2021先進結構設計與製造研討會

Advanced Design and Manufacturing Conference 2021

2021.11.25-26・9:30AM - 6 PM

香港城市大學香港高等研究院演講廳

Lecture Theatre, Hong Kong Institute for Advanced Study (HKIAS), City University of Hong Kong

內地會議 - 網上召開

Mainland - Online

主辦單位: 香港城市大學 City University of Hong Kong

資助單位: 国家自然科学基金委员会 National Natural Science Foundation of China; 京港學術交流中心 Beijing - Hong Kong Academic Exchange Centre

承辦單位: Hong Kong Branch of National Precious Metals Material Engineering Research Center 香港城市大學 City University of Hong Kong; Hong Kong Institute for Advanced Study 香港城市大學 City University of Hong Kong; Centre for Advanced Structural Materials 香港城市大學 City University of Hong Kong; HKMRS

研讨会简介

为进一步促进内地、香港两地高校的科研合作发展，为两地科研科研人员提供研讨和交流的平台，国家自然科学基金委员会、香港城市大学与京港学术交流中心计划于2021年冬季在香港合办学术研讨会，研讨主题为「先进结构设计与制造」。研讨会旨在围绕先进结构材料前沿热点问题，探讨相关研究的发展与创新设计，共谋在前沿问题的研究上展开深入合作，服务于国家建设的重大需求，促进中国内地与香港两地在先进结构材料领域的合作与发展。

主办单位： 香港城市大学

资助单位： 国家自然科学基金委员会
京港学术交流中心

支持单位： 中央人民政府驻香港特别行政区联络办公室教育科技部
国家自然科学基金委员会港澳台事务办公室
国家自然科学基金委员会工程与材料科学学部

承办单位： 香港城市大学国家贵金属材料工程技术研究中心香港分中心
香港城市大学香港高等研究院
香港城市大学先进结构材料研究中心
香港材料研究协会

会议时间： 2021年11月25日-26日

举办地点： 香港城市大学/腾讯会议

会议主题： 先进结构与制造
分议题：
(1) 先进结构设计与制造
(2) 仿生结构设计与制造
(3) 柔性器件设计与制造
(4) 3D/4D打印、智能结构设计与制造
(5) 2D材料与器件设计与制造
(6) 功能导向的新材料设计与制造

会议形式： 线上线下结合的大会发言及学术报告

会议语言： 普通话/英文

筹备委员会： 国家自然科学基金委员会港澳台办公室主任 张永涛先生
国家自然科学基金委员会港澳台事务办公室副主任 张琳女士
国家贵金属材料工程技术研究中心香港分中心主任、先进结构材料研究中心主任 吕坚教授
香港城市大学化学系胡晓明讲座教授(纳米材料)、材料科学及工程学系讲座教授 张华教授
香港城市大学理学院署理院长，化学系系主任，化学系、材料科学及工程学系讲座教授 李振声教授
香港城市大学材料科学及工程学系署理系主任，材料科学及工程学系、化学系讲座教授 张文军教授
香港科技大学电子及计算机工程学系教授 范智勇教授
京港学术交流中心总裁 徐海山先生
京港学术交流中心创新及科技部经理 黄冠麟先生
京港学术交流中心创新及科技部行政主任 何璐璐小姐

主办单位简介

国家自然科学基金委员会 National Natural Science Foundation of China

国家自然科学基金委员会

(简称自然科学基金委，英文名称为 National Natural Science Foundation of China，缩写为 NSFC)于 1986 年成立。国家自然科学基金委员会是管理国家自然科学基金的副部级事业单位，由科学技术部管理。国家自然科学基金委员会依法管理国家自然科学基金，相对独立运行，负责资助计划、项目设置和评审、立项、监督等组织实施工作。主要职责为根据国家发展科学技术的方针、政策和规划，按照与社会主义市场经济体制相适应的自然科学基金运作方式，运用国家财政投入的自然科学基金，资助自然科学基础研究和部分应用研究，发现和培养科技人才，发挥自然科学基金的导向和协调作用，促进科学技术进步和经济、社会发展；负责国家自然科学基金管理，制定和发布基础研究和部分应用研究指南，受理课题申请，组织专家评审，择优资助，着力营造有利于创新的研究环境；协同科学技术部拟定国家基础研究的方针、政策和发展规划，接受委托，对国家高科技、应用研究方面的重大问题提供咨询并承担相关任务；支持国内其他自然科学基金的工作；与外国的政府科技管理部门、科学基金会及有关学术组织建立联系并开展国际合作；负责对直属事业单位进行管理、监督和业务指导；及承办国务院及有关部门委托或交办的其他事项 。

香港城市大學 City University of Hong Kong

香港城市大学

香港城市大学(「城大」)是一所在全球踞领导地位的大学，于研究及专业教育的范畴表现卓越。城大现有超过23,000学生，其中有7,000多研究生。城大无论在教与学方面，均以人才培训、个人探索、汲取对社会具正面影响的知识为重点，其多元化课程致力培育学生的批判性思考、锻炼创意及专业技能，从而为学生的职业生涯开展出路。

京港學術交流中心 Beijing - Hong Kong Academic Exchange Centre

京港学术交流中心

是由杨振宁教授提议，于 1985 年 3 月在香港注册成立，是一个非牟利的教育科技交流服务机构，旨在促进内地与香港以至海外间开展学术、科技交流和科技产业合作之活动，提供咨询、联络及资助等服务。中心受中国内地及香港教育与科技单位委托，并得到中央人民政府驻香港特别行政区联络办公室的支持。现有中国国家科学技术部、国家教育部、中国科学院、中国社会科学院、中国医学科学院、中国科学技术协会、国家自然科学基金委员会，以及中央人民政府驻香港特别行政区联络办公室等机构参与京港学术交流中心董事局。

承办单位简介

香港城市大学国家贵金属材料工程技术研究中心香港分中心
(The Hong Kong Branch of National Precious Metals Material Engineering Research Center (NPMM))

The establishment of the Hong Kong Branch of National Precious Metals Material Engineering Research Center (NPMM) at City University of Hong Kong (CityU) was approved by the Ministry of Science and Technology (MOST) of the People' s Republic of China in November 2015. The core objective of setting up the branch is to strengthen the national center' s overall capacity by developing the research of precious metals and nanomaterials, as well as the relevant devices.

Precious metal elements (gold, silver, platinum, palladium, rhodium, iridium, osmium and ruthenium) because of the particularity of atomic structure, showed excellent physical and chemical properties (such as high-temperature oxidation resistance and corrosion resistance), electrical properties (excellent electrical conductivity, high-temperature thermoelectric performance and stable temperature coefficient of resistance, etc.), high catalytic activity, strong coordination ability and therefore have a wide use in industry and are closely related to the development of modern high-tech.

NPMM positions itself to carry out fundamental and applied research to develop new precious metallic materials and upgrade conventional precious metallic materials and to fulfill the need of precious materials for the development of national economy, high-tech industrial development and national defense.

香港城市大学香港高等研究院

Hong Kong Institute for Advanced Study (HKIAS) was launched on 22 November 2015. It aspires to be an international centre of excellence for the advancement of technology and innovation by bringing together an interdisciplinary team of world-renowned scholars and researchers, including Nobel laureates and academicians, to pursue curiosity-driven ideas and studies, and to conduct unfettered research based on free and deep thinking; an institute where the goals are to seek truth, to advance knowledge and to better humanity. HKIAS explores partnerships with prestigious academic institutions around the world in support of collaborative research that targets innovative solutions to global problems of critical importance. The work of HKIAS is to enable world-leading visiting scholars to spearhead bold new research initiatives and nurture postdoctoral/postgraduate/undergraduate students in the pursuit of knowledge, it committed to fostering an environment that provides them ample opportunities to work with each other through HKIAS Distinguished Lectures/Workshops, and many other activities and events.

承办单位简介

香港城市大学先进结构材料研究中心 (The Centre for Advanced Structural Materials (CASM))

Led by Professor Jian LU, The Centre for Advanced Structural Materials (CASM) consists of 12 Chair Professors, Professors, Associate Professors and Assistant Professor with the related expertise from the five main departments (Physics, Materials Science and Engineering, Mechanical Engineering, Chemistry, and Architecture and Civil Engineering) of College of Science and Engineering of the City University of Hong Kong (CityU).

香港材料研究协会 (Hong Kong Materials Research Society (HKMRS)

The Hong Kong Materials Research Society (HKMRS) was found in 1997 of over 20 years. Serving as a platform for materials researchers and students to exchange research findings and ideas, HKMRS aims to facilitate international networking by organizing joint conferences/symposia, particularly in the Greater Bay Area.

2021先进结构设计与制造研讨会日程

第一天（11月25日)		
时间	专题/研讨项目	讲者
9:30-10:15	研讨会开幕典礼 1. 主礼嘉宾致辞 2. 大合照	**郭位教授** 香港城市大学校长 大学杰出教授
		刘懋洲司长 中央人民政府驻香港特别行政区 联络办公室教育科技部二级巡视员
		张永涛主任 国家自然科学基金委员会港澳台事务办公室主任
		苗鸿雁副主任 国家自然科学基金委员会工程与材料科学部副主任
		徐海山先生 京港学术交流中心总裁
		吕坚教授 研讨会召集人 法国国家技术科学院院士 香港城市大学 · 机械工程学系 · 材料科学及工程学系 · 生物医学工程系及 · 生物医学系讲座教授 · 国家贵金属材料工程技术研究中心 香港分中心主任 先进结构材料研究中心主任
主题一：先进结构设计与制造 主持人：张华教授		
10:15 -10:30	报告 1 3D打印与创新设计	**卢秉恒院士** 中国工程院院士 西安交通大学教授
10:30-10:45	报告 2 Unified Fatigue Fracture Mechanics for Structural Durability and Reliability	**郭万林院士** 中国科学院院士 南京航空航天大学教授、院长
10:45-11:00	报告 3 高性能轻量化航宇结构的优化设计制造理论方法与应用	**张卫红院士** 中国科学院院士 西北工业大学教授、副校长
11:00 -11:15	报告 4 Atomic-resolved high-temperature mechanical testing system	**韩晓东教授** 北京工业大学教授、科学技术发展学院常务副院长
11:15 -11:30	讨论	

主题二：仿生结构设计与制造 **主持人：郑子剑教授**		
11:30 -11:45	报告 5 基于界面创新的水能关系	**王钻开教授** 香港城市大学工学院副院长、 机械工程系、材料科学及 工程学系讲座教授
11:45 -12:00	报告 6 Aqueous battery for large - scale energy storage	**支春义教授** 香港城市大学材料科学及 工程学系教授
12:00-12:15	报告 7 Bio-inspired in-sensor visual adaptation for accurate perception	**柴扬博士** 香港理工大学应用科学及纺织学院 助理院长(研究) 、 应用物理学系副教授
12:15 -12:30	报告 8 基于半球形高密度纳米线阵列的仿生视网膜和电化学仿生眼	**范智勇教授** 香港科技大学电子及计算器工程学系、 化学工程及生物分子工程学系教授 香港科技大学智能传感器与 环境技术中心主任
12:30-12:45	讨论	
12:45-14:00	午膳(HK Tech Lodge)	
主题三：柔性器件设计与制造 **主持人：宋波教授**		
14:00-14:15	报告 9 柔性器件的制造和应用	**李述汤院士** 李述汤院士 中国科学院院士 发展中国家科学院院士 苏州大学教授、功能纳米与软物质研究院院长、 纳米科学技术学院院长 苏州纳米科技协同创新中心主任 江苏省产业技术研究院 有机光电技术研究所所长
14:15 -14:30	报告 10 Fiber-enabled High -performance Wearable Battery and Beyond	**郑子剑教授** 香港理工大学纺织及服装学系教授
14:30-14:45	报告 11 Green Printing Technology for Manufacturing Optoelectronic Devices	**宋延林博士** 中国科学院化学研究所研究员、 实验室主任

14:45-15:00	报告 12 The hybrid unity power: Organic Cocrystals make materials diverse	**张其春教授** 香港城市大学化学系、 材料科学及工程学系教授
15:00-15:15	报告 13 富勒烯基柔性光伏器件	**王春儒博士** 中国科学院化学研究所研究员
15:15 -15:30	报告 14 基于折纸超结构的柔性可穿戴电子器件设计与制造	**于宏宇博士** 香港科技大学机械及 航空航天工程学系副教授
15:30-15:45	讨论	
15:45-16:00	茶歇	
主题四: 3D/4D 打印、智能结构设计与制造 **主持人：张文军教授**		
16:00-16:15	报告 15 增材制造与 4D 打印新进展	**吕坚教授** 法国国家技术科学院院士 香港城市大学 · 机械工程学系 · 材料科学及工程学系 · 生物医学工程系及 · 生物医学系讲座教授 · 国家贵金属材料工程技术研究中心 香港分中心主任 先进结构材料研究中心主任
16:15 -16:30	报告 16 增材制造结构创新设计	**宋波教授** 华中科技大学材料科学与 工程学院教授
16:30-16:45	報告 17 3D/4D 生物打印构建多功能免疫微环境用于探索肿瘤精准治疗 3D/4D Bioprinting cancer immune microenvironment for precision oncology	**万钧教授** 香港大学李嘉诚医学院外科学系教授 临床与转化实验室主任
16:45-17:00	報告 18 Templated - assisted manufacturing approaches for biomedical and energy applications	**李振声教授** 香港城市大学化学系系主任及 讲座教授、 材料科学及工程学系讲座教授、 理学院署理院长、 超金刚石及先进薄膜研究中心主任
17:00-17:30	讨论	
17:30-20:00	晚宴(香港城市大学中餐厅)	

第二天（11月26日)		
时间	专题/研讨项目	讲者
主题五：2D材料与器件设计与制造 主持人：范智勇教授		
09:30-09:45	报告 19 无机二维材料液晶的发现与发展	**成会明院士** 中国科学院院士 发展中国家科学院院士 中国科学院深圳理工大学、中国科学院深圳先进技术研究院教授、研究员
09:45-10:00	报告 20 Aggregate Science: There Is Plenty of Room beyond Molecules	**唐本忠院士** 中国科学院院士 发展中国家科学院院士 香港中文大学(深圳)理工学院院长、冠名校长讲座教授
10:00-10:15	报告 21 Phase Engineering of Nanomaterials 纳米材料相工程	**张华教授** 欧洲科学院外籍院士 香港城市大学化学系 胡晓明讲座教授席 (纳米材料)、 材料科学及工程学系讲座教授
10:15 -10:30	报告 22 高迁移率二维材料的制备与界面调控	**彭海琳教授** 北京大学化学与分子工程学院教授、副院长
10:30-10:45	报告 23 Electrode interface engineering towards stable metal (Li/Zn) anodes	**张文军教授** 香港城市大学材料科学及 工程学系署理系主任及讲座教授、 化学系讲座教授
10:45-11:00	报告 24 Heterogeneous integration of 2D materials for advanced optoelectronics	**王欣然教授** 南京大学电子科学与工程学院教授、副院长
11:00 -11:15	报告 25 Strong, Ductile and Tough Nanocrystal - Assembled Quasi - 2D Gold	**杨勇教授** 香港城市大学机械工程系、 材料科学及工程学系、 先进设计及系统工程学系教授
11:15 -11:30	报告 26 亚纳米二维材料控制合成及性质	**王训教授** 清华大学化学系教授
11:30 -11:45	报告 27 Nanoelectronics approaches to semiconductor/electrolyte interfaces	**何其远博士** 香港城市大学材料科学与工程系助理教授

11:45 -12:00	报告 28 二维材料：制备与应用	**任文才博士** 中国科学院金属研究所研究员
12:15 -14:00	午膳 (HK Tech Lodge)	
14:00-14:15	报告 29 碲基电子与光电子器件	**谭超良博士** 香港城市大学电机工程学系助理教授
14:15 -14:30	报告 30 Battery Intercalation Strategy for Material Synthesis, Energy Application and Mechanism Study	**曾志远博士** 香港城市大学材料科学及工程学系助理教授
14:30-15:00	讨论	
主题六 ： 功能导向的新材料设计与制造 联席主持人：吕坚教授、王训教授		
15:00-15:15	报告 31 二维材料范德华异质结晶体管电子器件	**张铮教授** 北京科技大学前沿科学技术交叉研究院教授、副院长
15:15 -15:30	报告 32 High-entropy alloy microlattice metamaterials 高熵合金微点阵超材料	**陆洋教授** 香港城市大学材料科学及工程学系、机械工程系教授
15:30-15:45	报告 33 The Road of Design in Technology-dominated World: Aesthetics in Design Science Research	**李鹂教授** 香港理工大学纺织及服装学系教授
15:45-16:00	报告 34 超长碳纳米管进化生长机制、结构控制与储能应用	**魏飞教授** 清华大学化学工程系教授
16:00-16:15	茶歇	
16:15 -16:30	报告 35 Electrocatalytic properties of metal nanomaterials with unconventional crystal phases	**陈也博士** 香港中文大学化学系助理教授
16:30-16:45	报告 36 Crystal phase-controlled synthesis of noble metal nanomaterials	**范战西博士** 香港城市大学化学系助理教授
16:45-17:00	报告 37 Biomimetic chiral photonic crystals	**唐智勇博士** 国家纳米科学中心研究员
17:00-17:15	报告 38 Optical micro - and nanocavity based coherent and incoherent light sources 基于微纳光腔的相干与非相干光源	**雷党愿博士** 香港城市大学材料科学与工程系副教授
17:15 -17:30	报告 39 Ultrahigh - strength and ductile superlattice alloys with nanoscale disordered interfaces	**杨涛博士** 香港城市大学材料科学及工程学系助理教授
17:30-18:00	讨论	

18:00-18:15	总结	**吕坚教授** 法国国家技术科学院院士 香港城市大学 · 机械工程学系 · 材料科学及工程学系 · 生物医学工程系及 · 生物医学系讲座教授 · 国家贵金属材料工程技术研究中心 香港分中心主任 先进结构材料研究中心主任
18:15-20:00	晚宴(香港城市大学中餐厅)	

讲者名单
(按出场顺序)

卢秉恒院士　中国工程院院士　西安交通大学教授

郭万林院士　中国科学院院士　南京航空航天大学教授、院长

张卫红院士　中国科学院院士　西北工业大学教授、副校长

韩晓东教授　北京工业大学教授、科学技术发展学院常务副院长

王钻开教授　香港城市大学工学院副院长、机械工程系、材料科学及工程学系讲座教授

支春义教授　香港城市大学材料科学及工程学系教授

柴扬博士　香港理工大学应用科学及纺织学院助理院长(研究) 、应用物理学系副教授

范智勇教授　香港科技大学电子及计算器工程学系、化学工程及生物分子工程学系教授
香港科技大学智能传感器与环境技术中心主任

李述汤院士　中国科学院院士　发展中国家科学院院士
苏州大学教授、苏州大学功能纳米与软物质研究院院长、纳米科学技术学院院长
苏州纳米科技协同创新中心主任　江苏省产业技术研究院有机光电技术研究所所长

郑子剑教授　香港理工大学纺织及服装学系教授

宋延林博士　中国科学院化学研究所研究员、实验室主任

张其春教授　香港城市大学化学系材料科学及工程学系教授

王春儒博士　中国科学院化学研究所研究员

于宏宇博士　香港科技大学机械及航空航天工程学系副教授

吕坚教授　法国国家技术科学院院士
香港城市大学机械工程学系、材料科学及工程学系、生物医学工程系及生物医学系讲座教授、
国家贵金属材料工程技术研究中心香港分中心主任、
先进结构材料研究中心主任

宋波教授　华中科技大学材料科学与工程学院教授

万钧教授　香港大学李嘉诚医学院外科学系教授临床与转化实验室主任

李振声教授　香港城市大学化学系系主任及讲座教授、材料科学及工程学系讲座教授、理学院署理院长
超金刚石及先进薄膜研究中心主任

成会明院士　中国科学院院士
发展中国家科学院院士
中国科学院深圳理工大学、中国科学院深圳先进技术研究院教授、研究员

唐本忠院士　中国科学院院士　发展中国家科学院院士
香港中文大学(深圳)理工学院院长、冠名校长讲座教授

张华教授　欧洲科学院外籍院士
香港城市大学化学系胡晓明讲座教授席 (纳米材料)、材料科学及工程学系讲座教授

彭海琳教授　北京大学化学与分子工程学院教授、副院长

张文军教授　香港城市大学材料科学及工程学系署理系主任及讲座教授、化学系讲座教授

王欣然教授　南京大学电子科学与工程学院教授、副院长

杨勇教授　香港城市大学机械工程系、材料科学及工程学系、先进设计及系统工程学系教授

王训教授　清华大学化学系教授

何其远博士　香港城市大学材料科学与工程系助理教授

任文才博士　中国科学院金属研究所研究员

谭超良博士　香港城市大学电机工程学系助理教授

曾志远博士　香港城市大学材料科学及工程学系助理教授

张铮教授　北京科技大学前沿科学技术交叉研究院教授、副院长

陆洋教授　香港城市大学材料科学及工程学系、机械工程系教授

李鹏教授　香港理工大学纺织及服装学系教授

魏飞教授　清华大学化学工程系教授

陈也博士　香港中文大学化学系助理教授

范战西博士　香港城市大学化学系助理教授

唐智勇博士　国家纳米科学中心研究员

雷党愿博士　香香港城市大学材料科学与工程系副教授

杨涛博士　香港城市大学材料科学及工程学系助理教授

温馨提示

- 大会提供餐食安排，请演讲嘉宾完成会议后跟随工作人员指引到餐厅用餐。
- 请按会议日程准时参加各项活动，因事缺席请通知会务人员。
- 请注意个人健康状况及公共卫生，若有呼吸道感染症状或发烧，请即时就医。
- 大会所发文件、材料、名单含个人资料及个别单位内部资料，请妥善保管。
- 参加会议室，请将手机设为静音或震动模式。

主题一 先进结构设计与制造
报告 1

3D打印与创新设计

卢秉恒院士 | 中國工程院院士
西安交通大學教授

个人简介 Biography

西安交通大学教授。我国3D打印领域领军人物。现任高端数控机床与基础制造装备国家重大科技专项技术总师、国家增材制造创新中心主任、中国增材制造标准委员会主任。获国家技术发明奖2项、科技进步奖1项，国家十一五科技攻关组织奖、五一劳动奖章、全球蒋氏科技成就奖获得者。

1982年、1986年分获西安交通大学硕士、博士学位。曾任国家自然科学基金委员会两届专家咨询委员、国务院学位委员会机械学科评议组召集人、中国机械工程学会副理事长等职。

报告摘要 Abstract

报告介绍3D打印作为一项颠覆性的技术，在航空航天汽车医疗及电子产品的开发环节中发挥的重要的作用，为产品和装备的提供了非常大的创新设计空间。其次，报告介绍3D打印正从创新结构、材料成形走向创材，即是创造材料。报告最后介绍了3D打印正处于从3D走向4D、5D的发展趋势。

主题一 先进结构设计与制造
报告 2

Unified Fatigue Fracture Mechanics for Structural Durability and Reliability

郭万林院士 | 中国科学院院士
南京航空航天大学教授、院长

个人简介 Biography

Wanlin GUO, Ph.D. Academician of Chinese Academy of Sciences, chair Professor in mechanics and nanoscience, founder and director of the Key Laboratory of Intelligent Nano Materials and Devices of Ministry of Education and the Institute of Nanoscience of Nanjing University of Aeronautics and Astronautics. He received the National Science Foundation of China for Distinguished Young Scholars in 1996 and the honor of Cheung Kong Scholars in 1999. In 2005, he leaded a team in Nanoscale Physical Mechanics enters the Cheung Kong Scholars Excellent Team Programme of the Ministry of Education of China. In 2010, he founded Key Laboratory of Intelligent Nano Materials and Devices of the Ministry of Education of China. In 2012, he obtained the National Nature Science Prize of China. He has published 400+ refereed papers in mechanics-related journals such as Nature Nanotech, Nature Comm., Phys. Rev. Lett., Nano Lett., J. Am. Chem. Soc., Adv. Mater., J. Mech. Phys. Solids, Phys. Rev. B, Appl. Phys. Lett., Int. J. Strct. Solids, Int. J. Fracture, Int. J. Fatigue, Int. J. Plasticity, Engng Fracture Mech. et al. His current research focuses on 1) three dimensional fatigue fracture and damage tolerance and durability design of structures; 2) intelligent nano materials and devices, multiscale physical mechanics, novel conception and technology for efficient energy conversion; 3) molecular physical mechanics for neuronal signaling and molecular biomimics.

报告摘要 Abstract

The fatigue process of materials has been extensively investigated for hundreds of years. It is well known that inreversible plastic deformation occurs at microscale under repeated loading is the reason for fatigue damage evolution. Although multiscale understanding of the process from dislocation theory of crystals and grain plasticity modelling and numerical simulations from molecular dynamics to continuum mechanics has been well developed, the S-N curve and related empirical modifications still play a dominated role in fatigue life prediction of practical structures. With the development of fracture mechanics, fatigue growth life of a existed crack can be more reasonably predicted using the fracture parameters such as the range of stress intensity factor and fatigue crack closure conception. As a result, crack initiation life comes as a concerned issue. As the S-N like material curves are obtained by smooth samples, while fatigue crack growth curves by cracked specimens, there is a big gap between the two methodologies. Although great efforts have been made sincesince 1980s to examine the behavior of small cracks to narrow the gap, it remains challenge to unify them. The fracture mechanics theories can serve as the fundamental for damage tolerant design of structures to guarantee safety, but fatigue life or durability of structures still relies on empirical fatigue estimations.

The durability of practical structures is mainly determined by the three-dimensional evolution and expansion of small initial defects under service load and environment. Here we present a three-dimensional fracture mechanics based strategy to bridge the gap, achieve whole life predication and explore unification of fatigue and fracture mechanics. Advances in bridging the gap from fracture and fatigue properties obtained in laboratory using standard specimens to durability and reliability of engineering structures in service environments.

1. Zhu J., Guo W., Guo W.L., Surface fatigue crack growth under variable amplitude loading. Engng. Fract. Mech. 2020, 239, 107317.
2. Guo W., Zhu J., Guo W., Guo W.L., Equivalent thickness-based three dimensional stress fields and fatigue growth of part-through cracks emanating from a circular hole. Engng. Fract. Mech. 2020, 228, 106927.
3. Cui P.F., Guo W.L. Crack tip opening displacement based description of three-dimensional creep crack border stress fields for partially penetrating cracked specimens. Engng. Fract. Mech. 2021, 241, 107425.
4. Cui P.F., Guo W.L. Crack tip opening displacement based description of creep crack border fields in specimens with different geometries and thicknesses. Int J Solids Struct, 2020, 188–189, 37-55.
5. Guo W., Chen Z., She C., Universal characterization of three-dimensional creeping crack-front stress fields. International Journal of Solids and Structures 2018, 152, 104-117.
6. Xiang M., Guo W., Formulation of the stress fields in power law solids ahead of three-dimensional tensile cracks. International Journal of Solids and Structures 2013, 50(20), 3067-3088.
7. Yu P., Guo W., An equivalent thickness conception for evaluation of corner and surface fatigue crack closure. Engineering Fracture Mechanics, 2013, 99, 202–213.
8. Yu P., Guo W., An equivalent thickness conception for prediction of surface fatigue crack growth life and shape evolution. Engineering Fracture Mechanics, 2012, 93, 65-74.
9. Xiang M., Yu Z., Guo W., Characterization of three-dimensional crack border fields in creeping solids. International Journal of Solids and Structures 2011, 48(19), 2695-2705.
10. Shen H., Guo W. Lu G., Corrosive fatigue of structures with dimple holes under spectrum environments. Fatigue Fract. Engng Mater.Struct. 2002, 23, 1-11.
11. Guo W., Wang C., Rose F. The Influence of cross-sectional thickness on fatigue cracks growth. Fatigue Fract. Engng Mater. Struct. 1999, 22, 437-444.
12. Guo W. Elastoplastic Three-dimensional Crack Border Field-I~III. Engng. Fract. Mech. I: 1993, 46: 93-104; II: 1993, 46: 105-113; III: 1995, 51: 51-71.

主题一 先进结构设计与制造
报告 3

高性能轻量化航宇结构的优化设计制造理论方法与应用

张卫红院士 | 中国科学院院士
西北工业大学教授、副校长

个人简介 Biography

张卫红，西北工业大学机电学院教授、副校长，国家杰青获得者，入选新世纪百千万人才工程。1991年获比利时列日大学博士学位，主要从事航宇结构设计制造优化理论方法与应用研究。以第一完成人获国家自然科学二等奖1项、省部级一等奖3项、第二届创新争先奖、冯如航空科技精英奖、亚洲ASSMO协会首届杰出贡献奖。主持科技部重点研发计划项目、973课题、国家自然基金重点项目及国际合作重点项目等60余项。发表论文350余篇，SCI论文250余篇，他引7,700余次，SCI他引4,500余次。出版专著5部，获发明专利92件、软件著作权10项。培养5名博士生获青长、优青、青拔、中国青年科技奖、全国学科优博、全国优博提名。

报告摘要 Abstract

航宇结构的优化设计与制造工艺优化理论方法是我国工程技术科学发展的重大需求，直接关系到高端装备创新研制水平与国家核心竞争力。本报告着重介绍相关研究成果。

- 创立了复杂结构整体式构型设计理论与方法。轻量化高性能航宇结构研制创新对传统优化设计理论方法提出了新挑战，如何突破性能设计极限、兼顾高端装备的结构高效承载与组件装填紧凑布局，在国际上全新提出了组件、结构匹配优化的整体式构型设计思想。建立了组件的无干涉布局统一包络圆约束、超单元化快速灵敏度分析、局部变形能控制保形、与特征驱动的关键优化设计方法，解决了重大型号结构设计难题。

- 创建了大型薄壁结构多柔性匹配切削工艺优化技术方法。大型薄壁结构的高精高效切削是我国运20等新一代大飞机制造的瓶颈难题，结构尺寸大、刚度弱、极易变形颤振损伤、加工效率低。为此，创建了多柔性匹配工艺优化理论与方法，突破了传统准刚性假设。建立了三元切削力模型、低切削力参数选配理论公式、加工变形强耦合分析与台阶式切削精准保刚度方法，发明了残余应力定向开槽释放、多模态多时滞抑振增效工艺新技术。实现了国内最大机翼壁板、机身框等5类构件的高精高效制造。

主题一 先进结构设计与制造
报告 4

Atomic-resolved high-temperature mechanical testing system
韩晓东教授 ｜ 北京工业大学教授、科学技术发展学院常务副院长

个人简介 Biography

韩晓东，教授，博士生导师，国家杰出青年科学基金获得者。现任中国电子显微镜学会理事长，北京工业大学科学技术发展院常务副院长。

原创性地发展了材料力学行为的原子层次原位动态表征方法，将材料力学行为原位表征技术的空间分辨率由纳米提高至皮米尺度，实现了1个数量级的提升，部分成果获 2007年中国高等院校十大科技进展。开发了具有自主知识产权和国际领先的力热耦合MEMS芯片、透射电子显微镜原位专用力学实验仪、多通道电学信号传输电路板等核心部件及配套应用分析软件，开辟了高温原子层次材料力学行为实验动力学研究新领域，应用于我国 "卡脖子" 难题的飞机发动机叶片的镍基单晶高温合金等关键材料研究，取得了一系列重要研究成果。关键技术获国内外授权专利33项，其中美国专利3项，国际PCT专利1项，中国发明专利27项。部分成果获得2017年北京市科学技术奖一等奖。发表论文160余篇，包括：Science 2篇，Nature Mater 3篇， Nature Commun 9篇，Nano Lett 12篇，Phys Rev Lett 4篇，Acta Mater 12篇等；承担国家自然科学基金重点项目、科学仪器基础研究专项、国家重大科研仪器设备研制专项课题、航空发动机重大研究计划重点项目等。组织团队开展显微组织结构大数据研究，量子(X-ray光子与高能电子)信息识别与表征，单量子体系材料物理与化学问题研究等。

培养2名全国百篇优秀博士学位论文奖及提名奖，北京市优秀博士学位论文奖4项，率领团队(成员)承担北京市创新团队、北京市卓青计划、国家自然科学基金委优青计划、111引智计划等20余项国家和省部级项目。

主要研究方向：1、原位透射电子显微学；2、材料物理与化学性质；宽温区(室温至1200度)及环境条件下微纳至原子分辨的材料力学行为研究；3、催化材料与显微结构相关性；4、气体传感材料；5、新能源材料与物理化学；6、光学、力学及温度传感材料与器件。

报告摘要 Abstract

Atomic-resolved high-temperature mechanical testing system

Xiaodong Han[1]

Collaborators:
Jianfei Zhang[1],*, Yurong Li[2],*, Xiaochen Li[1],*, Yadi Zhai[1],*, Qing Zhang[1],*, Dongfeng Ma[1],*, Shengcheng Mao[1], Qingsong Deng[1], Zhipeng Li[1], Xueqiao Li[1], Xiaodong Wang[3], Ze Zhang[1, 2] and Xiaodong Han[1]
[1]Beijing University of Technology
[2]Zhejiang University

xdhan@bjut.edu.cn, zezhang@zju.edu.cn

Time and atomic-resolved room-temperature mechanical testing system has been developed in the past [1-6]. Revealing the atomistic mechanisms of high-temperature mechanical behavior of materials is important for optimizing their properties for service at high-temperatures and their thermomechanical processing. However, due to the dynamic recovery and the absence of available in situ techniques, the high-temperature deformation behavior and atomistic mechanisms of materials are difficult to evaluate. Here, we report the development of timely and atomic-resolved high-temperature mechanical testing system that enables mechanical testing at temperatures above 1500K inside a transmission electron microscope [7]. Several metal and alloy examples including W, Cu and Ni-based superalloys are tested with the system. We will introduce tungsten fractures in a ductile manner at high temperature and the dislocation dynamics of Cu tested at high temperatures. Our research provides an approach for timely and atomic-resolved mechanical testing system of materials at high-temperatures.

[1] NATURE COMMUNICATIONS, 1, 24, DOI: 10.1038/ncomms1021, 2010
[2] NATURE COMMUNICATIONS, 3, 609, DOI: 10.1038/ncomms1619, 2012
[3] NATURE COMMUNICATIONS, 4, 2413, DOI: 10.1038/ncomms3413, 2013
[4] NATURE COMMUNICATIONS, 5, 4402, DOI: 10.1038/ncomms5402, 2014
[5] NATURE COMMUNICATIONS, 8, 2142, DOI: 10.1038/s41467-017-02393-4, 2017
[6] NATURE COMMUNICATIONS, 11, 1167, DOI: 10.1038//ncommss41467-020-14876, 2019
[7] NATURE COMMUNICATIONS, 2021, accepted

主题二 仿生结构设计与制造
报告5

基于界面创新的水能关系
王钻开教授 | 香港城市大学工学院副院长
机械工程系、材料科学及工程学系讲座教授

个人简介 Biography

王钻开，香港城市大学机械工程系讲座教授，工学院副院长。他于2000年在吉林大学获得学士学位，2003年在中国科学院上海微系统与信息技术研究所获得硕士学位，2008年伦斯勒理工学院获得博士学位。在哥伦比亚大学从事一年博士后研究后，于2009年9月加入香港城市大学。他是香港青年科学研究院的创始成员，国际仿生工程学会会士和中国教育部授予的长江讲座教授。他曾荣获科学探索奖(2020)，上银机械优秀博士论文银奖指导导师奖(2019)，国际文化理事会青年特别嘉奖(2018)，国际仿生工程学会杰出青年奖(2016)，香港城市大学杰出研究奖(2017)，香港城市大学校长Lectureship(2018，2020)。

Dr. Zuankai WANG is a Chair Professor in the Department of Mechanical Engineering and Associate Dean in the College of Engineering at the City University of Hong Kong. He earned B.S. degree in Mechanical Engineering from Jilin University in 2000 and Master degree in Microelectronics from Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, in 2003, and Ph. D. degree in Mechanical Engineering at Rensselaer Polytechnic Institute in 2008. After one-year postdoc training in Biomedical Engineering at Columbia University, he joined in the City University of Hong Kong in September 2009 as an assistant professor. He is the founding member of Young Academy of Science of Hong Kong, fellow of the International Society of Bionic Engineering and Changjiang Chair Professor awarded by Ministry of Education of China. He has won many awards including the Xplorer Prize (2020), Hiwin Outstanding Doctoral Dissertation Supervisor Award (Silver, 2019), World Cultural Council Special Recognition Award (2018), Outstanding Youth Award from International Society of Bionic Engineering(2016), Outstanding Research Award (2017) and President’ s Lectureship at the City University of Hong Kong (2018, 2020).

报告摘要 Abstract

科技和工业领域的显著进步促进了世界经济繁荣和人口增长，但同时也加剧了全球在水、热和能源三大方面的危机。为了缓解这些危机，人类开发了许多大型设备以实现集水、散热和发电，但是这些大型设备仍然面临多个瓶颈，比如体积笨重以及气候与地理依赖性。相比之下，由于水的普遍存在性及自身蕴含巨大的相变潜热能和动能，可扩缩的水基设备在调节水-热-能关系方面极具潜力。由于水基设备性能对水与表面的界面交互的强烈依赖性，以高效、精确和可编程的方式设计新颖的表面拓扑结构，从而改变表面的物理、化学特性，对于控制水、热和能量在界面上的交换/转换具有实际意义。

由于许多生物体已经进化出功能性表面拓扑结构以从根本上调节它们与液体的相互作用以应对复杂恶劣的外界环境，研发新型的功能性拓扑表面可诉诸于“向自然取经”。尽管仿生拓扑表面领域近年来取得了显著进展，其基本理解和实际应用仍然是两大难以突破的瓶颈。从基本认识的角度来看，自然界有机体的表面拓扑结构控制水滴动态行为的生物原理需要全面破译。从实际应用的角度来看，合理设计表面拓扑结构以整合多种功能于一体，对于工业应用，特别是极端恶劣的工作环境，具有重要意义。在本报告中，我们系统地回顾了课题组近年在推动仿生拓扑表面向实际应用领域转化的进展。首先，我们讨论了促进液滴快速弹跳和液体定向输运的拓扑表面结构设计策略。随后，我们展示了这些设计策略的代表性应用，包括集水、热管理和发电。最后，我们对新型仿生拓扑表面的发展进行了简要总结和展望。

The remarkable advances in technological and industrial fields have stimulated the world's economic prosperity and population growth, while in turn have also exacerbated the global water, thermal, and energy crises. To mitigate these crises, numerous large-scale devices have been constructed to harvest water, dissipate heat and generate energy, yet, they still encounter several bottlenecks, such as bulky size and climatic and/or geographic constraints. In contrast, scalable water-based devices have demonstrated their tremendous potential in water-heat-energy nexus due to the ubiquitous existence, large phase-change latent heat, and abundant kinetic energy of water. Owing to the strong dependence of their performances on the interfacial interactions between water and surface, designing novel surface topology, both in physical and chemical aspects, is of practical importance to impart them with ability to control interfacial interaction/exchange between water, heat and energy in an efficient, precise, and programmable manner.

Developing novel, functional, and topological surfaces can resort to learning from nature as many living organisms have evolved functional surface topologies to fundamentally tailor their interactions with liquids to survive in complicated and harsh environments. Although great progress has been made in bio-inspired topological surfaces, two major bottlenecks, that are, fundamental understandings and practical applications, remain elusive. From the perspective of fundamental understandings, the principles by which surface topology of organism controls dynamic behaviors of water droplet, need to be deciphered comprehensively. From the perspective of practical applications, rationally designing surface topologies to achieve multifunctionality in industrial processes, especially in the complex and harsh conditions, is of great importance. In this Account, we systematically review our recent progress in promoting bio-inspired topological surfaces towards practical applications. We start with the fundamental investigation on various topological surfaces for rapid droplet bouncing as well as directional liquid transport. Based on these fundamental understandings, we further demonstrate their representative practical applications, including water harvesting, thermal management, and energy generation. Finally, we offer a brief summary and perspectives on the development of novel bio-inspired topological surfaces.

主题二 仿生结构设计与制造
报告 6

Aqueous battery for large-scale energy storage
支春义教授 | 香港城市大学材料科学及工程学系教授

个人简介 Biography

Chunyi ZHI obtained B.S. degree in Physics from Shandong University and Ph.D. degree in condensed matter physics from Institute of Physics, Chinese Academy of Sciences. After two years' postdoc in National Institute for Materials Science (NIMS) in Japan, he was promoted to be ICYS researcher, researcher (faculty) and senior researcher (permanent position) in NIMS. Dr. Zhi is now an professor in MSE, CityU.

Dr. Zhi has extensive experiences in flexible energy storage, aqueous electrolyte batteries, zinc ion batteries and highly thermally conducting insulating polymer composites. He has published more than 400 papers, including Nature Review Mater.; Nature Commun.; Energy Environ. Sci.; Adv. Mater.; J. Am. Chem. Soc.; Angew Chem. In. Ed. etc, with >40 ESI highly cited papers (by 11, 2021), an H-index of 100 and other-citation of 35000. He has been granted more than 80 patents.

Dr. Zhi is a recipient of the outstand research award and President Award of CityU, NML Researcher award, IAAM medal and Beijing Science and Technology Award (first class). He is Clarivate Analytics Global highly cited researcher (2019, 2020, Materials Science), RSC fellow and member of The Hong Kong Young Academy of Sciences.

报告摘要 Abstract

Development of energy storage system in the past year focus on improvement of energy density. While the progress is remarkable, safety problems of lithium ion batteries (LIB) have been intensively exposed. On one hand, LIB is not intrinsically safe with very active anode, flammable electrolyte and oxygen-releasing cathode; on the other hand, many application scenarios actually don’ t require very high energy density.

We work on aqueous electrolyte batteries to achieve both high energy density and superior safety performance. we show how to activate the desired reversible I^0/I^+ redox at a potential of 0.99 V vs. SHE by electrolyte tailoring via F^-, Cl^- ions-containing salts. The electronegative F^- and Cl^- ions can stabilize the I^+ during charging. In an aqueous Zn ion battery based on an optimized $ZnCl_2$ + KCl electrolyte with abundant Cl^-, I-terminated halogenated $Ti_3C_2I_2$ MXene cathode delivers two well-defined discharge plateaus at 1.65 V and 1.30 V, superior to all reported aqueous I_2-metal (Zn, Fe, Cu) counterparts. Together with the 108% capacity enhancement, the high voltage output results in a significant 231% energy density enhancement.

In addition, we also develop various approaches to stabilize the Zn anode. We accurately quantifying the hydrogen evolution in Zn metal battery by in-situ battery-gas chromatography-mass analysis. Then, we propose an vapor-solid method for an highly electronically insulating (0.11 mS・cm^{-1}) but high Zn^{2+} ion conductive (80.2 mS・cm^{-1}) ZnF_2 solid ion conductor with high Zn^{2+} transfer number (0.65) to isolate Zn metal from liquid electrolyte, which can not only prohibit over 99.2 % parasitic hydrogen evolution reaction during cycling but also guide uniform Zn electrodeposition. Meanwhile, Zn@ZnF_2//Zn@ZnF_2 symmetric cell exhibits excellent stability over 2500 h (over 6250 cycles) with 1 mAh・cm^{-2} of Zn reversibly cycled at 5 mA・cm^{-2}, and stable cycling under ultrahigh current density and areal capacity (10 mA・cm^{-2}, 10 mAh・cm^{-2}) over 590 h (285 cycles), which far outperforms all reported Zn metal anode in aqueous system. In light of the superior Zn@ZnF_2 anode, the practical-level aqueous Zn@ZnF_2//MnO_2 batteries (~3.2 mAh・cm^{-2}) shows remarkable cycling stability over 1000 cycles with 93.63 % capacity retained at ~100 % coulombic efficiency.

Bio-inspired in-sensor visual adaptation for accurate perception

柴扬博士 | 香港理工大学应用科学及纺织学院助理院长(研究) 、
应用物理学系副教授

个人简介 Biography

Yang CHAI is Assistant Dean of Faculty of Applied Science of Hong Kong Polytechnic University, Vice President of Physical Society of Hong Kong, a member of The Hong Kong Young Academy of Sciences, IEEE Distinguished Lecturer since 2016, and was the Chair of IEEE ED/SSC Hong Kong Chapter (2017-2019). He is a recipient of RGC Early Career Award in 2014, the Semiconductor Science and Technology Early Career Research Award in 2017, PolyU FAST Faculty Award in Research and Scholar Activities in 2018/2019, Young Scientist Award of ICON-2DMAT in 2019, PolyU President's Award in Research and Scholar Activities in 2019/2020, Nano Research 45 Young Innovators Award in 2021, and Young Scientist of World Laureate Forum in 2021. His current research interest mainly focuses on emerging electronic devices.

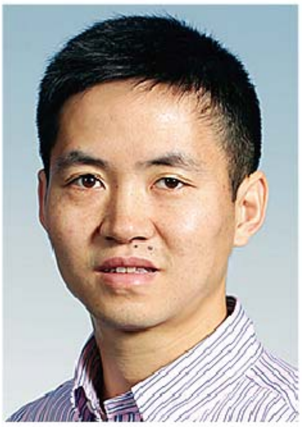
报告摘要 Abstract

The number of nodes in sensory networks is growing rapidly, leading to large amounts of redundant data being exchanged between sensory terminals and computing units. To efficiently process such large amounts of data, and decrease power consumption, it is necessary to develop approaches to computing that operate close to or inside sensory networks, and that can reduce the redundant data movement between sensing and processing units [1, 2]. The rapid development of machine vision demands optoelectronic devices that can capture and perceive the scene with wide-range light illumination for accurate representation [3]. Most of existing machine vision systems typically require complicated circuitry and algorithm to adapt natural scene with wide-range light illumination. Here we demonstrate bio-inspired vision sensors with MoS_2 phototransistors that can exhibit time-varying activation and inhibition characteristics and adapt to wide-range scenes at photo-sensory terminals. The light-intensity-dependent characteristics of the MoS_2 vision sensor match well with Weber's law, in which the perceived change in stimuli is proportional to the light stimuli. The gate terminal of phototransistors enables the visual adaptation with highly localized and dynamic modulation of photo-sensitivity under different lighting conditions at a pixel level, exhibiting an effective perception range up to 199 dB. Through this bio-inspired in-sensor adaptation process in the receptive field, the phototransistor array shows image contrast enhancement for both scotopic and photopic adaptation.

主题二 仿生结构设计与制造
报告 8

基于半球形高密度纳米线阵列的仿生视网膜和电化学仿生眼

范智勇教授 | 香港科技大学电子及计算器工程学系、化学工程及生物分子工程学系教授
香港科技大学智能传感器与环境技术中心主任



个人简介 Biography

范智勇，香港科技大学电子与计算机工程系正教授。香港科大智能传感器与环境技术中心主任，香港科大材料表征中心副主任，香港科大能源学院，先进显示与光电子技术国家重点实验室成员，粤港澳智能微纳光电联合实验室副主任，英国皇家化学会会士，IEEE资深会员，香港青年科学院创始成员。复旦大学本科和硕士，加州大学欧文分校材料科学博士。曾任加州大学伯克利分校电气工程和计算机科学系及劳伦斯伯克利国家实验室博士后研究员。获得多项奖项，包括加州大学BSAC杰出研究报告奖，香港科技大学工院青年研究员奖，杰出研究奖及香港科技大学校长奖及创新奖，山东省自然科学二等奖等。研究兴趣集中在可用于电子及光电器件的纳米材料和结构。迄今在Nature, Nature Materials, Nature Communications, Science Advances, PNAS等期刊发表了200多篇学术论文，谷歌引用次数~22,000，H指数78，为2018科睿唯安高引作者。

报告摘要 Abstract

对于地球上的大多数动物来说，生物眼是最重要的传感器官。我们的大脑通过我们的眼睛获取了80%以上的周围环境信息。亿万年的进化形成了我们半球形的视网膜，其独特的特性包括高达150度的宽广视野，在中央凹处视细胞的高分辨率为1弧分，以及对光学环境的出色适应性。而且，视网膜的圆顶形状具有通过直接补偿弯曲焦平面的像差来降低光学系统复杂性的优点。长久以来，世界各国的研究人员们致力于研制模仿人类眼睛构造的成像器件来用在诸如机器人和人类视觉修复等方面。原则上，仿生人类视网膜的半球形图像传感器设计可以实现此目标。但是商用电荷耦合器件(CCD)和互补金属氧化物半导体(CMOS)图像传感器都是用微电子工业中的平面微加工工艺制备而成，从而几乎不可能制造半球形器件。本报告将展示一种特殊的球形仿生电化学眼，其半球形视网膜是通过气相法生长的高密度钙钛矿纳米线阵列制成的。我们使用离子液体电解质用作纳米线的正面公共电极，液态金属线用作纳米线光传感器的背接触电极，同时仿生视网膜后的视神经纤维。器件测试表明，电化学眼具有高响应度，合理的响应速度，较低的检测极限以及较宽的视野，还具有基本的成像功能。除了与人眼的结构相似之外，半球形人工视网膜的纳米线密度高于人类视网膜中感光器的密度，因此有实现更高图像分辨率的潜力。

主题三 柔性器件设计与制造
报告 9

柔性器件的制造和应用

李述汤院士 | 中国科学院院士
发展中国家科学院院士
苏州大学教授、功能纳米与软物质研究院院长、
纳米科学技术学院院长
苏州纳米科技协同创新中心主任
江苏省产业技术研究院有机光电技术研究所所长

个人简介 Biography

中国科学院院士，发展中国家科学院院士。苏州大学功能纳米与软物质研究院(FUNSOM)创建院长、纳米科学技术学院(CNST)创建院长、苏州纳米科技协同创新中心(NANO-CIC)主任、江苏省产业技术研究院有机光电产业技术研究所(Institute of Organic Optoelectronics, JITRI)所长。曾任香港城市大学物理与材料科学系讲座教授、超金刚石及先进薄膜研究中心(COSDAF)创建主任，美国柯达公司高级研究员、项目主任等。

长期从事纳米功能材料及器件、有机光电子材料及器件以及金刚石和相关超硬薄膜领域的研究，在上述领域取得了卓越的成就，并获得了一系列创新性研究成果。其主要研究成果“金刚石及新型碳基材料的成核与生长”、“氧化物辅助合成一维半导体纳米材料及应用”和“高效光/电转换的新型有机光功能材料” 先后荣获德国洪堡基金会研究成就奖(Humboldt Research Award)和香港裘槎基金会高级研究成就奖(Croucher Senior Research Fellowship)，并三次荣获国家自然科学二等奖(2002年唯一完成人，2005年第一完成人，2013年第二完成人)。2008年获何梁何利基金科技进步奖。2013年获苏州市创新创业市长奖。

在国际化学、物理、材料等领域的期刊发表学术论文1,100余篇，撰写专著9部，获美国专利20余项，论文被他人引用超过70,000次，H-index达到130。其中有7篇研究论文发表在著名的《科学》(美国)和《自然》(英国)期刊，另有数十篇学术论文以封面文章的形式发表。其研究成果在国际材料科学界占有重要地位。2014-2020年入选科睿唯安(Clarivate Analytics，原汤森路透公司(Thomson Reuters))发布的“全球高引用科学家名录”(Highly Cited Researchers)。现任《ACS Nano》副总编辑。

报告摘要 Abstract

柔性电子是未来世界的重要新兴产业。柔性电子以柔性材料、器件与制造技术为核心，具备轻、薄、可拉伸、可弯曲、不易碎等机械特性，在新能源、光电信息、生物医学和绿色环境等领域带来广阔的应用前景。近年，柔性电子的研究发展迅速，产业化已开始兴起。特别是，以有机发光二极管(OLED)为代表的有机光电技术具有自主发光、快速响应、高效节能、材质轻薄、色彩丰富、可透明化、可柔性弯折等特性，在显示和照明领域具有独特的优势。OLED已在移动通讯、计算机及平板电视等信息显示领域进入商业化阶段，同时也在柔性显示、可穿戴显示、室内照明及医疗照明等领域进入应用开发的冲刺阶段。上述柔性电子技术虽然近年来已取得快速进步，但仍有诸多重大科技问题亟待解决。

本报告将集中介绍我们团队在柔性电子领域从科学研究至产业应用的探索工作，包括：OLED制造装备与系统集成；柔性器件界面光调控和薄膜封装；柔性摩擦纳米发电机及可穿戴式传感器；柔性有机及钙钛矿太阳能电池。

主题三 柔性器件设计与制造
报告 10

Fiber-enabled High-performance Wearable Battery and Beyond

郑子剑教授 | 香港理工大学纺织及服装学系教授

个人简介 Biography

Prof. Zijian ZHENG is currently Full Professor at the Institute of Textile and Clothing (ITC) and Research Institute for Smart Energy (RISE) at The Hong Kong Polytechnic University. His research interests are surface and polymer science, nanofabrication, flexible and wearable electronics, energy conversion and storage. Prof. Zheng received his B. Eng. in Chemical Engineering at Tsinghua University in 2003, and PhD in Chemistry at University of Cambridge in 2007 (Supervisor: Prof. Wilhelm T. S. Huck). In 2008, he worked as postdoctoral researcher with Prof. Chad A. Mirkin at Northwestern University in the USA. He joined ITC as Assistant Professor in 2009, and was promoted to tenured Associate Professor in 2013 and Professor in 2017. He has published more than 130 papers in high-impact international scientific journals including Science, Nat. Mater., Nat. Comm., Adv. Mate., JACS, Angew. Chem.. He also files 25+ patents and is recipient of more than 15 academic awards. He serves as Guest Editor of Advanced Materials and Small, and Editor-in-Chief of EcoMat, a flagship open-access journal in green energy and environment published by Wiley. He is Founding Member of The Young Academy of Sciences of Hong Kong, Chang Jiang Scholars Program by the Ministry of Education of China, and Senior Research Fellow of the UGC of Hong Kong.

报告摘要 Abstract

Wearable energy storage devices are indispensable corner stones for future wearable electronics. Current energy storage technologies are based on materials and devices that are rigid, bulky, and heavy, making them difficult to wear. On the other hand, fibers are flexible and lightweight materials that can be assembled into different textiles and have been worn by human beings thousands of years. Different from conventional two-dimensional thin films and foils, the three-dimensional fibre and textile structures not only provide superior wearing ability, but also much larger surface areas. This talk will introduce how our research group makes use of the attributes of fibres for high-performance wearable energy storage devices. We will demonstrate the strategies and discuss the perspectives to modify fibers and textiles for making wearable capacitators and batteries with excellent mechanical durability, electrochemical stability, and high energy/power density. This talk will also discuss the how to use fibrinous materials for highly stable and high energy density Na battery.

References

[1] Q. Huang, D. Wang, Z. J. Zheng*, Adv. Energy Mater. 2016, 6, 1600783.
[2] L. Liu, Y. Yu, C. Yan, K. Li, Z. J. Zheng*, Nat. Commun. 2015, 6, 7260.
[3] Y. Yu, C. Yan, Z. J. Zheng*, Adv. Mater. 2014, 26, 55085516.
[4] Y. Yang, Q. Huang, L. Niu, D. Wang, C. Yan, Y. She, Z. J. Zheng*, Adv. Mater. 2017, 160667.
[5] J. Chang, Z. J. Zheng* et al., Nat. Commun. 2018, 2018, 9, 4480.
[6] J. Chang, Q. Huang, Y. Gao, Z. J. Zheng*, Adv. Mater. 2021, 2004419
[7] J. Chang, Q. Huang, Z. J. Zheng*, Joule 2020, 4, 7, 1346-1349.
[8] L. Wang, J. Shang, Q. Huang, H. Hu, Y. Zhang, C. Xie, Y. Luo, Y. Gao, H. Wang, Z. J. Zheng*, Adv. Mater. 2021, 2102802.

主题三 柔性器件设计与制造
报告 11

纳米绿色印刷制备光电器件
Green Printing Technology for Manufacturing Optoelectronic Devices

宋延林博士 | 中国科学院化学研究所研究员、实验室主任

个人简介 Biography

宋延林，中国科学院化学研究所研究员、博士生导师，中国科学院大学长江学者特聘教授，中国科学院绿色印刷重点实验室主任。1996年于北京大学化学系获博士学位，1996-1998年清华大学化学系博士后。主要从事光电功能材料、纳米材料与绿色印刷技术研究。已发表SCI 收录论文400余篇，引用24,000余次，并多次被Nature, Science 等作为研究亮点报道。主持和参加编写英文专著10部，中文专著2部；获授权中国发明专利100余项，美国、日本、欧盟、韩国等授权发明专利26项。

Yanlin SONG is a professor in the Institute of Chemistry, Chinese Academy of Sciences (ICCAS). He received his Ph.D. degree from the Department of Chemistry at Peking University in 1996. Then he conducted research as a postdoctoral follow at Tsinghua University from 1996 to 1998. He has been working at ICCAS since 1998. His research interests include nano-materials and green-printing technology, printed electrics and photonics, fabrication and applications of nanostructured devices. He has published more than 400 papers with 24,000 citations, 2 books and 12 chapters, and has been granted more than 120 patents from China, USA, European Union , Japan and Korea, etc.

报告摘要 Abstract

基于纳米材料制备及功能墨滴图案化的基础科学问题，通过研究纳米材料构建浸润性差异的材料表面，发展了系统的绿色印刷技术；探究印刷过程中液滴的扩散、聚并及干燥行为，揭示了溶液印刷加工过程中材料界面融合和精细结构控制规律，实现功能材料从零维到三维以及“点、线、面、体”的精细图案化组装；通过微液滴、微气泡动态行为控制的深入研究，发展了以固、液、气不同形态微模板的调控印刷制备微纳米器件的印刷方法。在此基础上，发展出可以实现纳米尺度超高精度印刷的新概念印刷技术，并应用在可穿戴传感器、高精度嵌入式导电银线、集成电路微纳串线、太阳能电池、柔性驱动器、多分析传感芯片等功能器件领域。系列研究成果得益于对表界面控制、液滴操控成型以及功能性纳米材料制备等方面的基础与应用研究，构建了纳米绿色印刷技术的理论和技术体系。

Based on the droplet drying process on the surfaces of different wettability, controllable nanoparticles assembling and stereo structures patterning could be achieved. Through controlling the droplet spinning motion and movement of the vapor-solid-liquid three phase contact lines, the basic units (dot, line, plane and stereo structures) via the printing technology can be precisely controlled. Significantly, we achieved the silver nanoparticles assembled conductive patterns with single nanoparticle resolution. Our further work on assembling metal nanomaterials or graphene via printing process, patterned various linear or curved 1D/2D structures on diverse substrates. The desirable conductive patterns contribute the remarkable application on sensitive electronical skin, transparent touch screen, multi-layer circuits, ultra-integrated complex circuits, solar cells and soft actuators. Moreover, stereo structures can be prepared through manipulating the solid-solid interface, which contributes to a versatile additive manufacture procedure. This achievement on printed electronics and additive manufacture are benefited from the fundamental researches on interfacial wettability manipulation, morphology control of drying droplets, as well as functional nanomaterial fabrication, which constructs the theoretical and technical system of Green Printing Technology.

主题三 柔性器件设计与制造
报告 12

The hybrid unity power: Organic Cocrystals make materials diverse

张其春教授 | 香港城市大学化学系、材料科学及工程学系教授

个人简介 Biography

Dr. Qichun ZHANG obtained his B.S. at Nanjing University in China in 1992, MS in physical organic chemistry (organic solid lab) at Institute of Chemistry, Chinese Academy of Sciences in 1998, MS in organic chemistry at University of California, Los Angeles (USA), and completed his Ph.D. in chemistry at University of California Riverside in 2007. Then, he joined Prof. Kanatzidis' group at Northwestern University as a Postdoctoral Fellow (Oct. 2007 –Dec. 2008). Since Jan. 2009, he joined School of Materials Science and Engineering at Nanyang Technological University (NTU, Singapore) as an Assistant Professor. On Mar 1st, 2014, he has promoted to Associate Professor with tenure. On Sep 1st 2020, he moved to Department of Materials Science and Engineering at City University of Hong Kong as a tenured full professor. Currently, he is an associate editor of J. Solid State Chemistry, the International Advisory Board member of Chemistry – An Asian Journal, the Advisory board member of Journal of Materials Chemistry C, the Advisory board member of Materials Chemistry Frontiers, the Advisory board member of Inorganic Chemistry Frontiers, the Advisory board member of Aggerate, and the Advisory board member of Materials Advances. Also, he is Guest Editors of CCS Chemistry (2020-2021), Advanced Materials (2020-2021), J Mater Chem C (2020-2021, 2017-2018), Mater. Chem Front (2019-2020), Inorganic Chemistry Frontiers (2016-2017, 2017-2018). In 2018, 2019, 2020 and 2021, he has been recognized as one of highly-cited researchers (top 1%) in cross-field in Clarivate Analytics. He is a fellow of the Royal Society of Chemistry. Currently, his research focuses on carbon-rich conjugated materials and their applications. Till now, he has published >441 papers and 5 patents (H-index: 92).

报告摘要 Abstract

Organic cocrystals based on noncovalent intermolecular interactions (week interactions) have aroused enormous interest due to their unpredicted and versatile chemicophysical properties and charming applications (Figure 1). In this presentation, I will highlight recent emerging research of organic cocrystals on reducing aggregation-caused quenching (ACQ) effect, turning transport characteristic, and mechanic(solvo)-stimulus responsive behaviors.

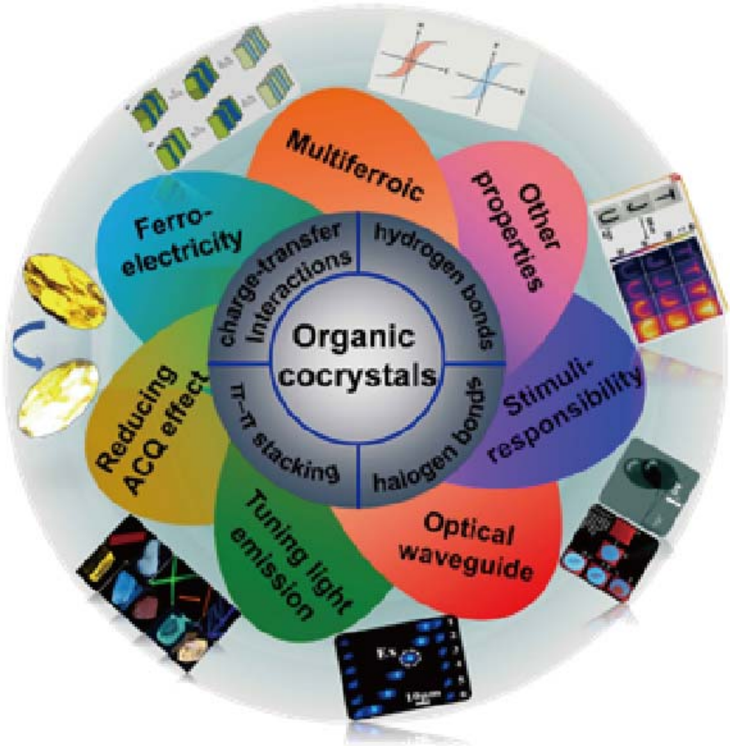


Figure 1. Emerging properties and applications of organic co-crystals

主题三 柔性器件设计与制造
报告 13

富勒烯基柔性光伏器件

王春儒博士 | 中国科学院化学研究所研究员

个人简介 Biography

王春儒，中科院化学所研究员，博士生导师，中科院引进国外杰出人才计划、基金委杰出青年基金获得者，第二批国家“万人计划”科技创业领军人才，现任中国科学院分子纳米结构与纳米技术重点实验室副主任。第十三届全国政协委员。

主要研究方向为富勒烯纳米材料及其应用研究，在国际上率先开展高纯度富勒烯和金属富勒烯的宏量制备，开发了富勒烯在有机柔性光伏器件，空气净化材料，以及生物医药方面的应用，特别是研究了富勒烯在治疗糖尿病、贫血、肺纤维化、脂肪肝等方面广泛的应用。近年来在包括Nature，Science, Nature Commun., JACS, Adv. Mater. 等杂志上发表文章260多篇，申请发明专利150项，其中80多项已经转让到相关企业。

报告摘要 Abstract

相比于硅基等无机太阳能电池，有机太阳能电池具有柔性、质轻、材料多样性等优势。尤其随着人工智能的快速发展，近年来柔性器件受到科研与商业界的广泛关注。如图1所示，柔性有机太阳能电池器件附着在布、织物等上仍可有效工作，有望为可穿戴电子设备及物联网中的软体机器人供电。但是，受限于有机半导体介电常数低、迁移率低等问题，有机太阳能电池效率偏低。为克服该问题，我们基于在富勒烯领域的深入研究与长期积累，设计合成了高迁移率、高LUMO能级的无定形富勒烯受体，提高了有机太阳能电池的效率与稳定性；设计合成了双功能富勒烯界面修饰材料，抑制了界面载流子复合，显著提高了器件效率；设计了富勒烯基三元有机太阳能电池，优化活性层形貌，促进载流子传输，在实现高效率的同时，揭示活性层形貌与器件性能之间的关系。

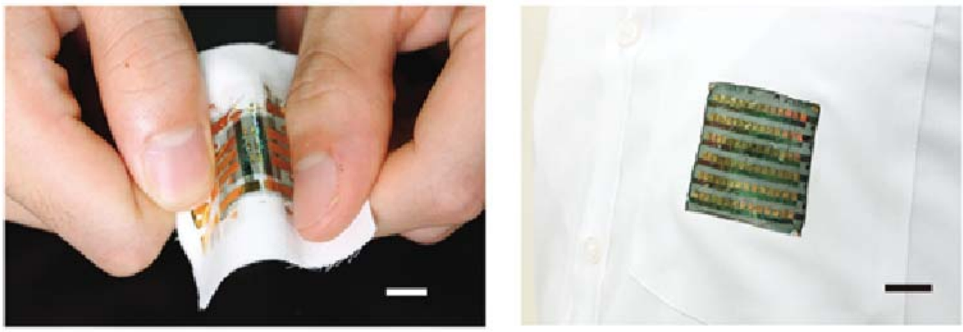


Figure 1
Photographs of ultrathin organic solar cells attached on a) texitle and b) cloth. a) Scale bar, 10 mm. b) Scale bar, 20 mm. (Adv. Energy Mater. 2020, 2000765)

主题三 柔性器件设计与制造
报告 14

基于折纸超结构的柔性可穿戴电子器件设计与制造
于宏宇博士 | 香港科技大学机械及航空航天工程学系副教授

个人简介 Biography

于宏宇分别于1997年和2000年在清华大学电子工程专业取得学士和硕士学位，于2005年在南加州大学取得电气工程博士学位。2008-2017于教授在亚利桑那州立大学任教并于2018年加入香港科技大学机械和航空航天工程学系任副教授。他的主要研究方向包括基于折纸的智能结构，传感器件及系统，以及应用于立方体卫星、飞行器和消费电子产品的微型仪器。

报告摘要 Abstract

在柔性电子领域，基于硅材料的刚性组件仍然必不可少。如果将刚性组件直接与柔性电路键合，在结合处会产生应力失配，进而引发器件整体的损坏。可动折纸结构为组件级的刚性和器件级的柔性假设了一座桥梁。

基于最简单的可动结构——三浦折迭结构，我们验证了基于折纸结构的可拉伸电路板的可行性，并提出了设计的基本过程。在此基础上，我们进一步研究了三浦折迭结构的一种推广——平面型可展双瓦楞结构在基于折纸的电路板的应用。我们将折纸结构与可拉伸的布料结合，并将除电池外的所有元器件集合到基于折纸结构的可拉伸电路板上，实现了一个心电监测系统。可动折纸结构均可依靠上述方法实现可变形的电子产品，有望应用于柔性器件和柔性机器人的制造。

主题四 3D/4D列印、智慧结构设计与制造
报告 15

增材制造与4D打印新进展

吕坚教授 | 法国国家技术科学院院士
香港城市大学机械工程学系、材料科学及工程学系、
生物医学工程系及生物医学系讲座教授、
国家贵金属材料工程技术研究中心香港分中心主任、
先进结构材料研究中心主任

个人简介 Biography

吕坚，香港城市大学机械工程讲座教授，先进结构材料研究中心主任。研究涉及先进纳米材料制备与力学性能，3D/4D打印，结构与功能材料预应力工程，其中已经获批的3个美国专利的4D打印陶瓷集成技术被欧盟【100 Radical Innovation Breakthroughs for the future】文件选为4D打印解决方案之一。78年考入北京大学， 79年获国家奖学金赴法国贡比涅技术大学读本科， 86年获该校博士学位。在Nature(封面文章)，Science, Nature Materials, Nature Communications, Science Advances, Materials Today, Advanced Materials, Acta Materialia, PRL等杂志上发表论文450余篇，引用3万余次，49项欧，美，中专利获授权。中科院首批海外评审专家, 中科院沈阳金属所客座首席研究员，东北大学，北京科技大学等大学名誉教授, 上海交大，西安交大，西北工业大学，西南交通大学顾问教授，中科院知名学者团队成员。2011年被法国国家技术科学院(NATF)选为院士，是该院300余位院士中首位华裔院士。2006年与2017年分别获法国总统任命获国家荣誉骑士勋章及国家荣誉军团骑士勋章，2018年获中国工程院光华工程科技奖。

报告摘要 Abstract

发展高效先进节能机械系统是人类社会发展的重要标志，新材料与增材制造为发展高效的仿生及无人系统带来了新的契机。本报告将介绍超纳双相等新型2D增材制造结构纳米材料的新发展趋势及其在不同系统应用中的集成。还将介绍柔性材料的3D打印及不同驱动方式的(预应力，水，酒精，光驱动聚集诱导发光)4D打印复杂形状材料与结构的工作原理和制备，以及它们的广泛应用前景。增材制造为我们带来了无数新的实现方案及拓展空间，也让实现新的高性能的超材料变成可能。

主题四 3D/4D列印、智慧结构设计与制造
报告 16

增材制造结构创新设计

宋波教授 | 华中科技大学材料科学与工程学院教授

个人简介 Biography

宋波，华中科技大学教授，博士生导师。现任中央军委科技委国防科技创新特区“4D打印技术”主题专家、办公室主任。获国家基金委优秀青年基金、湖北省杰出青年基金，湖北省楚天学子等。获聘Nano Materials Science，Metal，Advanced Powder Materials等期刊编委，Engineering青年通讯专家，《金属学报》与《中国有色金属学报》青年编委，《机械工程学报》“4D打印技术”客座编辑，《航空制造技术》“增材制造结构创新设计”专栏客座主编，《金属学报》“增材制造材料创新设计”专栏客座主编等。长期从事增材制造先进材料与结构设计的研究，近年来在Materials Today，Additive Manufacturing，Acta Materialia，Acta Biomaterialia，Scripta Materialia，Engineering，Composites Part B等国际期刊发表SCI收录论文70余篇，SCI他引2 500余次；授权发明专利10余项；主编学术专著2部(包括ELSEVIER出版英文专著1部)、参编专著4部；主持或参与制定国家标准3项。相关成果获湖北省技术发明一等奖(排5)、第二届全国源创杯南部赛区二等奖(排1)、中国机械工程学会工作成果奖等科研奖励。

报告摘要 Abstract

增材制造技术(Additive Manufacturing，AM)是高端制造业的重要发展方向之一，由于其独特的制造特性，能够实现复杂化、整体化、个性化的高性能构件，在航空航天航海、生物医疗领域存在较大的应用空间。为适应高端装备对构件多性能要求，结构设计从轻量化拓扑优化设计，发展到多物理场耦合的功能结构设计和基于环境激励响应的智能结构设计。其中，面向增材制造的多物理场耦合功能的超材料设计是未来重要的发展方向之一。超材料是一种经过合理设计以表现出特殊力学、声学、热学或电磁特性的工程材料。本报告从力学超材料、声学超材料和生物超材料等方面汇报本课题组近期在增材制造结构设计领域的研究进展。最后，总结并展望结构创新设计为各行各业对增材制造的需求提供技术支撑且切实的描绘了广阔的应用前景。

主题四 3D/4D列印、智慧结构设计与制造
报告 17

3D/4D Bioprinting cancer immune microenvironment for precision oncology
3D/4D 生物打印构建多功能免疫微环境用于探索肿瘤精准治疗
万钧教授 | 香港大学李嘉诚医学院外科学系教授临床与转化实验室主任

个人简介 Biography

万钧教授现任香港大学外科学系临床与转化实验室主任，器官移植与再生实验室主任，肝移植与肝癌实验室主任。主要从事肝脏移植损伤，肝癌及其肝移植后肿瘤复发的临床，转化和基础研究，是这一领域的杰出专家。并在动物模型的开发和建立、影相学于肿瘤研究的应用以及分子生物学等方面有相当丰富的经验。研究成果处于相关领域的国际领先水平，并在多家国际知名期刊上发表了超过200篇论文，其中包括：Journal of Hepatology, Gastroenterology, Annals of Surgery, Transplantation, Liver Transplantation, Clinical Cancer Research and Cancer Research, New England Journal of Medicine, Nature Medicine等。引用次数超过13268次 (H index 54)。2013-2019年起连续七年被评为港大最高(1%)引用率学者。

万钧教授是2018-2019国际肝脏移植学会(ILTS)主席及国际肝脏移植学会2018年会的大会主席，国际移植学会(TTS)女性创会会员及国际导师，国际移植学会移植科学委员会委员。曾任国际肝脏移植学会奖学金委员会主席，国际肝脏移植学会教育委员会委员和基础研究委员会委员。

万钧教授先后担任多个国际知名期刊的编委和审稿工作，目前任移植杂志(Transplantation)的 Deputy Editor及Annals of Surgery 编委。

万钧教授是浙江大学，南京医科大学和浙江省人民医院的荣誉教授。 作为香港科协主席，万钧教授在推动两岸四地的科研学术交流与合作中也不遗余力。 她在国际学术团体，地区间合作项目以及港大科研团队都有相当丰富的领导与管理經验， 通过与来自不同领域专家的精诚合作，万钧教授成功建立了一系多学科綜合研究平台，也开展了香港大学与国际及国内的实质性合作。

同时，万钧教授带领的研究团队具有优秀的团队合作精神，她带领的移植研究团队是亚洲最成功的团队之一。近16年来在肝脏移植，肝癌和肝炎的研究领域获得超发过65项国际大奖。包括国际肝脏移植协会的多项“青年学者奖”和“明日之星奖”；国际移植协会颁发的“青年学者奖”和“学员和导师奖”；美国癌症研究学会授予的“研究学者奖”。万钧教授也是中国教育部2013年高等教育科技成果一等奖和2014年中华医学会科技进步一等奖获得者。

Dr. Nancy K MAN is currently a Professor of Department of Surgery, LKS Faculty of Medicine of the University of Hong Kong. Her main research focus is in the area of liver graft injury and cancer recurrence after transplantation utilizing an integrated basic, clinical and translational approach. She has developed a series of novel animal models to mimic liver graft injury and cancer recurrence. She is the first to establish a rat orthotopic liver transplantation model using small-for-size graft in Hong Kong. These models have been extensively introduced into the investigation of liver transplantation. For example, the correlation between transient portal hypertension resulted from excessive portal flow and hepatic sinusoidal damage of small-for-size liver graft was first revealed in animal model she established and the finding was subsequently validated in a series of her clinical studies. The further studies for the mechanism of graft injury and novel treatments were also conducted in animal models she established. She is first to report the significance of small-for-size liver graft injury on tumor recurrence after transplantation in the world and further to explore the molecular mechanisms of inflammatory response in acute phase and tumor invasiveness in late phase. In parallel, she has focused on the molecular mechanisms involved inflammation and cancer progression, together with the development of novel therapies for cancer metastasis. In addition, she has also established the research platform for in vivo small animal imaging modalities, which are widely applied in various research fields in the Faculty and beyond.

She is the immediate past President of International Liver Transplantation Society (ILTS) and Program Chair of ILTS2018, and the member of the Basic Science Committee of The Transplantation Society (TTS). She is also the Founder member of Women Leaders in Transplantation (WLIL), International Mentor of WLIL and a Key Opinion Leader of TTS. She was the Chairperson of ILTS Scholarship Committee, member of ILTS Education Committee, Basic Science Committee and Publication Committee of ILTS.

Prof. Man is currently the Deputy Editor (Basic Science) of *Transplantation* as well as the Editorial Board Member of *Annals of Surgery*.

Being the President of Hong Kong Scientist Association (HKSA), Prof. Man plays critical role for the promotion of collaborations among the scientists in HK, Macau, Taiwan and Mainland of China. She is a visionary leader with extensive experience in the management of international, regional and local academic society and research collaborations. Prof. Man has successfully established a series of multidisciplinary research platforms under the collaborations with the experts in the fields of hepatology, cancer biology, stem cell, immunology, radiology, molecular imaging, biomaterials, bioengineering and bioinformatics.

She has published more than 185 original articles in international journals including *Annals of Surgery, Transplantation, Liver Transplantation, Clinical Cancer Research, Cancer Research, Journal of Hepatology, Hepatology, Gastroenterology, Nature Medicine & New England Journal of Medicine* etc with H index 54 (total citation 13268). She is one of the Top 1% Scholars at HKU according to ISI's Essential Science Indicators since 2013. She and her research team have obtained more than 65 international awards including numerous "Rising Star Awards", "Young Investigator Awards" in annual congress of ILTS, and "Mentee-Mentor Basic Science Awards", "Young Investigator Awards" In TTS meetings over the past 16 years. She has also got the "First Class Award of 2013 Higher Education Outstanding Scientific Research Output Award from Ministry of Education (MOE)" and "First Class Award for Science and Technology of Chinese Medical Association (CAE) 2014".

主题四 3D/4D列印、智慧结构设计与制造
报告 18

Templated-assisted manufacturing approaches for biomedical and energy applications

李振声教授 | 香港城市大学化学系系主任及讲座教授、材料科学及工程学系讲座教授、
理学院署理院长、超金刚石及先进薄膜研究中心主任

个人简介 Biography

Prof. Chun-Sing LEE obtained his BSc and PhD degrees from the University of Hong Kong in 1987 and 1991 respectively. He then furthered his research career at the University of Birmingham in the United Kingdom with the support from a Croucher Foundation Fellowship. He joined City University of Hong Kong in 1994 and is currently a Chair Professor of Materials Chemistry as well as the Head of Department of Chemistry. In 1998, Prof. Lee co-founded the Center Of Super-Diamond and Advanced Films (COSDAF) and now served as the Director of the Center. Prof. Lee' s current research interests include organic electronic devices and nanomaterials for energy, environmental and biomedical applications. He established the journal Materials Today Energy with Elsevier in 2016 and served as the Editor-in-Chief until 2021. Over the years, he has over 800 publications with more than 40,000 citations and a Scopus h- index of over 100.

报告摘要 Abstract

It is well-known that the therapeutic efficacy of drug particles depends critically on their sizes. While several studies have shown that drug particles with sizes of 20 to 50 nm show improved pharmacokinetics, there was no established manufacturing technology for preparing drug particles with such small sizes with good precision. In this talk, template-assisted approaches will be discussed for preparing drug nanoparticles with high precision and high throughput. Applications of template-assisted approaches for preparing composites for energy applications will also be discussed.

主题五 2D材料与器件设计与制造
报告 19

无机二维材料液晶的发现与发展

成会明院士 | 中国科学院院士、
发展中国家科学院院士、
中国科学院深圳理工大学、
中国科学院深圳先进技术研究院教授、研究员

个人简介 Biography

成会明，炭材料科学家。中国科学院金属研究所研究员。1963年10月生于四川省巴中市，籍贯四川省蓬安县。1984年毕业于湖南大学化工系，1987年、1992年在中科院金属研究所获硕士和博士学位。2013年当选中国科学院院士。提出了浮动催化剂化学气相沉积、非金属催化剂化学气相沉积制备碳纳米管等方法，促进了碳纳米管的研究与应用。提出了模板导向化学气相沉积等方法，制备出石墨烯三维网络结构材料、毫米级单晶石墨烯，发展了石墨烯材料的宏量制备技术。提出了可高效储能的层次孔材料设计和电化学电位调控的思路，制备出一系列新型能量转化与储存材料。研制出块体各向同性热解石墨材料，批量应用于多项重点工程。曾获国家自然科学二等奖、国防科技进步二等奖、何梁何利科学与技术进步奖、美国碳学会CharlesE.Pettinos奖等。

报告摘要 Abstract

无机二维材料液晶的发现与发展

丁宝福[1,2]，刘碧录[1]，成会明[2,3]
[1]清华大学深圳国际研究生院，材料研究院，深圳。
[2]中国科学院深圳先进技术研究院，碳中和技术研究所，深圳；
中国科学院深圳理工大学(筹)，材料科学与工程学院，深圳。
[3]中国科学院金属研究所，沈阳材料科学国家研究中心，沈阳

液晶是一类光学各向异性材料，其双折射这一本征光学特性可受外场连续调控。目前液晶已被广泛应用于显示器、智能门窗以及其他光调制相关的领域。以显示器为例，液晶显示器为主的市场规模已超过1000亿美元。目前，大多数液晶都是基于有机材料。然而有机液晶仍存在一些局限性，限制了它们在一些重要领域的应用。这些限制主要有：1)成本高； 2) 强紫外吸收以及紫外线照射下工作不稳定； 3) 极低的电光/磁光系数；4) 含有部分有毒的有机挥发物。在本报告中，我们将重点介绍我们最近发现的一类新型液晶——无机二维材料液晶，有望克服上述所有限制。基于磁/光各向异性与材料形状的几何各向异性之间的相互关联，我们首次在具有极大几何各向异性的宽带隙二维材料悬浮液中观察到了巨磁致双折射效应。其磁光克顿-穆顿系数比所有已报道的透明双折射介质高三个数量级。通过发明一种无污染、尺寸依赖的新型二维材料筛分方法，我们发现了该磁光系数与二维材料横向尺寸呈现二次依赖关系。这种二维材料分散液可以视为胶体体系，通过向该体系中引入集体行为，我们将其磁光系数又提升了一倍。二维材料液晶的巨磁光克顿-穆顿系数和宽透射窗口共同导致了透射式磁致干涉色效应的首次发现。这些新发现为使用宽带隙二维材料作为下一代光学液晶材料和使用透射磁致干涉色效应作为制备高质量干涉色的新方法打开了大门，并在彩色水凝胶等新型光学材料的应用中得到了概念性验证。

主题五 2D材料与器件设计与制造
报告 20

Aggregate Science: There Is Plenty of Room beyond Molecules

唐本忠院士 | 中国科学院院士
发展中国家科学院院士
香港中文大学(深圳)理工学院院长、冠名校长讲座教授

个人简介 Biography

男，教授，1957年2月生，1982年获华南理工大学学士学位，1985年、1988年先后获日本京都大学硕士、博士学位。曾在多伦多大学化学与药学系从事博士后研究、日本NEOS公司中央研究所任高级研究员。1994年至今历任香港科技大学化学系助理教授、副教授、教授、讲座教授、张鉴泉理学教授，并兼任香港科技大学工学院化学及生物工程学系讲座教授。2006年受聘为浙江大学"光彪讲座教授"。2009年当选中国科学院院士。2012年至今担任华南理工大学-香港科技大学联合实验室主任。2012年起受聘为华南理工大学双聘院士。2013年入选英国皇家化学会Fellow，2015年担任国家人体组织功能重建工程技术研究中心香港分中心主任，2017年起受聘为华南理工大学-香港科技大学联合研究院院长。2020晋升为中国化学会会士。2021年加入香港中文大学(深圳)担任理工学院院长。

已发表学术论文1,600多篇，总引超124,000次，h影响因子为158。作为项目负责人承担了科研项目80余项。在学术会议上作了400多场邀请报告，拥有100多项授权专利。现任德国Wiley出版社发行的Aggregate(《聚集体》)杂志主编，以及20多家国际科学杂志顾问、编委或客座编辑等。

主要从事高分子化学和先进功能材料研究，特别是在聚集诱导发光(Aggregation-Induced Emission, AIE)这一化学和材料前沿领域取得了原创性成果，是AIE概念的提出者和研究的引领者。

先后获得多项荣誉及奖励，于2002年获得由国家自然科学基金授予的"杰出青年学者"(B类，海外华裔科学家)称号，2007年获国家自然科学二等奖、Croucher基金会高级研究员奖、中国化学会王葆仁奖和Elsevier杂志社冯新德奖，2012获Science China Chemistry杰出贡献奖、美国化学学会高分子材料部：科学与工程分会Macro2012讲座奖等，2014年获伊朗国家科技部科学技术研究组织颁发的Khwarizmi国际奖和2015年获广州市荣誉市民。连续2014-2020年当选全球材料和化学领域"高被引科学家"。荣获2017年度何梁何利基金科学与技术进步奖，以第一项目完成人身份凭"聚集诱导发光"项目获得2017年度国家自然科学一等奖，并获得科技盛典-CCTV2018年度科技创新人物。2016年，AIE纳米粒子被《Nature》列为支撑即将来临的纳米光革命的四大纳米材料之一，并是唯一一种由中国科学家原创的新材料；同年，美国CNBC电视台以"Year of Cancer"的主题，实况专访唐院士，向全球直播介绍AIE荧光探针在识别癌症细胞等领域的应用。由AIE衍生出的有机室温磷光材料方面的研究以及AIE纳米粒子用于光声成像的研究被《2020研究前沿》列为化学和材料领域的重点热点前沿以及6个新兴前沿之一。2020年10月，AIE被国际纯粹和应用化学联合会(IUPAC)遴选为10大新兴技术之一。

报告摘要 Abstract

Molecular science has been developed to disclose the material structures and properties at the molecular level. However, aggregates, which served as the particularly useful form of materials, sometimes behave differently from individual molecules and show annihilated or new properties. Some unique properties such as aggregation-induced emission (AIE), crystallization-induced emission (CIE), room temperature phosphorescence (RTP), aggregation-induced delayed fluorescence (AIDF), aggregation-induced anti-Kasha transition (AKT), clusterization-triggered emission (CTE), through-space interaction (TSI), mechanoluminescence (ML), aggregation-induced circularly polarized luminescence (CPL), aggregation-induced generation of reactive oxygen species (AIG-ROS), photothermal/photoacoustic (PT/PA), solid-state molecular motion (SSMM) are only identified in aggregates, indicating their exotic features. By virtue of the flourishing research on aggregation-induced emission, the concept of aggregate science is put forward to fill the gaps between molecules and aggregates. The established structure-property relationship of aggregates is expected to contribute to new materials and technological development. Ultimately, the aggregate science may become an interdisciplinary research and serves as a general platform for academic research.

主题五 2D材料与器件设计与制造
报告 21

Phase Engineering of Nanomaterials

纳米材料相工程

张华教授 | 欧洲科学院外籍院士
香港城市大学化学系胡晓明讲座教授席 (纳米材料)、
材料科学及工程学系讲座教授

个人简介 Biography

Dr. Hua ZHANG obtained his B.S. and M.S. degrees at Nanjing University in China in 1992 and 1995, respectively, and completed his Ph.D. with Prof. Zhongfan Liu at Peking University in China in July 1998. He joined Prof. Frans C. De Schryver's group at Katholieke Universiteit Leuven (KULeuven) in Belgium as a Research Associate in January 1999. Then he moved to Prof. Chad A. Mirkin's group at Northwestern University as a Postdoctoral Fellow in July 2001. He started to work at NanoInk Inc. (USA) as a Research Scientist/Chemist in August 2003. After that, he worked as a Senior Research Scientist at Institute of Bioengineering and Nanotechnology in Singapore from November 2005 to July 2006. Then he joined the School of Materials Science and Engineering in Nanyang Technological University (NTU) as an Assistant Professor. He was promoted to a tenured Associate Professor on March 1, 2011, and Full Professor on Sept. 1, 2013. In 2019, he joined the Department of Chemistry in City University of Hong Kong as a Chair Professor, and currently he is the Herman Hu Chair Professor of Nanomaterials.

He has published 5 invited book chapters, 78 patent applications (including granted 1 China patent, 1 European patent, 3 Singapore patents, and 10 US patents), and over 530 papers. Until 26 Oct. 2021, the total cited times are over 93,800 with H-index of 152 (***Web of Science***), and over 108,700 with H-index of 161 (***Google Scholar***). In 2020, he was elected as a Foreign Fellow of the European Academy of Sciences (***EurASc***). In 2015, he was elected as an Academician of the Asia Pacific Academy of Materials (***APAM***). In Nov. 2014, he was elected as a ***Fellow*** of the Royal Society of Chemistry (***FRSC***). In 2016, he was listed in the top 300 most cited researchers in the field of materials science and engineering (Elsevier Scopus). In 2015-2020, he was listed in the "***Highly Cited Researchers***" in ***Chemistry and Materials Science*** (Clarivate Analytics/Thomson Reuters). In 2015, he was listed as one of 19 "***Hottest Researchers of Today***" in the world in the ***World's Most Influential Scientific Minds 2015*** (Thomson Reuters, 2015). In 2014, he was listed in the "***Highly Cited Researchers 2014***" in Materials Science, and also listed as one of 17 "***Hottest Researchers of Today***" and No. 1 in ***Materials and More*** in the world in the ***World's Most Influential Scientific Minds 2014*** (Thomson Reuters, 2014). Moreover, he got the ***Young Investigator Award*** (Young Giants of Nanoscience 2016, Hong Kong), ***Vice-Chancellor's International Scholar Award*** (University of Wollongong, Australia, 2016), ***ACS Nano Lectureship Award*** (2015), ***World Cultural Council (WCC) Special***

Recognition Award (2013), the ***ONASSIA Foundation Lectureship*** (Greece, 2013), ***Asian Rising Stars*** (15th Asian Chemical Congress, 2013), ***SMALL Young Innovator Award*** (Wiley-VCH, 2012) and ***Nanyang Award for Research Excellence*** (2011).

Dr. Zhang's research is highly interdisciplinary. His current research interests focus on phase engineering of nanomaterials (PEN) and controlled epitaxial growth of heterostructures, including the synthesis of ultrathin two-dimensional nanomaterials (***e.g.***, metal nanosheets, graphene, metal dichalcogenides, metal-organic frameworks, covalent organic frameworks, ***etc.***), novel metallic and semiconducting nanomaterials, novel amorphous nanomaterials, and their hybrid composites for various applications, such as catalysis, clean energy, (opto-)electronic devices, chemical and biosensors, and water remediation.

报告摘要 Abstract

In this talk, I will summarize the recent research on phase engineering of nanomaterials (PEN) in my group, particularly focusing on the rational design and synthesis of novel nanomaterials with unconventional phases for various promising applications. For example, by using wet-chemical methods, for the first time, we have successfully prepared novel Au nanostructures (***e.g.***, the hexagonal-close packed (***hcp***) 2H-Au nanosheets, 4H-Au nanoribbons, and crystal-phase heterostructured 4H/***fcc*** and ***fcc***/2H/***fcc*** heterophase Au nanorods), epitaxially grown metal nanostructures on the aforementioned unconventional Au nanostructures and 2H-Pd nanoparticles, and amorphous/crystalline heterophase Pd, PdCu, Rh and Rh alloy nanosheets. In addition, by using gas-solid reactions, metastable 1T'-phase group VI transition metal dichalcogenides (TMDs), ***e.g.***, WS_2, WSe_2, MoS_2, $MoSe_2$, $WS_{2x}Se_{2(1-x)}$ and $MoS_{2x}Se_{2(1-x)}$, have been prepared. Moreover, the phase transformation of TMDs during our developed electrochemical Li-intercalation process has also be observed. Impressively, the lithiation-induced amorphization of $Pd_3P_2S_8$ has been achieved. Currently, my group focuses on the investigation of phase-dependent physicochemical properties and applications in catalysis, (opto-)electronic devices, clean energy, chemical and biosensing, surface enhanced Raman scattering, waveguide, photothermal therapy, ***etc.***, which we believe is quite unique and very important not only in fundamental studies, but also in future practical applications. Importantly, the concepts of phase engineering of nanomaterials (PEN), crystal-phase heterostructures, and heterophase nanomaterials are proposed.

主题五 2D材料与器件设计与制造
报告 22

高迁移率二维材料的制备与界面调控
彭海琳教授 | 北京大学化学与分子工程学院教授、副院长

个人简介 Biography

彭海琳，北京大学博雅特聘教授。吉林大学学士(2000年)、北京大学博士(2005年)，斯坦福大学博士后(2005~2009年)，2009年到北京大学工作至今，主要从事二维材料物理化学研究，在高迁移率二维材料的精准合成、界面调控、制备装备研制和器件应用方面取得进展，已发表论文230余篇(含Science和Nature子刊20余篇)，连续入选"科睿唯安"高被引学者榜单，撰写中文专著两部，授权专利50余项。曾获国家杰青、万人计划领军人才、Small Young Innovator Award、MRS Singapore ICON-2DMAT Young Scientist Award、茅以升北京青年科技奖、国家自然科学二等奖、教育部青年科学奖、科学探索奖等荣誉。现任北京大学化学与分子工程学院副院长、北京石墨烯研究院(BGI)副院长。

报告摘要 Abstract

高迁移率二维材料展示出优异的电学、热学、光学和力学性质及广阔的应用前景。本报告将介绍新型高迁移率二维材(Bi_2O_2Se、石墨烯)的精准合成与关键界面结构调控方面的进展：率先开发了一类全新超高迁移率二维半导体材料Bi_2O_2Se，实现了二维单晶晶圆制备和表界面调控，构筑了高κ自然氧化物栅高性能场效应晶体管和逻辑门器件；实现了高品质石墨烯薄膜的精准快速合成和规模化制备，研制了石墨烯连续生长和4英寸石墨烯单晶晶圆生长装备，构筑了高性能石墨烯器件，并设计和开发了一系列表面洁净、高强度、超平整、功能化的石墨烯透射电镜载网，成功应用于高分辨冷冻电镜成像表征。

报告 23

Electrode interface engineering towards stable metal (Li/Zn) anodes

张文军教授 | 香港城市大学材料科学及工程学系署理系主任及讲座教授、
化学系讲座教授

个人简介 Biography

Wenjun ZHANG obtained his Doctor of Philosophy degree in 1994 from Lanzhou University. He was a postdoc at the Fraunhofer Institute for Surface Engineering and Thin Films (1995 to 1997) and at the City University of Hong Kong (1997 to 1998). From 1998 to 2000, he worked as a Science and Technology Agency Fellow at National Institute for Research in Inorganic Materials, Japan. He joined CityU in 2000 again as a Senior Research Fellow. He is currently Chair Professor and acting head of Department of Materials Science and Engineering; and he is also the deputy director of the Center Of Super-Diamond and Advanced Films (COSDAF). His research focuses on thin film technology, and nanomaterials and devices. Till now he has published over 400 peer-reviewed journal papers.

Home page: http://www.cityu.edu.hk/cosdaf/MemberProfiles/wjzhang-new/index.html

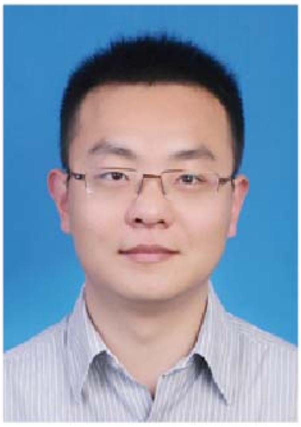
报告摘要 Abstract

Metallic Li and Zn are promising anode materials because they have intrinsically high gravimetric and volumetric specific capacities. However, the substantial volume change, the growth of dendrites, and low Coulombic efficiency of the metal anodes impede their practical applications. This presentation will share our recent effort on promoting the electrochemical performance of metal anodes through the electrode-electrolyte interface engineering, e.g., CuO modified current collectors towards stable Li metal anodes, and electrolyte solvation structure engineering to build stable SEI and promote the stability of both electrolyte and electrode materials.

主题五　2D材料与器件设计与制造
报告 24

Heterogeneous integration of 2D materials for advanced optoelectronics

王欣然教授｜南京大学电子科学与工程学院教授、副院长



个人简介 Biography

王欣然，南京大学电子科学与工程学院教授、副院长。2004年本科毕业于南京大学物理系，2010年获得美国斯坦福大学物理学博士学位，2010-2011年期间先后在斯坦福大学和伊利诺伊大学香槟分校做博士后研究员，2011年回到南京大学工作。主要从事低维信息材料、器件与集成电路的研究工作，在Science、Nature子刊和IEDM等国际权威期刊和会议发表论文100余篇，总引用超过20000次，多次入选全球高被引学者榜单。曾获得国家杰出青年基金、教育部长江学者特聘教授、中国青年五四奖章、中国青年科技奖、江苏省科学技术一等奖、国家自然科学二等奖、中国物理学会黄昆物理奖、“万人计划”科技创新领军人才等荣誉。现任全国青联委员，江苏省青联副主席，江苏省青年科技工作者协会副会长，国际学术期刊npj 2D materials and applications副主编，Nano Research、中国科学：信息科学、半导体学报等期刊编委。

报告摘要 Abstract

2D semiconductor transition-metal dichalcogenides are promising candidates in future electronics due to unmatched device performance at atomic limit and low-temperature heterogeneous integration. To adopt these emerging materials in computing and optoelectronic systems, back end of line (BEOL) integration with mainstream technologies is urgently needed. In this talk, I will present our recent results to address the challenges in material growth, device technology and BEOL integration towards advanced electronics and optoelectronics.

Reference:

[1] Weisheng Li et al., Nat. Electron., 2 563 (2019).
[2] Taotao Li et al., Nat. Nanotech., (2021) DOI: 10.1038/s41565-021-00963-8.
[3] Wanqing Meng et al., Nat. Nanotech., (2021) DOI: 10.1038/s41565-021-00966-5.
[4] Zhihao Yu et al. IEDM (2020) DOI:10.1109/IEDM13553.2020.9371917

主题五　2D材料与器件设计与制造
报告 25

Strong, Ductile and Tough Nanocrystal-Assembled Quasi-2D Gold

杨勇教授 | 香港城市大学机械工程系、材料科学及工程学系、
先进设计及系统工程学系教授

个人简介 Biography

Prof. YANG obtained his Bachelor degree in mechanics and economics (dual degree) from Peking University in 2001, MPhil degree from HKUST in 2003, and PhD degree in solid mechanics and materials science from Princeton University in 2007. His primary research interest is in the development and mechanical behavior of advanced structural materials, such as metallic glasses and high entropy alloys. His recent research also extends to materials informatics and fabrication of 2D metals.

报告摘要 Abstract

The structural and mechanical properties of low dimensional nanostructured metals have been attracting tremendous interest in the fast growing fields of nanosciences and nanotechnologies. However, it still remains a challenge today to develop strong yet ductile low dimensional metals that can support the further development of nano-devices. Here, through polymer assisted assembly of gold nanocrystals, we successfully fabricated a quasi-two-dimensional (2D) gold nanomaterial with an extremely high aspect ratio (~10^6). Unlike conventional bulk gold or other low dimensional gold nanostructures (i.e. nanowires and nanosheets), these quasi-2D gold nanomaterial is composed of highly distorted gold nanocrystals 3-5 nm in size, which are joined togehter through nano-sized amorphous carbon interphases. As a result of this unique nanostructure, our quasi-2D gold nanomaterial exhibits superb strength (up to 1.2 GPa), excellent ductility (>50%) and superior fracture toughness (>100 J/m^2), outperforming various gold nanostructures hitherto reported, such as gold nanowires, gold films and polymer-gold nanocomposites.

报告 26

亚纳米二维材料控制合成及性质

王训教授 | 清华大学化学系教授

个人简介 Biography

国家杰出青年科学基金获得者(07年)，教育部“长江学者”特聘教授(14年)。1994-2001年就读于西北大学，获本科、硕士学位；2004年获清华大学博士学位。2004-2007年任清华大学化学系助理研究员、副教授，2007年起任清华大学化学系教授。主要从事无机纳米材料化学研究，在无机纳米晶体新结构控制合成、形成机制及组装领域取得了一些进展。共发表SCI论文200余篇。兼任《化学学报》、《中国科学：化学》、《高等学校化学学报》、《结构化学》、《无机化学学报》编委，Editorial board member of Advanced Materials，Editorial board member of Nano Research，Scientific Editor of Materials Horizons，Associate Editor of Science China Materials，Associate Editor of Science Bulletin，Associate Editor of Nano Research，中国化学会副秘书长。曾获2019年首届科学探索奖、Hall of Fame (Advanced Materials, 2018)、国际溶剂热水热联合会ISHA Roy-Somiya Award (2018)、Fellow of the Royal Society of Chemistry(2015)、首届高等学校科学研究优秀成果奖(科学技术)青年科学奖(2015)、第八届“中国化学会 - 巴斯夫青年知识创新奖”、2009年第十一届中国青年科技奖、2009年“中国化学会-英国皇家化学会青年化学奖”、2005 IUPAC Prize for Young Chemists等奖励和荣誉。

报告摘要 Abstract

亚纳米尺度(Sub-1nm)材料指至少在一个维度上特征尺寸小于1纳米的材料。这个特征尺寸接近高分子链/DNA单链的直径，并与无机晶体单晶胞的尺寸相当。亚纳米尺度材料理论上具有如下特征而具有重要的研究价值：1. 分子间相互作用力可以主导其自组装过程，无机亚纳米尺度材料自组装特性更类似于高分子或生物大分子，多级相互作用的存在使得组装体具有优异的力学和可加工特性，可能成为打破有机/高分子材料与无机材料之间界限的切入点；2. 亚纳米尺度材料尺寸接近于无机晶体的单晶胞，因而表面原子比例接近100%，与外场的相互作用会极大的增强，可能导致优异的光学、催化等性质。

我们围绕亚纳米尺度材料开展了系统性研究工作：以良溶剂-不良溶剂体系控制晶核尺寸策略为基础，发展出亚纳米尺度材料合成方法学，以此为基础提出亚纳米尺度材料的新概念；发现一维无机纳米材料直径限制在1纳米左右时，会表现出类生物大分子及高分子的特征，其宏观组装体兼具无机与高分子材料的优异性能(力学、偏光、手性)；实现了具有明确结构亚纳米尺寸团簇的精确组装，进一步证明团簇可以与亚纳米尺寸无机晶核共组装，从而在亚纳米尺度实现对无机材料组分及功能的调控。

主题五　2D材料与器件设计与制造
报告 27

Nanoelectronics approaches to semiconductor/electrolyte interfaces

何其远博士 ｜ 香港城市大学材料科学与工程系助理教授

个人简介 Biography

Dr. Qiyuan HE is currently an Assistant Professor in the Department of Materials Science & Engineering at the City University of Hong Kong. He obtained his PhD Degree from Nanyang Technological University in Singapore in 2013. He then joined the University of California, Los Angeles as a Postdoctoral Fellow before returning to Nanyang Technological University as a Research Fellow in 2016. Dr. HE's research scope is highly interdisciplinary, focusing on the fundamentals of semiconductor interfaces and their applications in nanoelectronics, iontronics, chemical/biological sensors, catalysis, and on-chip electrochemistry. He has published over 80 research papers in highly-esteemed journals such as Nature, Nature Chemistry, Nature Materials, Nature Electronics, Advanced Materials, Nano Letters, and ACS Nano. He has over 15,000 citations with an H-index of 42 (SCOPUS). He has been listed as a Highly Cited Researcher (cross-field) by Clarivate in 2018 and 2021.

报告摘要 Abstract

Solid-electrolyte interface (SEI) dominates semiconductors' performance in diverse applications such as sensor, catalysis, and electronics. In electronic sensing, the adoption of chemical/biological species at the interface modulates the electronic states of the semiconductor surface; In electrocatalysis, the charge transfer across the interface defines the catalytic performance; In the emerging iontronics, ionic gating via the electrical-double-layer capacitor at the interface demonstrates superior carrier modulation. In this talk, I will introduce an on-chip electrochemical platform that combines electronic and electrochemical measurements to investigate electrochemical processes of SEI at the microscopic scale. Our hybrid system was used to probe the molecular-intercalation kinetics, semiconductor electrocatalysis, phase-dependent electrocatalysis and discovered many new phenomena and mechanisms inaccessible to conventional technologies.

主题五 2D材料与器件设计与制造
报告 28

二维材料：制备与应用

任文才博士 | 中国科学院金属研究所研究员

个人简介 Biography

任文才，中国科学院金属研究所研究员，国家杰出青年科学基金获得者。主要从事石墨烯等二维材料研究。在Science等期刊发表主要论文160多篇，被引用30,000多次。入选科睿唯安公布的材料科学领域全球高被引科学家。获授权发明专利70多项，多项已转化，孵化出2家高技术企业。曾获国家自然科学二等奖2项(2017、2006)、何梁何利基金科学与技术创新奖、辽宁省自然科学一等奖、中国青年科技奖等。现任《2D Materials》主编。

报告摘要 Abstract

以石墨烯为代表的二维材料具有多种独特的物理化学性质，为电子、信息、能源、环境等领域的发展提供了新的机遇。如何实现二维材料的控制制备和应用，特别是发现二维极限下的新材料、新物性和新应用，是二维材料领域的重要挑战。本报告将重点介绍研究组针对上述挑战取得的主要研究进展：(1)发展了高质量石墨烯的CVD制备方法，实现了控制制备，研制出高性能OLED、锂离子电池等多种柔性器件；(2)发明了氧化石墨烯和石墨烯片的绿色高效制备技术，实现了规模生产，在热管理中获得应用；(3)制备出二维过渡金属碳化物晶体，开拓了二维$MoSi_2N_4$材料体系，发现了空位诱导二维材料薄膜超快离子传导的特性，拓展了二维材料的物性和应用。

主题五 2D材料与器件设计与制造
报告 29

碲基电子与光电子器件

谭超良博士 | 香港城市大学电机工程学系助理教授

个人简介 Biography

谭超良，工学博士，香港城市大学电机工程系助理教授、博导。谭教授于2016年6月于新加坡南洋理工大学材料科学与工程学院获得博士学位(导师张华教授)，2017年9月年前往加州大学伯克利分校从事博士后研究(合作导师Ali Javey教授)，2020年加入香港城市大学电机工程系任助理教授。谭博士的研究集中在二维功能纳米材料与器件。迄今为止，共发表SCI论文大于130篇，其中第一或通讯作者40余篇，包括*Nat. Nanotechnol.*、*Nat. Rev. Mater.*、*Chem. Rev.*、*Chem. Soc. Rev.*、*Adv. Mater.*、*J. Am. Chem. Soc.*、*Angew. Chem. Int. Ed.*、*Nat. Commun.*、*Energy & Environ. Sci.*，*ACS Nano*、*Mater. Today*、*Small*等。论文引用超过18,800次，个人H因子59(基于谷歌学术统计)。谭博士2018至2021年连续四年入选"全球高被引学者"名单(科睿唯安)，2020入选斯坦福大学发表的工程领域 "世界前2%科学家"。并获2021年国家自然基金委"优秀青年基金(港澳)" 资助。并长期担任*Nat. Commun.*、*Adv. Mater.*、*J. Am. Chem. Soc.*、*Adv. Funct. Mater.*、*Small*、*Appl. Phys. Rev.*、*Chem. Commun.*等学术期刊独立审稿人，担任《物理化学学报》和《中国化学快报》青年编委。

报告摘要 Abstract

范德华半导体材料由于其结构上的优势，近年来逐渐成为构筑红外探测器活性层的热门候选材料和研究热点。首先，我们将介绍一种可大量制备、空气中稳定、窄带隙(0.31 eV)碲纳米片的水热合成策略，并详细研究其在短波红外探测器上的应用。通过设计简单的Au/Al_2O_3光学腔基板，以碲纳米片为沟道材料构筑光导体红外探测器，实现了短波红外(1-3微米)可调的探测，达到了室温下1.7微米的光响应和较高的比探测率(16 AW^{-1}和2.9×10^9 cm $Hz^{1/2}W^{-1}$)。为了进一步优化器件性能并实现大面积制备，我们采用简单的热蒸镀法将窄带隙的碲(Te；0.31 eV)与宽带隙的硒(Se；1.9 eV)合金化，制备系列带隙连续可调的二维Se_xTe_{1-x}合金薄膜。遴选出合适的Se_xTe_{1-x}薄膜料构筑光导体红外探测器，其室温下1.55微米的比探测率分别可高达6.5×10^{10} cm $Hz^{1/2}W^{-1}$。同时，我们成功实现了基于Se_xTe_{1-x}合金薄膜42×42焦平面阵列的制造并呈现出良好的器件性能。其次，可低温生长的高性能半导体薄膜对构筑高性能柔性电子器件及单片三维整合互补金属氧化物半导体(CMOS)电路领域至关重要。因此，我将介绍一种圆晶尺寸p型碲纳米薄膜的低温热蒸镀制备方法，并将其用于构筑场效应晶体管。研究发现，制得的器件空穴迁移率和开关比分别可达35 $cm^2V^{-1}s^{-1}$和10^4，并揭示了薄膜晶畴大小及薄膜厚度与器件性能的内在关联。4英寸圆晶上不同位置晶体管的各项性能指标都非常优越和均一，并实现了构筑高性能柔性电子器件、功能良好的逻辑门、计算电路和单片三维整合电路。

主题五　2D材料与器件设计与制造
报告 30

Battery Intercalation Strategy for Material Synthesis, Energy Application and Mechanism Study

曾志远博士 ｜ 香港城市大学材料科学及工程学系助理教授

个人简介 Biography

曾志远，男，香港城市大学助理教授，博士生导师。2006年，2008年和2013年分别在中南大学，浙江大学和新加坡南洋理工大学获得材料学的学士，硕士和博士学位，博士导师张华教授。2013-2017在美国劳伦斯伯克利国家实验室从事博士后科学研究，导师郑海梅科学家。2017-2019在美国应用材料公司硅谷总部从事半导体芯片的等离子体刻蚀工艺研发，历任工程师、高级工程师。2019年加入香港城市大学材料科学与工程学院(CityU课题组主页：https://www.zeng-lab.com/)。主要从事电化学锂离子插层技术、原位液体电镜技术等前沿领域的研究，在二维过渡金属硫化物、污染物降解等领域的研究中取得一系列成果。在Nature Materials, Nature Protocols, Nature Communications, Journal of the American Chemical Society, Angewandte Chemie International Edition, Nano Letters, Advanced Materials等杂志共发表SCI论文85篇(53篇IF>10)，他引14856 次，单篇引用100次以上论文31 篇，16 篇入选ESI 高被引论文(Web of Science)，H 因子46。其中通讯、一作总共32 篇(22 篇IF > 10)，第一作者单篇SCI 最高他引1566次。曾任美国电化学协会旧金山分会秘书长(2014-2015)，2020，2018两年度被科睿唯安评为 “高被引科学家” 。2021，2020年分别获Chemical Communications，Journal of Materials Chemistry A 新锐科学家(Emerging Investigators)称号，现任Energy & Environmental Materials (影响因子15.122),《电化学》(主编：孙世刚院士)，Chinese Chemical Letters等杂志的青年编委。

报告摘要 Abstract

In this presentation, I will focus on Material Synthesis, Energy Application and Mechanism Study using Battery Intercalation Strategy. For material synthesis, I will discuss how to design battery intercalation "environments" to obtain a serials of high quality single layer transition metal dichalcogenides (TMD) nanosheets (MoS_2, WS_2, TaS_2, TiS_2 and ZrS_2)- the Li insertion can be monitored and finely controlled in the battery testing system, so that the galvanostatic discharge is stopped at a proper Li content to avoid decomposition of the intercalated compounds; Moreover, the battery intercalation strategy can be optimized and the controllable lithiation process can be extended to BN, $NbSe_2$, WSe_2, Sb_2Se_3, Bi_2Te_3 and so on. The prepared noble metal-2D TMD composites are promising candidate for hydrogen evolution reaction. For mechanism study, I am interested in failure mechanism study of Lithium/Sodium Ion Batteries at nanometer scale utilizing imaging and spectroscopy protocols. With the self-designed electrochemical liquid cell TEM, we can directly vapture the dynamic electrochemical lithiation and delithiation of electrode in a commercial $LiPF_6$/EC/DEC electrolyte, such as lithium metal dendritic growth, electrolyte decomposition, and solid-electrolyte interface (SEI) formation. This technique opened a venue by which looking inside the dynamic electrochemical reactions in real-time. Which render us to improve the electrode design for reducing short circuit failure and improving the performance of lithium/sodium ion batteries.

主题六 功能导向的新材料设计与制造
报告 31

二维材料范德华异质结晶体管电子器件

张铮教授 | 北京科技大学前沿科学技术交叉研究院教授、副院长

个人简介 Biography

张铮博士，现任北京科技大学前沿交叉科学技术研究院副院长，教授，博士生导师，国家万人计划青年拔尖人才项目入选者。主要从事低维半导体材料异质结构构筑及其在电子与光电器件应用基础研究，发表SCI论文100余篇，引用3500余次；以第一或通讯作者在Nature Energy、Nature Communications、Advanced Materials等期刊发表论文50余篇；参与撰写英文专著一部；申请专利20项，授权发明专利12项。主持国家自然科学基金重大研究计划重点项目、面上项目，北京市科技计划项目子课题，中国博士后科学基金特别资助和面上项目等，作为项目骨干参与了国家重点研发计划重点专项、国家自然科学基金重大项目、国家重大科研仪器研制项目等科技攻关项目。担任中国体视学学会理事、材料学分会副秘书长，以第五完成人获国家自然科学二等奖一项，中国体视学学会青年科技奖，强国青年科学家提名奖，《纳米研究》NR45 青年科学家奖等。

报告摘要 Abstract

探索突破亚十纳米物理极限的变革性材料与新原理器件是信息产业与半导体材料产业亟待解决的科学技术难题。以MoS_2、WSe_2为代表的过渡金属硫族化合物(TMDs)是典型的二维半导体材料，具有独特的电子结构、优异的半导体特性和超平整的表面结构，在亚纳米尺寸下仍可以保持优异的电学性能，通过精确转移、范德华堆垛等形式构筑全新的范德华异质结构，在未来高性能、低功耗电子与光电功能器件方面具有巨大潜力。本报告围绕高效调控二维半导体材料性能的方法、设计构筑新原理高性能范德华异质结晶体管器件、有效降低器件接触电阻的调控方法等方面展开，展望二维TMDs半导体材料及其范德华异质结构在未来晶体管器件研究中的发展方向。

主题六 功能导向的新材料设计与制造
报告 32

High-entropy alloy microlattice metamaterials
高熵合金微点阵超材料

陆洋教授 | 香港城市大学材料科学及工程学系、机械工程系教授

个人简介 Biography

陆洋，香港城市大学机械工程学系教授，材料科学与工程系兼职教授，并担任城大深圳研究院“纳米制造实验室”主任。致力于金属和半导体材料的微纳米力学研究，促进其在微机电系统及精密制造等应用。他与研究团队发现了超细金属纳米线的“冷焊 (cold welding)”以及微纳尺度下硅与金刚石的“超大弹性”等现象，并首次实现了单层石墨烯的独立拉伸测试。以第一或通讯作者在Science、Nature Nanotechnology、Science Advances、Nature Communications等学术刊物发表文章百余篇，并担任著名期刊 Materials Today 的副主编。陆教授曾获得香港城市大学2019年度“杰出研究奖.青年学者”，并入选首届(2019)国家自然科学基金(NSFC)优秀青年科学基金(港澳)项目以及首届(2020/21)香港研究资助局(RGC)“研资局研究学者”。

报告摘要 Abstract

Mechanical metamaterials such as microlattices are man-made materials that can harness the benefits of architecture through their engineered three-dimensional (3D) geometries and unique structural designs. This talk focuses on how these microlattices are combined with micro/nanoscale size effects and high/medium-entropy alloys (HEA/MEA) to produce metamaterials with superior and tunable mechanical properties, providing an insight on overcoming traditional material property trade-offs, such as strength-ductility, which has limited our structural material selection for many years. An overall perspective on how these HEA/MEA microlattice metamaterials can be designed, manufactured, and applied for a multitude of future engineering applications will be discussed as well.

报告 33

The Road of Design in Technology-dominated World: Aesthetics in Design Science Research

李鹂教授 | 香港理工大学纺织及服装学系教授

个人简介 Biography

Dr. Li LI is Professor at the Institute of Textiles & Clothing in the Hong Kong Polytechnic University. In addition to her academic background and accomplishments, she has acquired many years of practical experience working in the industry as a senior designer and eventually a design director prior to arriving at PolyU.

Her research is characterized by creative design thinking and interdisciplinary design methods, which she applied to a range of problems including smart functional textile technologies and advanced manufacturing processes. As demonstrated by her work, Dr. Li has been able to leverage design beyond just the product conception stage and instead expand its potential as an interdisciplinary tool that provides constructive solutions and innovations across the entire value chain, whether meeting a specific market demand or solving a technical defect. Thus, her method of interdisciplinary design generates technological innovation via the crossover of knowledge from different disciplines which not only speeds up innovation, but also integrates different research methods in a new direction towards viable solutions.

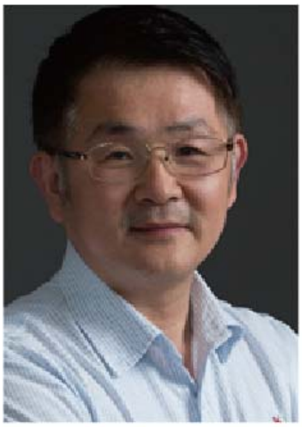
报告摘要 Abstract

With rapid development of technology, it has shown the desire for new knowledge and efficiency, thus prompting businesses to rethink the traditional and consider a new methodology from "art to science" paralleled "science to art" as well as creating value by multidisciplinary research. This trend has contributed to a bourgeoning expansion of the creative economy, indicating that inevitably, industries of the 21st century will depend increasingly on the generation of knowledge through creativity and innovation. As a core part of creativity and arts, aesthetics are intertwined and embedded into our everyday lives. It governs human motivations and behaviors through congenital and acquired sensori-emotional values. It also governs how we experience and understand the world around us; its "size" and "position" shapes our understanding of "being" and "time". Indeed, it also influences the "trends" and "decisions" of human societies.

This presentation will present our projects as examples which demonstrate the use of a "art to science" research methodology. Our team adopts a creative-driven interdisciplinary approach in their fundamental and applied research on wearable technologies and its applications to effectively enable knowledge transfer and realize market applications. In short, these topics are centered on understanding the customer experience, social needs, and the past to shape the future. Aesthetic research method (or Design thinking research) thus provides a creative approach try to solve complex problems in a user-centric manner. These research works have contributed to discoveries, inventions and developments which have been adopted by some of the largest textile manufacturers and implemented into their products, deriving concrete financial gains.

超长碳纳米管进化生长机制、结构控制与储能应用

魏飞教授 | 清华大学化学工程系教授



个人简介 Biography

清华大学化学工程系教授，绿色反应工程与工艺北京市重点实验室主任。1984毕业于石油大学炼制系有机化工专业，1990年获石油大学有机化工博士学位。中国颗粒学会能源颗粒材料专业委员会主任，在Science、Nature等杂志发表论文600余篇，SCI他引5万余次，是克莱恩近六年材料领域高被引科学家之一。获教育部“长江学者”特聘教授、国家杰出青年基金等。

成功实现了千吨级碳纳米管在锂离子电池中的规模应用，实现了气固下行床催化裂化、高速湍动床甲醇制芳烃、苯胺、氯乙烯、丙烯腈、间苯二腈等30台新概念反应器产业化，研究成果获国家科技进步二等奖、教育部自然科学、技术发明一等奖。

报告摘要 Abstract

碳纳米管(CNT)和石墨烯的独特性能和巨大的应用潜力是由于它们的完美sp^2结构所带来。特别是对于高端应用，超低缺陷密度和超高选择性是先决条件，低活化能的金属催化化学气相沉积(CVD)过程是合成该类材料最有前途的方法之一。由于其结构和特性，CNT和石墨烯本身可以提供生长模板和非局部电子、空穴输运，与CVD生长过程协同作用，使具有可调带隙的碳模板发生模板自催化作用，从而使材料准确可控。但是，目前的生长动力学研究模型都集中在外部因素和材料边缘上。碳纳米管的原子组装速率和带隙之间的相互作用，发现生长过程与带隙之间具有明显的火山型关系，其峰值与生长环境相关。完善的sp^2结构的拓扑保护以及互锁的动力学生长机制是动力学选择性生长完美纳米碳的核心。这样碳纳米管可在TOF达10^6 1/s条件下实现半米长碳纳米管的无缺陷生长。并可得到强度、韧性、耐疲劳性均高于目前已知最好碳纤维材料数量级以上性能的碳纳米管高强材料。利用流化床方法可以对阵列碳纳米管进行千吨级批量制备，并将其规模应用于锂离子电池导电剂等动力电池中。

Electrocatalytic properties of metal nanomaterials with unconventional crystal phases

陈也博士 | 香港中文大学化学系助理教授

个人简介 Biography

Dr. Ye CHEN is currently an Assistant Professor at the Department of Chemistry in The Chinese University of Hong Kong. She received her B. Eng. and Ph.D. degrees in Materials Science from Nanyang Technological University (Singapore) in 2015 and 2019, respectively. Her current research interest focuses on wet-chemical synthesis of novel low-dimensional nanomaterials and their applications in catalysis and clean energy. Group website: https://chengroupcuhk.org/.

报告摘要 Abstract

In this talk, I will present some recent works related to the phase dependent catalytic properties of metallic nanomaterials. I will first introduce how Pd and Cu nanostructures with unconventional crystal phases are prepared by using epitaxial growth strategy in wet-chemical synthesis. Following that, the catalytic behaviors of the as-synthesized Pd and Cu nanomaterials in electrochemical ethanol oxidation and electrochemical CO2 reduction, respectively, will be discussed in details. The importance of exploring the phase-dependent catalytic properties of metallic nanomaterials will be highlighted.

主题六 功能导向的新材料设计与制造
报告 36

Crystal phase-controlled synthesis of noble metal nanomaterials

范战西博士 | 香港城市大学化学系助理教授

个人简介 Biography

Zhanxi FAN is an Assistant Professor in the Department of Chemistry, City University of Hong Kong, and a core member of Hong Kong Branch of National Precious Metals Material Engineering Research Center (NPMM). He received his B.S. degree (2010) in Chemistry from Jilin University (China), and completed his Ph.D. (2015) in Materials Chemistry from Nanyang Technological University (Singapore) under the supervision of Prof. Hua Zhang. He then did postdoctoral research in Nanyang Technological University with Prof. Hua Zhang and Lawrence Berkeley National Laboratory (USA) with Prof. Haimei Zheng, respectively. His research interest lies in the fields of materials chemistry, nanoscience, catalysis, and energy conversion. Currently, his research projects mainly include the controlled synthesis of novel low-dimensional metal nanomaterials, designed preparation of functional metal-based heteronanostructures, and catalytic conversion of small molecules. Zhanxi has been listed as a global Highly Cited Researcher by Web of Science in last four years (2018-2021), and World's Top 2% Scientists in Nanoscience & Nanotechnology by Stanford University in both 2020 and 2021. He is also the recipient of multiple awards/honors like Vebleo Fellow (Vebleo), Emerging Investigator 2021 (JMCA), Young Scientist Award (E-MRS), MSE Doctorate Research Excellence Award, and Chinese Government Award for Outstanding Self-financed Students Abroad. To date, he has published over 80 SCI papers with a total citation of over 11800 and H-index of 46.

报告摘要 Abstract

In the past two decades, although significant progress has been achieved for the size, composition, shape and architecture manipulation of noble metal nanomaterials, the crystal phase-controlled synthesis remains a great challenge. As the electronic structure and optical response of noble metals are closely related to their crystal structure, the target synthesis of noble metal nanomaterials with unusual crystal phases could benefit many of their potential applications, such as surface-enhanced Raman scattering (SERS), organic catalysis, electrocatalysis, waveguide, biosensing and near-infrared photothermal therapy. In this presentation, I will talk about our efforts towards this newly emerged research direction in the following three parts. First, by using colloidal methods, free-standing Au nanostructures with unconventional 4H phase and well-defined fcc-2H-fcc heterophase have been synthesized under mild conditions for the first time. Then, we found that surface modification can induce a complete phase transformation of ultrathin Au square sheets from (110)h-oriented 2H to (100)f-oriented fcc structures, which is a new phase transition pathway of close-packed metals/alloys. Last but not the least, we demonstrated that a series of novel bi-/multi-metallic core-shell nanomaterials was obtained by using a templated synthetic strategy, in which 4H Pd, Pt, Ir, Rh, Ru, Os, Cu, PdAg, PtAg and PtPdAg nanostructures have been first observed. Besides, the important applications of unusual phase noble metal nanomaterials in catalysis will also be highlighted.

講者简介及报告摘要

主题六 功能导向的新材料设计与制造
报告 37

Biomimetic chiral photonic crystals

唐智勇博士 | 国家纳米科学中心研究员

个人简介 Biography

Dr. Zhiyong TANG is currently a Professor (2006-) at National Center for Nanoscience and Technology, China. He obtained his Bachelor and Master degree from Wuhan University in 1996. He then moved to Changchun Institute of Applied Chemistry of Science, Chinese Academy of Sciences with Professor Erkang Wang and obtained a Ph.D. degree in 1999. After six years as a postdoctoral fellow in Swiss Federal Institute of Technology Zurich, Oklahoma State University and University of Michigan, in November 2006 he won the 100-Talent Program, Chinese Academy of Sciences and started his current position. Professor Tang' s research interests are mainly focused on assembly of inorganic nanomaterials, exploration of optical activity and their application in energy and catalysis.

报告摘要 Abstract

The amazing iridescent colors from the cuticle of beetles are known to originate from their intricate nanoscale organization of bio-fibers, artificial inorganic materials with comparable optical response. In past years, we developed a general method to fabricate biomimetic chiral photonic crystals via Langmuir-Schaefer assembly of colloidal inorganic nanowires. We not only reproduce the intricate helical structure and circularly polarized color reflection in beetles, but also acquire the highest chiroptical activity with a dissymmetry factor of -1.6 among the chiral inorganic nanostructures. More importantly, beyond nature, programmable structural control based on the precise interlayer arrangement endows us an unprecedented freedom to manipulate the optical activity of as-fabricated chiral photonic crystals, for instance, strong chiral photoluminescence and laser could be also realized.

主题六 功能导向的新材料设计与制造
报告 38

Optical micro- and nanocavity based coherent and incoherent light sources

基于微纳光腔的相干与非相干光源

雷党愿博士 | 香港城市大学材料科学与工程系副教授

个人简介 Biography

雷党愿：香港城市大学材料科学及工程学系副教授，伦敦帝国理工学院博士，主要从事低维材料和纳米结构的极化激元物理和非线性光学的实验研究，同时利用时间分辨和超快光谱技术研究低维材料中新颖的光学特性。自2007年起在Nature Communications, Nature Photonics, Science Advances, Light: Science & Applications, Physical Review Letters, Advanced Materials和Nano Letters等国际一流期刊发表学术论文166篇，h-index为49，总引用6720多次。曾获得国家自然科学基金委"优秀青年科学基金(港澳)"和香港研究资助局"杰出青年学者计划"基金，香港城市大学"Outstanding Research Award for Junior Faculty"，香港高等研究院"Rising Star Lecturer"，APEC Science Prize for Innovation, Research and Education香港唯一被提名人，伦敦帝国理工学院"校长奖学金"和"安妮·索恩博士论文奖"，纳米研究杂志2021 Young Innovators Award，英国皇家学会"International Exchange Award"，山西省科学与技术二等奖，深圳市科技创新委员会"国家级科技项目先进个人"等荣誉称号。雷博士目前为美国光学学会高级会员(OSA Senior Member)，英国物理学会(IOP)和国际光电工程学会(SPIE)会员，担任Light: Science & Applications杂志编辑部香港办公室负责人，Frontiers in Photonics杂志Associate Editor，以及多个杂志的编委，包括Journal of Semiconductors，Journal of Physics Communications，Journal of Applied Physics，Acta Physica Sinica, Chinese Physics B，以及Nano Materials Science。

报告摘要 Abstract

报告人会介绍香港城市大学纳米光子学研究组在微纳尺度先进光源方面的最新研究进展，具体包括基于微纳尺度光子学腔和低维半导体材料的非相干自发辐射光源(ACS Nano 11, 3067-3080, 2017)、相干二次谐波产生(Nature Communications 12, 4326, 2021)和双光子泵浦的微纳激光器(Nature Communications 11, 1192, 2020)。

主题六 功能导向的新材料设计与制造
报告 39

Ultrahigh-strength and ductile superlattice alloys with nanoscale disordered interfaces

杨涛博士 | 香港城市大学材料科学及工程学系助理教授

个人简介 Biography

Dr. Tao YANG received his MS degree from Xiaman University in 2014, and PhD degree in CityU in 2018. In 2020, he joined CityU as an Assistant Professor at Department of materials and engineering. He has been awarded the Rising Star Award by HKIAS, and Early Career Award by UGC in 2021.

Dr. Yang's research focuses on the innovative design and fabrication of advanced metallic materials for structural and functional applications, including the high-entropy alloys, intermetallic materials, high-temperature superalloys, deep cryogenic alloys and electrocatalysis materials. His current work is primarily focused on the control of nanoprecipitation, grain-boundary characters, and atomic structures by using multiple state-of-the-art techniques, such as the 3D atom probe tomography (3D-APT), high-resolution transmission electron microscope (HR-TEM), and 3D printing. He has authored more than 50 publications with an H-index of 20, including three in Science (first author and corresponding author), and others in Advanced Materials, Nature Communications, Acta Mater, Mater Research Letters, etc.

报告摘要 Abstract

Alloys that have high strengths at high temperatures are crucial for a variety of important industries including aerospace. Alloys with ordered superlattice structures are attractive for this purpose but generally suffer from poor ductility and rapid grain coarsening. We discovered that nanoscale disordered interfaces can effectively overcome these problems. Interfacial disordering is driven by multielement cosegregation that creates a distinctive nanolayer between adjacent micrometer-scale superlattice grains. This nanolayer acts as a sustainable ductilizing source, which prevents brittle intergranular fractures by enhancing dislocation mobilities. Our superlattice materials have ultrahigh strengths of 1.6 gigapascals with tensile ductilities of 25% at ambient temperature. Simultaneously, we achieved negligible grain coarsening with exceptional softening resistance at elevated temperatures. Designing similar nanolayers may open a pathway for further optimization of alloy properties.