开辟了构筑高性能柔性硅基光电器件新路径。

以上部分创新成果获产业应用。

Organic functional materials for optoelectronic conversion have attracted intense attention due to their advantages over traditional inorganic materials. Optoelectronic devices based on these materials such as organic light-emitting diodes (OLEDs) organic thin film transistors, organic photovoltaics (OPVs), etc. are easier to be fabricated and capable of achieving high performance, and thus widely regarded as one of the most important research fields for the next generation of optoelectronic technology. However, there are still some bottlenecks in the development of optical organic functional materials, especially for molecular design, study of the structures and properties of the materials. Prof. Zhang mainly targeted at solving these bottlenecks. By systematic exploration of molecular structure and molecular aggregate structure for optical organic functional materials, He has obtained a number of innovative achievements. The main achievements are described as follows:

1. Organic functional materials for efficient optoelectronic conversion

General strategies of designing high-efficiency exciplex materials for the third-generation OLED have been proposed, such as using the solution redox potentials of constituting molecules to predict exciplex system and its resulting energy levels, and realizing exciplexes with multiple reverse intersystem crossing (RISC) channels. Several efficient material systems approaching the theoretical limit have been developed.

2. Aggregate structure of organic functional materials for efficient optoelectronic conversion

General strategies have been proposed for the controllable growth of crystalline one-dimensional (1-D) organic micro/nanostructures, and large-area (wafer-scale) fabrication of organic optoelectronic micro/nanostructure arrays with directional and patterned structures induced by interfaces and patterned substrates. The breakthrough in the large-area fabrication of this kind of high-performance materials has been realized.

3. Organic/Si micro-nanostructure composites for efficient optoelectronic conversion

General strategies have been developed for controlled preparation of one-dimensional silicon micro-nanostructure arrays and mild-condition fabrication of organic/Si micro-nanostructure composites with radial PN junctions, which opens a new door for construct high-performance flexible silicon-based optoelectronic devices.

Some of the above innovative achievements have been applied in industry.

个人简介

张晓宏教授的研究领域为功能材料，主要从事有机光电功能材料的研究。于北京理工大学获博士学位，先后在英国剑桥大学及香港城市大学从事博士后及访问学者的研究工作。现任苏州大学教授、博士生导师。已在Nat. Commun.、Adv. Mater.、Angew. Chem.、JACS 等国际期刊（SCI）发表研究论文400余篇，他引10000余次，获美国和中国专利50余项，部分创新成果实现产业应用。获国家自然科学基金二等奖1项（排名1），省部级科学技术一等奖3项。张晓宏教授的研究工作得到了国际国内同行的普遍认可，是国家“杰出青年基金”获得者，教育部“长江学者”特聘教授，国家“万人计划”科技创新领军人才，国家“973 项目”首席科学家，国家“基金委创新研究群体项目”负责人。



难溶有机共轭半导体的溶液加工及热电性能研究

Research on solution processing of insoluble organic conjugated semiconductors and their application in thermoelectrics

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有些有机共轭半导体材料由于非常强的分子间相互作用或者高度交联结构，具有高导电性特征，但也难以溶解加工成膜，研究与应用甚少。如何保持这些材料独特的性能，并对其进行处理应用是材料领域研究的难题。最近，我们通过“离子化增溶掺杂”的策略实现了难溶有机共轭半导体的功能性溶液加工，并探究了其在热电领域中的应用。例如，我们以难溶的酞亚胺染料分子为原料，通过还原剂将其还原成可溶的阴离子态，再溶液加工得到了分子紧密堆积的高结晶态薄膜，应用于有机热电，电导率可达 1 S cm^{-1} 以上，室温下优化的 ZT 值达到了 0.23，是目前报道的最优 n 型有热电材料。类似的，我们通过质子酸对卟啉交联聚合物进行离子化掺杂，得到可溶液加工的胶体。通过滴涂成膜的方法制备了具有微纳结构的离子态薄膜，同样展现了优异的热电性质（功率因子达 $185 \mu\text{W m}^{-1} \text{ K}^{-2}$ ）。这样研究表明我们的策略对难溶有机共轭半导体材料的加工应用具有普适性。

Some of organic conjugated semiconductive materials have fascinating high conductivities due to their very strong molecular interaction or highly cross-linked structure, but they are also difficult to be dissolved and processed into films, leading to few research and application. How to maintain the unique properties of these materials and process them for application is a key issue in the field of materials research. Recently, we proposed a strategy called "ionization-enhanced solution and doping", to realize functional solution-processing of insoluble organic conjugated semiconductors, and explored their applications in thermoelectrics. For example, the insoluble pigments, imides, could be reduced to soluble anionic states by reducing agents, and then processed to form high crystallinity films with tightly packed molecules for thermoelectrics. The electrical conductivity of the film reached as high as 1 S cm^{-1} and the optimized ZT value up to 0.23 at room temperature, which was the best n-type thermoelectric material reported at present. Similarly, the cross-linked porphyrin polymers could be also ionized by protic acid, and formed colloid for solution processing. The ionic films prepared by drop-casting showed well micro/nano structure, as well as excellent thermoelectric properties (power factor up to $185 \mu\text{W m}^{-1} \text{ K}^{-2}$). These results indicate that our strategy should be a common approach to process insoluble organic conjugated semiconductive materials.

个人简介

马於光，教授、博士生导师、发光材料与器件国家重点实验室主任，杰青、教育部“长江学者”特聘教授、2020年跨学科领域“高被引科学家”。重要学术贡献包括：（1）提出并论述了利用磷光材料提高电致发光器件效率的原理，开拓了一类大幅度增加器件效率的材料体系；（2）提出“杂化激发态”（HLCT）、“热激子”等发光材料设计新概念，推动新一代电致发光材料发展；（3）发现了被命名为 X-聚集的发光效率最高的分子排布方式，解决了长期困扰发光材料领域的聚集猝灭荧光的问题；（4）发明有机发光薄膜的电聚合方法，实现高效率、简易化、图案化薄膜与器件，改变传统器件制备工艺。



高效率、低成本非稠环电子受体光伏材料

High efficiency low-cost non-fused ring electron acceptors

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稠环受体的出现推动了有机太阳能电池效率的大幅提升，单结电池效率达到了 18%以上，但稠环受体的合成相对比较复杂、制备成本比较高。我们在 2017 年，我们提出了通过分子内的非共价相互作用来构筑高效率非稠环电子受体的设想，以缩短受体分子的合成步骤、避免使用低收率的成环反应，从而降低受体分子的成本，为有机光伏电池走向实际应用奠定基础。这里主要介绍我们组近几年在高效率、低成本、非稠环受体材料设计合成及器件性能方面的工作。

The emergence of fused ring acceptor has greatly enhanced the power conversion efficiency (PCE) of organic solar cells (OSCs), and the PCE of single junction OSCs has reached more than 18%. But the synthesis of fused ring acceptors is relatively complicated and the cost is rather high. To shorten the synthesis steps of acceptor molecules, to avoid the use of low yield ring closure reactions, and to reduce the cost of acceptors, in 2017, we proposed the idea of constructing high efficiency non-fused ring electron acceptors by the aid of intramolecular noncovalent interactions. Here, we mainly introduce our recent work on designing and synthesizing high efficiency low cost non-fused ring electron acceptors and their device performances.

个人简介

薄志山，1967年生，吉林大学学士、硕士、博士，德国柏林自由大学和美国北卡州立大学博士后，2002年获选中科院“百人计划”任中国科学院化学研究所研究员，2002年获得基金委“杰出青年科学”基金支持，教育部长江学者特聘教授（2015-2020），教育部长江学者创新团队带头人，能量转换与存储材料北京市重点实验室主任。主要从事共轭聚合物光电功能材料的合成与性能研究，在国际重要学术期刊发表学术论文 240 余篇。



固态发光探针与原位成像

Solid-state fluorochrome-based molecular probes for in situ imaging

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原位成像检测细胞内生物分子具有重要的生物学意义。然而，已有的荧光探针大多是基于水溶性荧光染料，与酶作用后产生的荧光信号分子会快速扩散远离酶的反应位点，因此很难捕获细胞内相关酶的原位信息。我们利用具有分子内质子转移性质的 HTPQ 化合物开发了固态发光荧光成像探针，用于蛋白水解酶活性的检测及原位成像研究，开发了新型适用于商业激光共聚焦显微镜的固态发光荧光染料 HTPQ，并构建了酶荧光成像探针 HTPQA，实现了活细胞内碱性磷酸酶活性的原位成像检测。针对细胞膜表面原位成像的特殊要求，开发出强疏水性、弱脂溶性荧光染料 HYPQ，构建了刺激响应型探针，实现了细胞膜表面长时间成像，并利用肿瘤标志物 Cathepsin B 作为靶标，设计具有肿瘤长时间原位成像能力的近红外固态发光探针 HYPQ-B，用于长时间手术导航，指导肿瘤精准手术切除。

Optical bio-imaging with small-molecular fluorescent probes might be the most attractive molecular imaging technique for *in vivo* detection of bio-related species by virtue of its high sensitivity, fast response, real-time spatial imaging and non-sample damaging. However, conventional fluorescent probes with short excitation wavelengths suffer from disturbance by strong autofluorescence from living tissues. We have developed a series of NIR-II fluorescent probes that show reduced autofluorescence, greatly improved imaging resolution and deep tissue and *in vivo* imaging capability. Moreover, localizing a specific biocatalytic activity is of great importance in the field of biomedicine. Current molecular fluorescent probes are generally based on fluorophores that are soluble in the cytoplasm. These responsive probes largely fail to provide *in situ* information about biocatalytic activity, because the products of enzyme conversion quickly diffuse away from the site of their generation. To this end, we have developed an excited-state intramolecular proton transfer (ESIPT)-based solid-state fluorochrome HTPQ that is far better suited to use with a commercial confocal microscope. HTPQ is further utilized in the design of an alkaline phosphatase (ALP) enzyme-responsive, fluorogenic probe (HTPQA). HTPQA makes possible diffusion-resistant *in situ* detection of endogenous ALP in live cells. Next, we have also developed a novel solid-state fluorophore HYPQ, which is characterized by strong hydrophobicity and weak lipophilicity. HYPQ is further converted to an enzyme-responsive fluorescent probe and displays the excellent staining properties on cell membrane. HYPQ may hold great promise for developing various cell membrane anchored fluorescent probes. In another aspect, HYPQ was constructed to a NIR cathepsin B-responsive fluorescent probe (HYPQ-B) for long-term and *in situ* imaging of tumors, which illuminates that HYPQ-B may be a precise tool for fluorescence-guided cancer surgery. Next, HYPQ is further constructed into a solid-state photosensitizer to prevent its diffusion, thereby improving the local concentration of photosensitizer and reducing the photo-toxicity to normal tissues. Moreover, this solid-state photosensitizer can be activated remotely in deep tissues due to its NIR excitation and emission wavelength.

个人简介

张晓兵，湖南大学教授，博士生导师，长江学者特聘教授，国家杰出青年科学基金获得者，国家“万人计划”科技创新领军人才，英国皇家化学会会士（FRSC）。湖南大学学术委员会副主任、湖南大学化学化工学院院长。1989 年考入湖南大学化学化工学院，先后取得有机化工学士学位、有机化学硕士学位和分析化学博士学位。2001 年留校任教，后又赴法国里昂高等师范学校、瑞典皇家工学院从事生物有机化学方向博士后研究。2005 年回国开展疾病标志物荧光检测和成像的系统研究，2006 年起任教授。以第一完成人身份获 2018 年湖南省自然科学一等奖及 2018 年教育部自然科学一等奖，入选爱思唯尔 2017、2018、2019 年中国高被引学者。2010 年至今主持包括国家重点研发计划项目、国家自然科学基金重大项目课题等项目 10 余项，已在 Nature Commun., J. Am. Chem. Soc., Angew. Chem.等 SCI 源刊发表论文 200 多篇，现任 Spectrochim. Acta A、《中国科学-化学》、《化学学报》、《分析化学》等期刊编委。



有机分子电催化转化

Electrocatalytic Conversion of Organic Molecules

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有机电催化转化，是利用电催化的手段，通过催化剂与有机分子（包括气体小分子）之间的电子相互作用，降低反应活化能，从而加快有机物转化反应的过程。因为与传统有机反应相比具有高效绿色的优点，近几年来有机电催化转化在能源，环境，医药，化工等领域有着重要发展。我们课题组近期在有机电催化转化方向开展了部分工作，主要集中在“气体小分子耦合的有机电催化合成”、“亲核有机小分子的电催化氧化”及“生物质平台衍生物的转变升级”等几个方面。研究工作首次在常温常压条件下将惰性分子耦合转化为有机分子；通过原位同步辐射、原位拉曼等方法探究了亲核有机分子在镍基催化剂上的反应机理；首次利用原位和频共振技术明确了有机物合成过程中的反应路径。这些工作对于进一步扩展有机电催化反应底物，明确催化机理，实现有机物可控精准合成等具有重要意义。

Organic electrocatalytic conversion is a process of reducing the activation energy and accelerating organic conversion reactions, through the electronic interaction between the catalyst and organic molecules (including small gas molecules). Compared with traditional organic reactions, organic electrocatalytic conversion has made important developments in energy, environment, medicine, chemical and other fields in recent years, due to its high efficiency and green advantages. Recently, our group mainly focus on "organic electrocatalytic synthesis of small gas molecules coupling", "electrocatalytic oxidation of nucleophilic organic small molecules" and "transformation of biomass platform derivatives" and other aspects. Converting inert molecules into organic molecules firstly under normal temperature and pressure conditions is the highlight for this research work; and then in-situ synchrotron radiation, in-situ Raman and other methods have been adopted to explore the reaction mechanism of nucleophilic organic molecules on nickel-based catalysts; in-situ and Frequency resonance technology clarifies the reaction path in the organic synthesis process. These works are of great significance to further explore organic electrocatalytic reactions, clarify the catalytic mechanism, and realize the controllable and precise synthesis of organic compounds.

个人简介

王双印，国家杰出青年基金获得者、海外高层次人才特聘专家, 科睿唯安全球高被引科学家（化学）, 爱思唯尔中国高被引学者（化学）。现为湖南大学二级教授，博士生导师。2006 年本科毕业于浙江大学化工系，2010 年在新加坡南洋理工大学获得博士学位，随后在美国凯斯西储大学，德克萨斯大学奥斯汀分校、英国曼彻斯特大学（玛丽居里学者）开展研究工作。主要研究方向为电催化剂缺陷化学，有机分子电催化转化，燃料电池。代表性论文发表在《国家科学评论》，《中国科学化学、材料》，《科学通报》，JEC, Nature Chem., Nature Catalysis, JACS, Angew. Chem. (14), Adv. Mater. (14), Chem 等期刊，总引用17000余次，H 指数 70，ESI 高被引论文55篇，单篇引用超200 次的论文20余篇，单篇引用超100次的论文 50 余篇，获教育部青年科学奖、湖南省自然科学奖一等奖（第一完成人）。



Wiley 材料科学期刊论文发表

Publishing in Wiley Materials Science Journals

袁吉培 Wiley 出版社

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将研究工作的结果整理成文稿，然后经过同行评审发表在科技期刊上，是科研工作的一部分。针对研究产出的迅速增长，虽然不断有新的期刊推出，但稿件在投稿过程中所面临的竞争也越来越激烈。那么，如何能够提高稿件被接受的机会？我们将从编辑的角度向大家介绍 Wiley 材料科学期刊(Advanced Materials, Advanced Functional Materials, Small 等)稿件处理的流程。例如如何对稿件进行初审，如何寻找合适的审稿人，以及在收到审稿人的意见之后如何对稿件做出决定等等。并给出一些在投稿过程中需要注意的事项，希望对大家今后文章的发表有所帮助。

A highly competitive research environment with increasingly limited research funding has created a “Publish or Perish” attitude among scientists who are judged on the quantity rather than quality of their research articles. This presentation provides a brief overview of current trends and challenges in scientific publishing, some ethical considerations, how publishers and authors interact and influence each other, and how the publishing arena is being transformed. Tips will be presented on how to select an appropriate journal for your paper, what aspects of preparation and presentation to focus on from an editor’s and referee’s perspective, and hints for increasing the discoverability of your paper after publication.

个人简介

袁吉培，2009 年 12 月于中国科学院长春应用化学研究所取得博士学位。之后分别在德国德累斯顿工业大学和以色列耶路撒冷希伯来大学进行半导体纳米晶及 DNA 纳米技术研究。2015 年 1 月加入WILEY出版集团。目前从事 WILEY-VCH 旗下知名材料科学期刊 (Advanced Optical Materials, Laser & Photonics Reviews, Small, Advanced Energy Materials 和 Advanced Energy & Sustainability Research) 的编辑工作。



自组装超粒子：构建，光学活性及催化应用

Self-assembled superparticles: construction, optical activity and catalytic applications

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超粒子是指两个以上的纳米粒子，通过非共价相互作用自限制组装而形成的超结构。超粒子具有形貌、尺寸和结构可控的特征，并表现出独特的光电磁和催化性质。报告人将结合过去几年课题组的研究工作，介绍如何通过选择纳米基元的种类、改变基元在超粒子中的空间分布、以及调控基元间的光电耦合：（1）构建高光学活性的组装体，（2）实现超粒子体系在催化中的高效应用。

Superparticle is a superstructure formed by self-limiting assembly of two or more nanoparticles through the non-covalent interaction. Superparticles have the characteristics of controllable morphology, size and structure, and exhibit unique photoelectromagnetic and catalytic properties. Based on the work of the research group over the past few years, the speaker will introduce how to select the type of nanounits, change the spatial distribution of the units in the superparticle, and regulate the photoelectric coupling among the units. (1) construct assemblies with high optical activity, (2) realize the efficient application of the superparticle system in catalysis.

个人简介

唐智勇，研究员，博士生导师，国家纳米科学中心副主任，基金委创新群体负责人，科技部纳米重大研究计划首席科学家。武汉大学获学士、硕士学位，中国科学院长春应用化学研究所获博士学位，瑞士苏黎世联邦高等工业学院、密歇根大学从事博士后工作，后任职于国家纳米科学中心。主要研究无机纳米材料的制备、组装及其在能源和催化领域的应用。获国家杰出青年科学基金资助、并先后入选新世纪百千万人才工程国家级人选，中国科学院“杰出青年”、第二批国家“万人计划”科技创新领军人才等，2018年获国家自然科学奖二等奖（第一完成人）。



高效被动辐射冷却聚合物薄膜材料设计
The design of highly efficient passive radiation cooling polymer film materials

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被动辐射冷却是将波长范围约在 0.3-2.5 μm 的太阳光高反射回去，同时把自身热量通过波长为 8-13 μm 的大气透明窗口散逸到寒冷的外太空。但现有技术需要使用复杂昂贵的加工设备，难以大规模推广，且湿热环境降温效果差等问题。

为此，我们通过在聚合物薄膜设计大量的微孔和纳米孔结构。由于这些丰富的多级孔道能够高效散射太阳光并且增加热的发射率，使得该薄膜在太阳光谱范围内的反射率高达~0.95，长波红外发射率高达~0.98。在夜间降温约 8.2 $^{\circ}\text{C}$ 、正午低 6.0-8.9 $^{\circ}\text{C}$ 。即使在炎热潮湿气候下，也能实现约 5.5 $^{\circ}\text{C}$ 的日间降温，实现了全天候环境的高效被动辐射冷却。

All-day passive radiative cooling has recently attracted tremendous interest by reflecting sunlight and radiating heat to the ultracold outer space. While some progress has been made, it still remains big challenge in fabricating highly efficient and low-cost radiative coolers for all-day and all-climates. Herein, we report a hierarchically structured polymethyl methacrylate (PMMA) film with a micropore array combined with random nanopores for highly efficient day- and nighttime passive radiative cooling. This hierarchically porous array PMMA film exhibits sufficiently high solar reflectance (0.95) and superior longwave infrared thermal emittance (0.98) and realizes subambient cooling of ~8.2 $^{\circ}\text{C}$ during the night and ~6.0 $^{\circ}\text{C}$ to ~8.9 $^{\circ}\text{C}$ during midday with an average cooling power of ~85 W/m^2 under solar intensity of ~900 W/m^2 , and promisingly ~5.5 $^{\circ}\text{C}$ even undersolar intensity of ~930 W/m^2 and relative humidity of ~64% in hot and moist climate. The micropores and nanopores in the polymer film play crucial roles in enhancing the solar reflectance and thermal emittance.

个人简介

武利民，复旦大学材料科学系教授、长江学者、科学技术学院院长。共发表 SCI 论文 320 多篇，他引 13000 多次，H-因子 65；出版中英文专著 4 部；基金委创新群体带头人、国家重点研发计划纳米重点项目首席负责人。国家重点研发计划“变革性技术关键科学问题”重点专项总体专家组成员。教育部第八届科技委员会委员。



光致形变液晶高分子及光控微流体芯片

Photodeformable Liquid Crystal Polymers and All-optical Microfluidic Chips

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光致形变液晶高分子通过结合光敏分子的光异构化和液晶的协同作用，能够将微观分子构象的变化放大为材料的宏观形变，在微机械系统、人工肌肉、微型机器人等诸多领域具有广阔的应用前景。近年来，我们开发了一种光致形变线型液晶高分子，可以通过熔融、溶液等各种通用高分子加工方法制备薄膜、纤维、微管等各种执行器，并且具有优良的光致形变性能。进一步，采用这种具有光致形变特性的液晶高分子构建柔性微管，通过光刺激精准控制微流体所在部位的管道沿着管径方向发生梯度形变，产生轴向不对称毛细作用力，微流体在拉普拉斯压差的作用下自发向微管道的细部移动。由于光致形变具有可逆性和可控性，能够很方便地通过改变光照条件（波长、光强等）调节液体的移动方向和速度等。因此，在微管道结构中利用光致拉普拉斯压差驱动微量液体运动，无需特殊的光学装置和复杂的微组装过程，可以极大的简化微流体系统的结构。本研究中，我们基于该流体操控机理，采用复合构筑策略，设计并制备了一款能够实现全光控液体运输、融合、分离和搅拌的光流控芯片。液晶高分子薄膜光致形变产生的拉普拉斯压差用于驱动通道内的液体完成定向运输。通过芯片流体通道结构的理论计算与设计，引入了毛细凝结作用，使该芯片结构中无需连接任何微阀即可实现液体的光控融合与分离。进一步，我们验证了光控微流体芯片在无机物检测、有机催化以及生物分析中的应用，初步证明了该芯片在集成实验室操作方面的可行性。

Photodeformable liquid crystal polymers can magnify the change of molecular conformation into macro-deformation of materials by combining the photoisomerization of molecules and the synergistic effect of liquid crystals, and show broad application prospects in many fields such as micro-mechanical systems, artificial muscles, micro-robots and so on. Recently, we have developed a linear liquid crystal polymer (LLCP) which has excellent photodeformation properties, and can be used to fabricate thin films, fibers and other actuators by melting, solution and other general polymer processing methods. LLCPS were chosen to fabricate microtubes due to its excellent deformability and good processability for building three-dimensional actuation structures. Laplace pressure was generated when the microtubes deformed from cylinder-like to cone-like geometry attributed to the photoinduced orientation change of the liquid crystal units, which leads to the motion of the liquid toward the narrower side. In this work, a new type of optofluidic chip was fabricated by combining photodeformable LLCP film with general plastic chip substrates. We further combined the Laplace pressure and the capillary condensation to integrate liquid transportation, fusion, separation and mixing in one chip, realizing the first all-optical microfluidic chip (AOMC) for micro reactions and detections. Laplace pressure, attributed to the photodeformation of the LLCP film, is generated to pump the liquid. Capillary condensation is introduced by the delicate design of the fluid channels, allowing the liquid fusion and separation without any connected microvalves. Catalytic oxidation reaction and protein detection processes are realized in the AOMC, which are amenable to a variety of miniaturized bio-medical applications, such as portable analysis and point of care testing.

个人简介

俞燕蕾，复旦大学材料科学系教授，博导，教育部长江学者特聘教授。1993年毕业于安徽大学，1996年获中国科技大学硕士学位，同年进入复旦大学工作。2004年获得日本东京工业大学博士学位。主要从事液晶高分子和光响应性高分子的研究，利用其构筑光致形变材料和光响应功能界面材料。先后获得国家杰出青年科学基金（2012年）、国家“万人计划”科技创新领军人才（2017年）、上海市领军人才（2017年）、第四届中国化学会-赢创化学创新奖—杰出科学家奖，及上海市自然科学一等奖（2018年，第一完成人）。在



ature, J. Am. Chem. Soc., Angew. Chem. Int. Ed., Adv. Mater., Adv. Funct. Mater.等学术期刊上共已发表SCI 论文 80 余篇。已获授权国家发明专利 10 余件。担任 Advanced Optical Materials、European Polymer Journal、Journal of Materials Science & Technology、Chinese Journal of Polymer Science、

《高分子学报》、《功能高分子学报》等学术期刊编委。

拓扑异构高分子网络 Topology isomerizable network

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动态共价交联高分子由于其特殊性能（自修复、重加工及固态塑性等）逐渐成为有别于传统热塑性及热固性的第三类高分子。目前已知的动态共价交联高分子在动态键交换前后拓扑结构保持不变，其对应的物理性能不能调控。报告人认为，由“物性不变”到“物性可调可变”，将是动态交联高分子领域发展的新机遇。为实现这一点，本文提出拓扑异构高分子网络（Topology Isomerizable Network, TIN）的概念。本报告将建立及阐明其分子设计基本原理，使动态键交换后网络拓扑结构发生变化以调控材料物性(热转变温度，模量，结晶度等)，最终实现将一个交联高分子编程为无数个物性不同的高分子的全新可能。在此基础上，报告将进一步探讨特殊器件应用(软体机器人、柔性电子及仿生结构材料)。

Dynamic covalent polymer networks (DCPN) have emerged as a third class of polymers with properties distinctive from classical thermoplastic and thermoset polymers. Currently known DCPN can undergo network topological rearrangement via dynamic bond exchanges, but their topology remains unchanged after the bond exchange. We report a new class of DCPN with unique topological design that enables it to undergo topological isomerization. As a result of this unique feature, the so-called topology isomerizable network (TIN) can be programmed into an unlimited number of polymers with distinct physical properties. This talk will illustrate its principle and describe how TIN can impact emerging applications.

个人简介

谢涛，浙江大学化学工程与生物工程学院求是讲席教授、国家特聘专家。1993 年本科毕业于浙江大学化学系，2001 年获美国马萨诸塞大学高分子系博士学位。2001 至 2013 年先后任职于美国通用汽车公司及休斯实验室，2013 年全职回国工作，2016 年获国家杰出青年科学基金资助。研究方向包括智能高分子材料及 3D/4D 打印。获专利授权超过 80 项。多项研究工作被国内外媒体报道，包括中央电视台、人民日报、麻省理工技术综述、华尔街日报、Nature、Science 等。曾获美国 Conte 国家高分子研究中心杰出研究奖、美国制造工程师协会创新奖、全球百大研发奖（R&D100 award）及中国化学会高分子基础研究王葆仁奖。2020 年当选美国化学会高分子材料分会（ACS PMSE）会士。目前担任美国化学会 ACS Applied Materials & Interfaces 副主编。



水下自愈合聚合物

Underwater Self-healing of Polymers

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随着结构聚合物材料在造船、近海和组织工程（支架）中的应用增多，它们在水下或潮湿环境中通过自我修复从而恢复强度的能力成为一个重要问题。然而，到目前为止，由于缺乏合适的解决方案，关于这方面研究的报道很少。例如，对于外加愈合剂进行自修复的策略，催化剂易于在水中失活或释放的愈合剂反应将被水抑制；而就利用可逆键的本征型自愈合聚合物而言，因其通常是疏水性的，裂纹表面上的大分子链倾向于在水中收缩，不利于它们在界面间扩散和碰撞。因此，必须提出聚合物结构的创新设计和工作原理才能解决面临的挑战。

With the increasing application of structural polymeric materials in shipbuilding, offshore and tissue engineering (scaffolds), their ability of self-healing in water or wet environment towards strength restoration becomes an important issue. So far, however, there have been rare reports concerning the researches in this aspect because of lacking suitable solutions. In the case of extrinsic self-healing based on embedded healing agent, for example, either the catalyst would be deactivated or the reaction of the released healing agent would be inhibited by water. With respect to intrinsic self-healing polymers utilizing reversible bonding, which are often lipophilic, the macromolecular chains on the cracked surfaces tend to shrink in water, preventing their diffusion and collision across the interface. Therefore, innovative design of polymer structure and working principle has to be put forward.

个人简介

章明秋，中山大学化学学院教授，兼任《复合材料学报》（主编）、“Composites Science & Technology”（副主编）。主要从事高分子及高分子复合材料的科研与教学，研究方向主要包括高分子材料，高分子共混物和高分子复合材料的结构与性能关系，表征技术，功能化应用等。



All-solid-State Li Battery: the Fabrication and Challenges

全固态锂电池：制备与挑战

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基于石榴石结构 $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ (LLZO) 固体电解质的全固态锂电池 (SSLB) 因其内在高安全性和高能量密度，被认为是最具希望的新型储能设备之一。然而，为使电池内的陶瓷材料形成有效的离子扩散路径，电池在制备过程中往往需要高温烧结。这种高温处理通常导致杂质相在电池内部界面处形成，极大的阻碍锂离子传输，降低电池性能。此外，尽管使用金属锂作为负极可以显著提高 SSLB 的能量密度，但锂枝晶的形成和生长往往导致 SSLB 的迅速短路。因此，开发基于 LLZO 的 SSLB 仍然存在巨大的挑战，特别是如何优化电池材料之间的界面以实现快速离子传输和解决锂枝晶的形成。基于此，我们在此提出如何通过对正极的材料合理选择和加工制造低界面电阻，高性能 SSLB 的策略。此外，为使用金属锂作为固态电池负极的策略提供参考，还将在此总结 SSLB 中的锂枝晶的形成比传统的锂离子电池更迅速的原因。

All-solid-state lithium batteries (SSLB) based on garnet structured $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ (LLZO) solid electrolyte have been regarded as the next generation energy storage devices due to their high intrinsic safety and high energy density. However, the necessary of sintering process at elevated temperatures during battery fabrication to form ionic diffusion paths through ceramic materials within the battery usually forms second phases at interfaces that dramatically lag the ionic transports. Furthermore, the using of metallic Li as the negative electrode, which is expecting to increase the overall SSLB energy density, usually form Li dendrite and cause short circuiting of the SSLB. Therefore, the development of LLZO based SSLB is still remaining as big challenges in the fabrication of a compatible interfaces between the used materials to achieve high interfacial ionic transport and resolving Li dendrite formation. Herein, we present a strategy on how to fabricate a low interface resistance SSLB that can be achieved straightforwardly by materials selections and processing for the positive electrode to realize high performance SSLB. Furthermore, an overview of why Li dendrite formation is much more pronounced in a SSLB than conventional Li-ion batteries is also provided for future strategy development on using metallic Li as the negative electrode for SSLBs

Resume

Dr. Tsai obtained his BSc and MSc in physics from Fu Jen Catholic University, Taiwan, in 2001. Afterward, he had two years of research experience as an instructional lab instructor at the Department of Optoelectronic Sciences, National Taiwan Ocean University. Dr. Tsai chose the Montana State University for his second MSc and PhD in physics with Prof. Hugo V. Schmidt with his dissertation topic on proton conductive solid oxide fuel cell and separation membrane. Continuously, in 2011, he moved to Europe, Energy Cooperative Research Center, for postdoctoral research in the field of inorganic Li ion conductor with guidance from Prof. John Kilner from Imperial College, UK. By the time of 2012, Dr. Tsai joined Forschungszentrum Jülich as a permanent research scientist. Dr. Tsai's research fields including Li/Na batteries, high temperature metal-air batteries, solid oxide fuel cells, high-temperature gas separation membrane and domain structure and phase transition of ferroelectric materials. Since 2020, Dr. Tsai starts to build up his own research group on the development of all-solid-state batteries, especially focusing on the chemistry and electrochemistry at interfaces and interphases of the solid components. His new findings on the relevant topics are of general interest to the research community and thus obtained fruitful scientific output including a set of methodology patterns.



纳米器件界面修复与增韧

Interfacial repair and toughening for nano-devices

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基于半导体纳米复合材料的机械弯折和界面修复是柔性纳米器件领域的重要研究内容之一。针对半导体纳米器件中界面失配和缺陷修复以及机械稳定性关键科学问题，利用高分子纳米复合界面技术，实现了柔性太阳能电池湿热稳定性提升和机械应用。提出协同分散策略制备高导电复合透明电极，采用仿生粘结技术有效增韧无机纳米晶，提出高分子微交联修复钙钛矿缺陷和增韧新机制，原位构建高分子支架促进两步法碘化铅转化和钙钛矿取向生长。

Mechanical bending and interfacial defects repair based on the semiconductor nanocomposites is one of the important researches in the field of flexible nano-devices. In order to solve the key scientific issues of interfacial mismatch, defect repair and mechanical stability in semiconductor nano-devices, the applicant has performed polymer nanocomposite interface technology to successfully achieve the improvement on humidity- and thermo-stability for flexible solar cells, as well as their mechanical applications. The applicant has also proposed cooperative dispersion strategy to prepare highly conductive composite transparent electrodes, bionic bonding technology to toughen inorganic nanocrystals effectively, polymer microcrosslinking strategy to repair perovskite defects and toughness, and construction of in-situ polymer scaffolds to promote the conversion of lead iodide and oriented growth of perovskites in the two-step process.

个人简介

谈利承，博士，1985年9月生，南昌大学教授/博导，南昌大学“赣江特聘教授”、省“双千计划”人才、省百千万人才工程、省青年井冈学者、省杰出青年人才、江苏省双创计划创业类双创博士，曾获得省青年五四奖章、省优秀博士论文、中国青少年科技创新奖等荣誉。2007年毕业于南昌大学获学士学位，同年保送硕博连读，师从陈义旺教授。2011年赴德国马尔堡大学进行博士联合培养。2012年获博士学位并留校任教。近年来主要基于柔性太阳能电池及超级电容器等高分子能源体系纳米复合界面开展研究。主持国家自然科学基金5项(面上2项)、教育博士点基金等项目。近五年以第一作者/通讯作者发表 AM, AEM, AFM 等 SCI 论文 35 篇，其中封面论文 4 篇；撰写专著 1 部和教材 2 部；授权发明专利 7 项，其中模板原位聚合制备导电聚合物和免转印金属网电极专利技术，分别应用于多家高技术企业。获教育部自然科学二等奖（2019 排名第三）、省自然科学二等奖 2 项（2020 排名第一/2015 排名第二）。



含氮杂环非富勒烯受体材料分子构筑及其光伏性能研究

Molecular construction of N-heteroacenes based nonfullerene acceptors and studying their photovoltaic properties

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有机太阳能电池活性层电子给体材料和受体材料的开发设计是提高其能量转换效率的关键，有机太阳能电池的短路电流和开路电压较难协同提升是制约其器件性能进一步提高的关键科学问题。如何通过分子结构的设计拓宽材料的光谱吸收，使其吸收尽可能红移，同时降低器件的能量损失十分关键。本研究主要围绕有机太阳能电池活性层受体材料的设计展开，通过构筑含氮杂环的一维、二维、三维共轭的给体核用于构建具有近红外吸收的非富勒烯受体材料，解决材料吸收窄和能量损失高的关键问题。

The development and design of electron donor and acceptor materials for the active layer of organic solar cells is the key to improving their power conversion efficiency. The difficulty of synergistic improvement of short-circuit current density and open-circuit voltage of organic solar cells is a key scientific issue that restricts the further improvement of device performance. How to broaden the spectral absorption of the material through the design of the molecular structure to make the absorption as red-shifted as possible while reducing the energy loss of the device is very important. This research mainly focuses on the design of acceptor materials for the active layer of organic solar cells. By constructing a one-dimensional, two-dimensional, and three-dimensional conjugated donor core of nitrogen-containing heterocycles, it is used to construct non-fullerene acceptors with near- infrared absorption to solve the key problems of narrow material absorption and high energy loss.

个人简介

廖勋凡，江西师范大学高等研究院特聘教授，江西省“双千”计划入选者。2009-2013 年南昌大学获学士学位，2013-2018 年南昌大学获博士学位（导师：陈义旺教授），2017-2018 年美国华盛顿大学进行博士联合培养（国家公派项目），合作导师为 Alex K-Y. Jen 教授。2018-2020 年任东华大学材料科学与工程学院副教授，入选上海市青年英才杨帆计划和上海市晨光计划。2020 年加入江西师范大学，主持国家自然科学基金面上/青年项目 2 项、上海市人才项目 2 项以及江西省创新领军人才等项目。以第一作者（含共一）或通讯作者在 J. Am. Chem. Soc.; Adv. Energy Mater.; Adv. Funct. Mater.; Nano Energy.; Chem. Mater.; Chem. Commun.; J. Mater. Chem. A 等国际期刊发表 SCI 学术论文 24 篇，论文被引用900 余次，申请发明专利两项，其中一项实现成果转化，在有机太阳能电池领域取得多项突破。



会 议 证 明

由江西师范大学高等研究院承办的 2021 年瑶湖功能材料论坛暨中德合作交流项目双边论坛将于 2021 年 3 月 26-28 日在江西南昌举行，会议期间，参会代表的交通和食宿费用自理。

特此证明！

江西师范大学高等研究院

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