The Second International Training Course on Industrial Synthetic Biotechnology

第二期工业合成生物技术国际培训班

Program Book

Hosted by

Tianjin Institute of Industrial Biotechnology (TIB),

Chinese Academy of Sciences (CAS)

Supported by: COMSATS-UNESCO South South Technical Cooperation Programme, and ANSO

December 20th-30th, 2021

Tianjin , China

Contents 目录

About the Second ITC–ISB

Background

Synthetic biology is widely regarded as a forward-looking and disruptive technology. The industrial application of synthetic biology is expected to provide new solutions to the major challenges on resources, health and environment faced by human beings.

Previously in 2019, TIB hosted the first International Training Course on Industrial Synthetic Biotechnology (ITC-ISB), whereby over 20 young S&T scholars from 10 countries were trained in China.

Introduction

To encourage more young researchers to extend their career to synthetic biology, the COMSATS Joint Center for Industrial Biotechnology (CCIB), Tianjin Institute of Industrial Biotechnology (TIB), Chinese Academy of Sciences (CAS) is organizing the second ITC-ISB via online and offline in December 2021. Over 110 researchers from nearly 20 developing countries have applied to attend the training course in due time.

Contents

The training course will focus on the theory, practice and application of the Industrial Synthetic Biotechnology. The main contents include:

◆ Technical courses: senior experts and scholars will be invited to introduce the progress in frontier technologies in various areas including biomedicine, bio-agriculture, future food, bio-chemicals, bio-based materials, bioenergy, etc.

◆ Experimental courses: demonstration experiments of enabling technologies will be presented, including High Throughput Genome Editing, Systems Biotechnology, Protein Structure Analysis, DNA Synthesis, Bio-design and Intelligent Fermentation Technology.

◆ Discussions: panel discussion will be arranged to further learn about each other and discuss for future collaboration.

◆ Test: a test would be arranged at the end of the course to evaluate the effects on the for the trainees.

◆ Questionnaires: a questionnaires will be designed for trainees to give suggestions for the course thus for the improvement of the next trainings.

Objectives

◆ To accelerate the capacity building of the areas of industrial biotechnology and synthetic biology;

◆ To provide a platform for interaction and future collaboration among researchers between China and the other developing countries.

Organizing Committee

Chairman of the Organizing Committee

- Prof. Jibin Sun
  CCIB Director and the Deputy Director-General of TIB, CAS
  sun_jb@tib.cas.cn

Members of the Organizing Committee

- Prof. Huifeng Jiang
  Coordinator of CCIB Joint R&D Group on Biomedicine, TIB-CAS
  jiang_hf@tib.cas.cn

- Prof. Zhiyong Huang
  Coordinator of CCIB Joint R&D Group on Bio-agriculture, TIB-CAS
  huang_zy@tib.cas.cn

- Dr. Demao Li
  Coordinator of CCIB Joint R&D Group on Bioenergy, TIB-CAS
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- Prof. Wenqin Bai
  Coordinator of CCIB Joint R&D Group on Bio-based Materials, TIB-CAS
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- Dr. Yu Wang
  Coordinator of CCIB Joint R&D Group on Bio-chemicals, TIB-CAS
  wang_y@tib.cas.cn

- Dr. Ting Shi
  Coordinator of CCIB Joint R&D Group on Future Food, TIB-CAS
  shi_ting@tib.cas.cn

General Secretary and Coordinator

- Ms. Qianqian Chai
  CCIB Coordinator and the International Cooperation Officer, TIB-CAS
  chai_qq@tib.cas.cn

Supporters

- Alliance of International Science Organizations (ANSO)
- Department of International Cooperation, Ministry of Science and Technology, PRC
- Commission on Science and Technology for Sustainable Development in the South (COMSATS)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- CAS-TWAS Center of Excellence for Biotechnology
- Innovation Cooperation Center (Bangkok), CAS

Virtual Platform

VooV Meeting (download from its official website:https://voovmeeting.com), ID: 608 6508 9263

Notice and Tips for Trainees

1.Please follow the related arrangements during the training course.

2.Please keep an eye on your email, since the organizing committee may send related news or updated arrangements during the course.

3.Please attend the training course on time, or else you may not get the graduation certificate.

4.Please inform the conference staff in advance in case that you will be absent to the course.

5.Please turn on the camera and be kindly to turn off the microphone during the lecture, and turn on the microphone when necessary during the Q&A session.

6.To protect the intellectual properties of the training course, please do not record the video privately and share it on the Internet.

7.To save the time, it is encoraged to type your questions into the chat area in advance during the Q&A session.

8.To make a complete group photo, please take a screenshot of yourself on your computer during group photo session and send it to ccib@tib.cas.cn after the opening ceremony.

9.Please be free to contact the organizing committee staff if you need any help:

Ms. Qianqian Chai 86-22-84861925, chai_qq@tib.cac.cn
Ms. Zhihong Xiao 86-18340815670, ccib@tib.cas.cn

Schedule

Date	Week	Time	Contents
Dec. 20th	Mon.	14:00-15:00	Trainee check-in and device tuning
		15:00-16:00	Opening Ceremony
		16:00-17:30	Keynote Speech: Introduction to the Industrial Synthetic Biotechnology
		17:30-18:30	Cloud Excursion to TIB
Dec. 21th	Tue.	14:00-18:30	Technical Session 1: Frontier Technology on Biomedicine
Dec. 22th	Wed.	14:00-18:30	Technical Session 2: Frontier Technology on Bio-agriculture
Dec. 23th	Thu.	14:00-18:30	Technical Session 3: Frontier Technology on Future Food
Dec. 24th	Fri.	14:00-18:30	Technical Session 4: Frontier Technology on Bio-chemicals
Dec. 26th	Sun.	14:00-18:30	Technical Session 5: Frontier Technology on Bio-based Materials
Dec. 27th	Mon.	14:00-18:30	Technical Session 6: Frontier Technology on Bioenergy
Dec. 28th	Tue.	14:00-18:30	Experimental Session 1-3 (High-Throughput and Automated Genome Engineering, Systems Biotechnology and Cell Factory, Protein Structure Analysis)
Dec. 29th	Wed.	14:00-18:30	Experimental Session 4-6 (Introduction to DNA Synthesis, Metabolic Pathway Design for Chemical Synthesis, Intelligent Fermentation Technology)
Dec. 30th	Thu.	14:00-15:30	Group Discussion
		15:30-17:00	Test and Questionnaire Survey
		17:00-17:30	Graduation Ceremony

Agenda

December 20th-30th, 2021 [Beijing time, UTC/GMT+8]

Date	Week	Time	Contents	Speaker	Organization
Dec. 20th	Mon.	14:00-15:00	Trainee check-in and device tuning		
		15:00-16:00	Opening Ceremony		
		16:00-17:30	Keynote Speech: Introduction to the Industrial Synthetic Biotechnology	Jibin Sun Deputy Director-General	Tianjin Institute of Industrial Biotechnology (TIB), Chinese Academy of Sciences (CAS)
		17:30-18:30	Cloud Excursion to TIB	Jibin Sun Deputy Director-General	TIB, CAS
Dec. 21th	Tue.	**Technical Session 1: Frontier Technology on Biomedicine**			
		14:00-15:30	Biosynthesis of Plant-derived Natural Products	Tao Liu Professor	TIB, CAS
		15:30-17:00	Engineering the Plant Cell Factory for the Production of Plant Natural Products.	Zhichao Li Professor	TIB, CAS
		17:00-18:30	Green Biomanufacturing of Fine Chemicals Including Pharmaceuticals	Dunming Zhu Professor	TIB, CAS
Dec. 22th	Wed.	**Technical Session 2: Frontier Technology on Bio-agriculture**			
		14:00-15:30	Biomass Degradation and Biobased Chemicals Production	Chaoguang Tian Professor	TIB, CAS
		15:30-17:00	Synthetic Microbiome and Its Application in Agriculture	Zhiyong Huang Professor	TIB, CAS
		17:00-18:30	Intelligent Design of Artificial Biological Nitrogen Fixation System and Its Application in Agriculture	Yongliang Yan Professor	Biotechnology Research Institute, Chinese Academy of Agricultural Sciences
Dec. 23th	Thu.	**Technical Session 3: Frontier Technology on Future Food**			
		14:00-15:30	Progress in Production Technology and Industrialization of Microbial Polyunsaturated Fatty Acids	He Huang Professor	Nanjing Tech University
		15:30-17:00	Technology Development of Carbohydrate Engineering	Jiangang Yang Associate Professor	TIB, CAS
		17:00-18:30	Biomanufacture of Artificial Meat	Jingwen Zhou Professor	Jiangnan University
Dec. 24th	Fri.	**Technical Session 4: Frontier Technology on Bio-chemicals**			
		14:00-15:30	Biochemical Industry Using Biocatalysis	Wuyuan Zhang Professor	TIB, CAS
		15:30-17:00	Challenges and Opportunities for Bioconversion of Low-cost Biomass into Biofuels	Qiang Fei Professor	Xi'an Jiaotong University
		17:00-18:30	Biomanufacturing and Intelligent Control Systems	Peng Xu Assistant Professor	Guangdong Technion Israel Institute of Technology

		Technical Session 5: Frontier Technology on Bio-based Materials			
Dec. 26th	Sun.	14:00-15:30	Bio-based Production of Material Monomers	Xueli Zhang Professor	TIB, CAS
		15:30-17:00	Synthesis of Biodegradable Plastic Polylactic Acid in the era of SynBiotech	Bo Yu Professor	Institute of Microbiology, CAS
		17:00-18:30	Key Technologies for Strengthening the Synthesis Process of Bio-based Materials	Dan Wang Associate Professor	Chongqing University
		Technical Session 6: Frontier Technology on Bioenergy			
Dec. 27th	Mon.	14:00-15:30	Progress of Anaerobic Digestion Technology for Biogas Production	Liang Yu Assistant Professor	Washington State University
		15:30-17:00	Construction of Bioelectrochemical Systems for Bioelectricity Conversion	Zhiguang Zhu Professor	TIB, CAS
		17:00-18:30	Application of Synthetic Microbial Consortia for Biofuels and Natural Products Production	Fengxue Xin Professor	Nanjing Tech University
		Experimental Session 1-3			
Dec. 28th	Tue.	14:00-15:30	High-throughput and Automated Genome Engineering	Yu Wang Associate Professor Yanmei Guo Senior Engineer	TIB, CAS
		15:30-17:00	Technology of Systems Biology in Metabolic Engineering	Jibin Sun Professor Qichen Cao Associate Professor	TIB, CAS
		17:00-18:30	X-ray Protein Crystal Structure Determination	Weidong Liu Professor	TIB, CAS
	Experimental Session 4-6				
Dec. 29th	Wed.	14:00-15:30	Introduction to DNA Synthesis	Miao Feng Associate Professor	TIB, CAS
		15:30-17:00	Design of Metabolic Pathways Based on the Genome-Scale Metabolic Network	Qianqian Yuan Associate Professor	TIB, CAS
		17:00-18:30	Intelligent Fermentation Technology	Jianye Xia Professor	TIB, CAS
Dec. 30th	Thu.	14:00-15:30	Group Discussion		
		15:30-17:00	Test and Questionnaire Survey		
		17:00-17:30	Graduation Ceremony		

Note: The program on Dec. 30 is only for the trainees.

日程安排

(2021年12月20日至30日)

日期	星期	时间	内容	主讲人	主讲人单位
12月20日	一	14:00-15:00	学员在线签到		
		15:00-16:00	开班仪式		
		16:00-17:30	主旨报告：工业合成生物技术概述	孙际宾，副所长	天津工业生物所
		17:30-18:30	“云游”天津工业生物所		
12月21日	二	14:00-18:30	**技术课程Session 1：生物医药前沿技术进展**		
		14:00-15:30	微生物合成植物天然产物	刘涛，研究员	天津工业生物所
		15:30-17:00	利用植物细胞工厂合成植物天然产物	李志超，研究员	
		17:00-18:30	医药中间体的绿色生物制造技术	朱敦明，研究员	
12月22日	三	14:00-18:30	**技术课程Session 2：生物农业前沿技术进展**		
		14:00-15:30	生物质降解和化学品转化	田朝光，研究员	天津工业生物所
		15:30-17:00	合成微生物组的构建与农业应用	黄志勇，研究员	
		17:00-18:30	人工固氮体系的智能设计与农业应用	燕永亮，研究员	中国农科院生物技术研究所
12月23日	四	14:00-18:30	**技术课程Session 3：未来食品前沿技术进展**		
		14:00-15:30	微生物生产多不饱和脂肪酸油脂的技术开发及产业化放大	黄和，教授	南京工业大学
		15:30-17:00	糖工程研究进展	杨建刚 副研究员	天津工业生物所
		17:00-18:30	人造肉的生物制造	周景文，教授	江南大学
12月24日	五	14:00-18:30	**技术课程Session 4：生物化工前沿技术进展**		
		14:00-15:30	基于酶催化的绿色生物化工	张武元，研究员	天津工业生物所
		15:30-17:00	生物转化低值生物质合成生物燃料的机遇与挑战	费强，教授	西安交通大学
		17:00-18:30	化学品生物制造的智能控制	徐鹏，副教授	广东以色列理工学院
12月26日	六	14:00-18:30	**技术课程Session 5：生物基材料前沿技术进展**		
		14:00-15:30	材料单体的生物合成	张学礼，研究员	天津工业生物所
		15:30-17:00	生物基可降解材料聚乳酸的研究进展及技术趋势	于波，研究员	微生物所
		17:00-18:30	生物基材料合成过程强化关键技术	王丹，副教授	重庆大学

12月27日	一	14:00-18:30	**技术课程Session 6：生物能源前沿技术进展**		
		14:00-15:30	厌氧生物沼气能源方面的进展	郁亮，助理教授	华盛顿州立大学
		15:30-17:00	生物电催化系统构建 及在生物产电的应用	朱之光，研究员	天津工业生物所
		17:30-18:30	人工混菌体系在合成生物燃料和 天然产物的应用	信丰学，教授	南京工业大学
12月28日	二	14:00-18:30	**实验课程Session 1-3**		
		14:00-15:30	高通量自动化基因组编辑	王钰，副研究员 郭艳梅，高级工程师	天津工业生物所
		15:30-17:00	代谢过程中的系统生物学技术	孙际宾，研究员 曹琦琛，副研究员	
		17:00-18:30	X-射线蛋白质结构解析	刘卫东，研究员	
12月29日	三	14:00-18:30	**实验课程Session 4-6**		
		14:00-15:30	DNA合成技术简介	冯淼，副研究员	天津工业生物所
		15:30-17:00	基于基因组尺度代谢网络模型的 产品最优合成途径预测	袁倩倩，副研究员	
		17:30-18:30	智能发酵技术	夏建业，研究员	
12月30日	四	14:00-15:30	集中研讨交流		
		15:30-17:00	培训效果测试及问卷调查		
		17:00-17:30	结业仪式		

备注：本次培训班除面向“一带一路”沿线国家正式报名的学员外，也面向公众开放。
直播时间：12月20日-29日 14:00-18:30

Introduction to the Lecturers
讲师简介

(* shown according to the lecturers' sequence)

SUN JI BIN
孙际宾

Dr. Jibin SUN obtained his PhD degree in Biotechnology at Technical University Braunschweig/German Research Center for Biotechnology, Germany in 2004, and joined TIB as a full professor in 2008. He is the winner of State Council Special Allowance, member of China Biotech Fermentation Industry Association, member of Chinese Society for Microbiology, Vice Chairman of Tianjin Society for Microbiology.

His research interest is to establish methodological toolbox useful for understanding and engineering industrial working horses such as E. coli, C. glutamicum or A. niger, and to develop or rebuild industrial superbugs hyperproducing bulk or fine chemicals such as amino acid, organic acid or its derivatives. He did substantial contributions to the foundation of the institutional core facility and the National Center of Technology Innovation for Synthetic Biology.

In the past years, he published more than 100 peer-reviewed papers in leading international journals and applied 90 patents. He sequenced more than 100 Chinese industrial strains and developed efficient cell factories producing diverse amino acids, organic acids and transferred to the industry successfully.

孙际宾，研究员，博士生导师。2004年毕业于德国布伦瑞克工业大学，现任中国科学院天津工业生物技术研究所副所长，系统生物学中心主任。享受国务院特殊津贴专家，中国生物发酵产业协会会员，中国微生物学会会员，天津市微生物学会副会长。研究领域定位于工业微生物系统生物学，致力于发展工业微生物的先进研究方法，认知工业微生物的高产抗逆分子基础，设计和创造符合工业化需求的微生物。主持和参与了国家发改委、科技部、基金委、天津市等多个重要科研项目。在Nature Communication、Trends in Biotechnology、Metabolic Engineering、ACS Synthetic Biology等杂志上发表了系列有影响力的科研论文100余篇，申请中国发明专利90余项。聚焦解决氨基酸、有机酸等行业的关键科技问题，推动大宗氨基酸、高附加值氨基酸等多项技术在行业龙头企业成功实现产业化应用。

LIU TAO

刘涛

Tao Liu is professor at the Tianjin Institute of Industrial of Biotechnology (TIB). Dr. Liu's research is focused on natural product biosynthesis. It includes the elucidation of complex multi-step biosynthetic pathways, carried out by bacteria or plants, generation of modified natural product drugs through genetic engineering, microbial synthesis of plant derived natural products through metabolic engineering and synthetic biology. Dr. Liu has published more than 30 papers, which can be found in ACS Synth. Biol., Metab. Eng., Org. Lett., etc.

刘涛，中国科学院天津工业生物技术研究所研究员。刘涛研究员长期从事天然产物生物合成研究，主要包括：微生物天然产物生物合成途径解析；植物天然产物生物合成途径解析；微生物合成植物源天然产物；天然产物的组合生物合成等方面的研究。在Metab. Eng., ACS Synth. Biol., PNAS, J. Am. Chem. Soc., Org. Lett., Phytochemistry等期刊发表论文30余篇。

Selected publications

1. Yang, Y., et al., Discovery of glycosyltransferases involved in the biosynthesis of ligupurpuroside B. Organic Letters, 23(20):7851-7854. (2021)

2. Song, W., et al., CYP82AR subfamily proteins catalyze C-1' hydroxylations of deoxyshikonin in the biosynthesis of shikonin and alkannin. Organic Letters, 23(7):2455-2459. (2021)

3. Bi,H., et al., Biosynthesis of a rosavin natural product in Escherichia coli by glycosyltransferase rational design and artificial pathway construction. Metabolic Engineering, 69:15-25. (2021)

4. Bi,H., et al., Producing gram-scale unnatural rosavin analogues from glucose by engineered Escherichia coli， ACS Synthetic Biology, 8(8), 1931-1940. (2019)

Biosynthesis of Plant-derived Natural Products

lant natural products are currently widely used in the pharmaceutical, health food, and cosmetics industries. The natural supply of these compounds is very limited due to the limited availability and yield from plants. Chemical synthesis suffers from low yield, using expensive intermediates and causing serious pollution. Recent developments in functional genomics and high-throughput analytical techniques have led to discovery of genes involved in the biosynthesis of plant natural products. The knowledge thus derived has been successfully utilized to produce target specialized plant origin by metabolic engineering and synthetic biology approaches. Herein, we discuss biosynthetic pathway elucidation and microbial synthesis of plant natural products, especially polyphenols.

微生物合成植物天然产物

植物天然产物目前广泛应用于制药、医疗等领域。目前植物天然产物的主要来源依赖于从植物中提取，这种生产方式受限于植物资源，占用耕地。化学合成的缺点是产率低，使用昂贵的中间体和催化剂。近年来，随着功能基因组学及高通量分析技术的发展，越来越多植物天然产物生物合成的基因和酶被发现。相关的知识已被用于，通过代谢工程和合成生物技术生产目标专用植物源天然产物。这里，我们讨论植物天然产物的生物合成途径阐明和微生物合成，特别是多酚天然产物。

LI ZHI CHAO

李志超

Zhichao Li, professor in Tianjin institute of industrial biotechnology, Chinese academy of sciences. His research topic is to study the mechanism of horizontal gene transfer (natural transgene) by experimental evolution strategy. The aim is to develop the new technology of transgene delivery, genome fusion and cell fusion. We also work on developing the plant enabling technologies and constructing the plant cell factories to produce the plant natural products, which are hard to be synthesized in microbe. Our latest research work is published on Nature Communications, Nucleic Acids Research , Plant Physiology, Journal of Experimental Botany and so on.

李志超，中国科学院天津工业生物技术研究所，研究员，博导，主要从事利用实验进化手段，解析水平基因转移（天然转基因）进化事件的分子机制，借此开发新型的基因递送技术、基因组融合及细胞融合技术；同时致力于开发植物使能技术、构建植物细胞工厂，对微生物合成困难的重要天然植物药物进行植物同源合成。近期研究工作发表于Nature Communications、Nucleic Acids Research、Plant Physiology、Journal of Experimental Botany等。

Engineering the Plant Cell Factory for the Production of Plant Natural Products.

Plant natural products (PNPs) are the main sources of drugs, food additives or new biofuels and have become the hotspot in synthetic biology. In the past two decades, the engineered biosynthesis of many PNPs have been achieved by constructing the microbial cell factories. Along with rapid development of plant physiology, genetics and plant genetic modification technique, the host has now expanded to complex plant system from initial single-celled microbes. Plant synthetic biology is an emerging field that combines engineering principles with plant biology. In this technical lecture, we will focus on plant-specific genetic and metabolic engineering technologies and introduce the recent advances of identification of PNPs biosynthetic pathway and summarized the progress of engineered PNPs biosynthesis in plant.

利用植物细胞工厂合成植物天然产物

植物天然产物(PNP)是高值药物、食品添加剂或新型生物燃料的主要来源，已成为合成生物学研究的热点。近二十年来，通过构建微生物细胞工厂，实现了许多PNP的工程化生物合成。随着植物生理学、遗传学和植物基因改造技术的迅速发展，宿主已由最初的单细胞微生物扩展到复杂的植物系统。植物合成生物学是将工程原理与植物科学相结合的新兴学科。在本次技术讲座中，我们将重点介绍植物特异的遗传和代谢工程技术，并对近年来利用植物研究PNP生物合成途径及工程化生产的进展进行介绍和总结。

ZHU DUN MING

朱敦明

Dunming Zhu, Ph.D. Director of Tianjin Engineering Research Center of Biocatalytic Technology. He got his BS from the University of Science & Technology of China and his Ph.D. from Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences (CAS). Before joining TIB, he held several positions in academia and industry in the United States. He has co-authored more than 150 peer-reviewed articles in core international journals including Nature Catalysis, JACS, Angewandte Chemie, Chemical Science, ACS Catalysis. He authored a book "Chemo-Enzymatic Cascade Reactions" published by Wiley. His team has transferred 4 bioprocesses which are applied at annually 100 to 10000 ton scale. He serves an Editorial Board Member of several scientific journals and committee member of several Chinese professional organizations. He gave invited talks at various international conferences such as Gordon Research Conferences Biocatalysis and Green Chemistry, and Engineering Conference International Enzyme Engineering conferences. His research interests focus on the interface of synthetic biology and synthetic chemistry, and range from discovery of novel industrial enzymes to understanding of biocatalytic reaction mechanisms, and the integration of biocatalysis into complex organic synthesis.

朱敦明，博士生导师，中国科学院天津工业生物技术研究所研究员、天津市生物催化技术工程中心主任。1987年毕业于中国科学技术大学高分子化学专业，1993年毕业于中国科学院上海有机化学研究所，获有机化学专业博士学位。研究方向为合成化学与合成生物学的交叉领域，开展系统生物催化理论和技术方法的研究，开发绿色生物合成技术及其在化学工业中的应用，探索生物催化二氧化碳固定化的反应机理及其高值化利用。在Nature Catalysis, JACS, Angewandte Chemie, ACS Catalysis, Chemical Science等刊物发表研究论文15多篇，出版英文专著1部 （Chemo-Enzymatic Cascade Reactions,Wiley）；在应用研究方面，实现了4项成果的技术转让，生产规模分别达到每年100-10000吨的规模。担任多种期刊的编委和多个专业委员会委员；应邀在Gordon Research Conferences 的绿色化学研讨会和生物催化研讨会，以及Engineering Conference International 的 酶工程研讨会等国际著名学术会议作大会邀请报告。

Green Biomanufacturing of Fine Chemicals Including Pharmaceuticals

Given the importance of fine chemical industry including pharmaceutical industry to our daily life and the impacts of fine chemical industry on the environment, it is highly desired to develop technologies that could enable the sustainable development of fine chemical industry. This short course will discuss the recent advances in biocatalysis and its advantages in the green production of biocatalysis. Retro-biosynthesis based on biotransformation will be introduced using some examples. Recently developed bioprocesses for the production of pharmaceutical intermediates in our laboratory and their application at industrial scale will be presented to demonstrate that combination of biocatalysis and chemical synthesis can enable us to address the challenges in the green biomanufacturing of fine chemicals, thus benefiting our society in a sustainable way.

医药中间体的绿色生物制造技术

从制药工业等精细化学工业对于人类生存的重要性和在资源、环境等方面带来的挑战出发，指出精细化学品绿色制造的重要性；介绍生物催化的重要进展，特别是生物催化在精细化学品绿色制造中体现出来的优势；介绍利用生物合成拟分析和系统生物催化原理进行高效化学生物组合合成路线的设计；最后通过一些具体事例（包括一些已经工业化应用的事例）阐述了化学合成和生物催化的高度融合是实现医药、农药等精细化学品绿色生物制造，促进人类社会的可持续发展的必需技术路径。

TIAN CHAO GUANG

田朝光

Dr. Chaoguang Tian, PI, Tianjin Institute of Industrial Biotechnology, CAS, since 2010. PhD graduated from Institute of Genetics and Developmental Biology, CAS at 2004. postdoc study at U.C. Berkeley, 2005-2009. The current research mainly focuses on study of chassis cell genetics and engineering using filamentous fungi and mammalian cell as working system. Developing the cell factory for biobased chemicals and industrial proteins, and the new synthetic biotechnology for biotherapy.

田朝光，博士，研究员。2004年博士毕业于中国科学院遗传发育所，2005-2009加州大学伯克利分校做博士后研究，2009.12至今，中科院天津工业生物技术研究所工作。主要以丝状真菌和哺乳动物细胞为对象，开展真核底盘细胞遗传改造研究；研发可用于大宗化学品和工业蛋白质生产的细胞工厂以及可用于生物治疗的合成生物学新技术。先后主持包括国家重点研发计划等各类科研任务20余项，在Science、PNAS等国际著名期刊发表论文40余篇，申请专利20余项。

Biomass Degradation and Biobased Chemicals Production

Biomanufacturing is one the major output of synthetics biology, biorefinery is the core component of biomanufacturing. This lecture will focuses on biorefinery, the study including the mechanism of biomass degradation, cell factory construction using genome editing tools for biobased chemicals production will be discussed then.

生物质降解和化学品转化

生物制造是合成生物学重要出口，生物炼制是生物制造的核心内容，本次课程内容主要围绕生物炼制展开，包括丝状真菌降解利用过程中转录调控机理研究，以及利用基因组编辑技术构建生物基化学品细胞工厂等。

HUANG ZHI YONG

黄志勇

Dr. Zhiyong Huang, PI, Professor of Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences, Deputy Director of Tianjin Key Lab of "Industrial Biosystems and Process Engineering". He used to study and work in the University of Tokyo (Japan), the University of Missouri (USA), and the University of Georgia, Savannah River Ecological Laboratory (USA) for many years. In 2008, he joined in Tianjin Institute of industrial biotechnology, Chinese Academy of Sciences. Prof. Huang kept focus on Microbial Ecology, Environmental Microbiology, Microbiome, and developed a series of engineered microbial techniques in the Environment, and Agriculture fields.

黄志勇，博士，团队负责人，中国科学院天津工业生物技术研究所研究员，天津市“工业生物系统与过程工程”重点实验室副主任。先后在日本东京大学、美国密苏里大学、美国佐治亚大学萨瓦纳河生态实验室学习工作多年。2008年加入中国科学院天津工业生物技术研究所。长期研究微生物生态学、环境微生物学、微生物组学，以及工程化应用技术的研究，开发系列环境微生物技术应用于环境治理、生态农业等领域。

The Construction Method and Application in Agriculture of the Synthetic Microbiome

The microbiome plays a vital role in human health, agriculture, and the environment. This course mainly introduces the definition, connotation and technical methods of the microbiome, focusing on the important role of the microbiome in agricultural production (promoting growth, preventing disease, resisting stress, repairing, etc.). In addition, the advantages of the engineered microbiome are introduced, and the design principles and best practices of the "top-down" and "bottom-up" of the engineered microbiome are emphasized. The construction method of the microbiome was demonstrated in combination with typical cases. Finally, the technical development route of the future engineering microbiome and its specific application in the agricultural field are discussed.

合成微生物组的构建与农业应用

微生物组在人类健康、农业、环境等方面均发挥着至关重要的作用。本课程主要介绍了微生物组的定义、内涵及其研究的技术方法，重点展示了微生物组在农业生产中（促生、防病、抗逆、修复等）的重要作用。此外还介绍了工程微生物组的优势，并重点阐述了工程微生物组“自上而下”和“自下而上”的设计原则和最佳实践。结合典型案例对微生物组的构建方法进行了展示。最后，讨论了未来工程微生物组的技术发展路线以及在农业领域的具体应用。

YAN YONG LIANG

燕永亮

Dr. Yongliang Yan, Professor at Biotechnology Research Institute, Chinese Academy of Agricultural Sciences.

His research focuses on signal transduction cascades that regulate nitrogen fixation genes in response to environmental clues in the root-associated nitrogen-fixing bacterium Pseudomonas stutzeri A1501. He also engages in the design and optimization of artificial nitrogen fixation system through synthetic biology. Through functional genomics platform, his team analyzed the regulatory mechanism of nif gene, and identified multiple functional elements involved in nitrogen signal transduction in A1501. Furthermore, they reported the first described case of a bacterial small RNA involved in the regulation of optimal nitrogen fixation via a direct baseparing interaction in A1501. They have designed a series of functional elements and constructed several engineering strains with ammonium secretion ability, which have important application potential in reducing chemical fertilizer application and increasing crop productivity.

燕永亮，中国农业科学院生物技术研究所研究员，农业微生物学研究中心主任，微生物智能设计与合成创新团队执行首席，2016年入选中国农科院“青年英才”计划。主要从事微生物功能基因组与合成生物学研究，系统解析联合固氮菌网络调控机制并开展人工固氮体系的设计优化工作。解析了施氏假单胞菌的高效固氮机制，首次报道了非编码RNA直接参与固氮基因表达的转录后调控机制，设计并构建了一系列固氮元件和功能模块，为人工固氮体系的组装优化奠定了工作基础。主持国家重点研发计划、973计划、863计划、国家自然科学基金等课题20余项；在PNAS等国际刊物发表SCI论文40余篇；获国家发明专利授权10余项。

Artificial Nitrogen Fixation System and Application in Agriculture

Biological nitrogen fixation, carried out by prokaryotes, leads to the reduction of molecular nitrogen to ammonia, subsequently assimilated in amino acids, and provides Earth's ecosystems with about 200 million tons N per year. The use of biological nitrogen fixation to reduce chemical nitrogen fertilizer is one of the most potential technical ways to promote the high-quality development of agriculture. However, the natural nitrogen fixation system has the defects of narrow host range or low nitrogen fixation activity, which greatly limits the wide application of biological nitrogen fixation in agriculture. Enhancing the efficiency of crop root-associated nitrogen fixation, developing root nodule symbioses strategies in cereals and creating artificial nitrogen-fixing eukaryotes are not only the frontiers of biological nitrogen fixation research, but also a worldwide challenge of agricultural science and technology. The synthetic biology emerging in this century will provide a revolutionary solution for the agricultural application of biological nitrogen fixation. In this report, I will systematically review the latest progress in the synthetic biology of biological nitrogen fixation systems, and briefly discuss our attempts to develop an efficient artificial non-legume associative nitrogen fixation system.

人工固氮体系的智能设计与农业应用

自然界中，某些原核微生物能将空气中的氮素转化为氨，这一过程称为生物固氮。地球上生物固氮每年固定的氮素量可达2亿吨，约占全球作物需氮量的3/4。利用生物固氮替代化学氮肥，是促进农业绿色高质量发展最具应用潜力的技术途径之一。但是，天然固氮体系存在宿主范围窄和固氮活性低等缺陷，大大局限了生物固氮在农业中的广泛应用。如何增强根际联合固氮效率，扩大共生固氮宿主范围，构建自主固氮的非豆科作物，是当前国际生物固氮研究的前沿方向，也是世界性农业科技难题。本报告将汇报相关领域的国际前沿成果，同时分享课题组在非豆科联合固氮方面取得的研究进展。

黄和

HUANG HE

He Huang is the professor at Nanjing Tech University and the dean of the School of Pharmaceutical Sciences. He received his undergraduate education from Zhejiang University, P.R. China (1993-1997), and obtained a PhD degree in Chemical Engineering from Purdue University (2002). His research was focused on mining and utilization of industrial microbial resources. Through the establishment of metabolic engineering and synthetic biology-based strain targeted construction technologies, as well as system integration-based process optimization technology, a variety of fermentation products were produced on an industrial level, including a new generation of food sour agent (L-malic acid), functional nutritional chemicals (docosahexaenoic acid, arachidonic acid), plant growth regulators (gibberellins) and so on. Until now, he has published more than 160 papers in the international journals and obtained more than 87 granted patents. In this year, he was re-elected in the list of Most Cited Chinese Researchers by Elsevier, this is the seventh time that Professor He Huang has been selected in the list since 2014. Based on the above outstanding achievements, he has won the second prize of National Technology Invention Award (ranks first) in 2013 and 2018.

黄和，教授、博士生导师，现任南京工业大学药学院院长。1997年本科毕业于浙江大学，2002年博士毕业于美国普渡大学化学工程系。研究方向为工业微生物资源开发与利用研究，通过建立基于代谢工程与合成生物学的菌种定向选育和高效改造技术，结合基于系统集成的过程优化技术，实现了新一代酸味剂（苹果酸）、功能性营养化学品（二十二碳六烯酸、花生四烯酸）、植物激素（赤霉素GA4、赤霉素GA3）等多种发酵产品的工业规模生产。相关成果以第一发明人获授权发明专利87件，发表SCI论文160余篇，2014-2020年连续入选Elsevier化学工程中国高被引学者榜单，并以第一完成人获国家技术发明二等奖2项（2013年、2018年）。

Progress in Production Technology and Industrialization of Microbial Polyunsaturated Fatty Acids

Microbial lipid is emerging as a new developed edible lipid after vegetable oils and animal fats. Due to the advantages of short production cycle, less land occupation, less impact of climate change and more abundant raw material sources comparing with lipids from plants and animals, microbial lipid production has attracted much attention from academic and industrial circles in recent years. Polyunsaturated fatty acids are the most typical microbial lipids, which has an extremely important relationship with human health. However, there are still many limitations on the large-scale production of microbial lipids, including low lipid content, difficult control of lipid components and fermentation processes. Our group has been engaged in the research of polyunsaturated fatty acids for many years and accumulated quite a lot of experience from Laboratory to Industrialization. This report takes the industrial production of polyunsaturated fatty acid docosahexaenoic acid (DHA) as an example. The main content includes (1) Screening of DHA high-producing strains; (2) Development of the high cell-density fermentation technology (3) Development of a green solvent-free DHA extraction technology, and looking forward to the future development direction.

微生物生产多不饱和脂肪酸油脂的技术开发及产业化放大

微生物油脂是继植物油脂、动物油脂之后的又一食用油脂新资源，具有生产周期短、占地少、受天气影响小、原料来源丰富等优势，近年来备受学术界和产业界重视。其中不饱和脂肪酸油脂与人体的健康有着极其重要的关系，是最具典型的微生物油脂。然而，微生物油脂的产业化依然面临着诸多挑战，包括油脂产量低、油脂组分控制难、发酵过程调控难等。本课题组多年来长期从事多不饱和脂肪酸的研究工作，在技术开发及产业化放大方面进行了深入研究。本报告以多不饱和脂肪酸-二十二碳六烯酸（DHA）生产为例，报告内容包括（1）筛选高产DHA的菌株；（2）开发高密度发酵技术实现DHA油脂的高效积累（3）开发绿色无溶剂提取新工艺，并对未来发展方向进行了展望。

YANG JIAN GANG

杨建刚

He is the associate professor from Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences. His research focuses on biomanufacturing functional sugars and natural products. The detail research area contains: i) discovery and engineering of enzymes such as aldolases, phosphatases and glycosyltransferases to improve their catalytic efficiency and thermostability; artificial pathway design and multi-enzyme system construction to manufacture value-added carbohydrates; biosynthesis of chemicals based on C-C bond formation using metabolic engineering and synthetic biology strategies. He developed low-cost routes for producing rare sugars from starch and one-carbon compound and has successfully synthesized many nutrient chemicals such as mannose, glycosylglycerol, mannosyl-oligosaccharides, and so on. He published more than fifteen papers in internationally magazines like ACS catalysis and Biotechnology advance. Also, he applied many patents for his work.

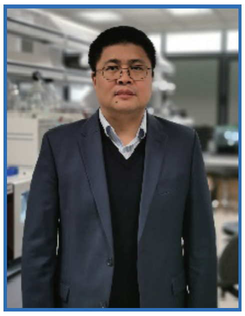
杨建刚,中国科学院天津工业生物技术研究所，副研究员，主要研究方向为功能糖及天然活性产物的生物制造。利用生物信息学、酶工程及合成生物学技术手段，开展稀少糖和功能寡糖转化合成一系列关键酶的挖掘、生物合成途径设计及微生物代谢工程研究，构建了由甲醛、甘油、淀粉糖为原料低成本稀少糖制造技术路线，开发了甘露糖、甘油葡萄糖苷、甘露寡糖等营养化学品及医药中间体生物合成方法。以第一作者或通讯作者在ACS catalysis, Biotechnology advance等国际知名杂志发表文章15篇。申请专利20项（含PCT专利2项），获得授权专利4项。

Technology Development of Carbohydrate Engineering

This report would present the concept of carbohydrate science and engineering. It would also talk about the technology development of carbohydrate engineering and its application in food and medicine area. The manufacturing technology for carbohydrate would contain enzymatic transformation, multienzyme cascade reaction, microbial fermentation technologies. This report would mainly focus on the biosynthesis of sugar and sugar alcohol based on isomerization and oxidation-reduction reactions and the application of aldol reactions in synthesis of deoxysugars. It would also discuss the method for production of new functional oligosaccharides based on transglycosylation reactions. Finally, the future trends of technology development in synthesis of sugars with high structural diversity are presented and evaluated.

糖工程研究进展

本报告介绍糖科学和糖工程概况，将介绍功能糖开发相关技术及食品、医药等领域内的应用，功能糖制备技术将从酶转化技术，多酶偶联催化技术，微生物发酵技术等方面进行谈论，重点介绍基于异构反应转化廉价单糖制备稀少糖、基于氧化还原反应制备糖醇，基于羟醛缩合反应创制脱氧糖、基于转苷反应制备功能寡糖等新方法，进一步针对未来功能糖创制技术进行讨论。



ZHOU JING WEN

周景文

Jingwen Zhou received his Ph.D in Fermentation Engineering, at Jiangnan University in 2009, his M.S. in Microbiology at Huazhong Agricultural University in 2006 and a B.A. in Food Science and Technology at Huazhong Agricultural University in 2003. He is the vice dean of Science Center for Future Foods, and a Professor of School of Biotechnology at Jiangnan University. His research areas include metabolic engineering of microorganisms for the efficient production of plant natural products and vitamins, development of strategies related to carbon-nitrogen balance regulation, fine-tuning of metabolic pathway and high-throughput screening. He has over 160 peer reviewed publications and invited reviews, and awarded with National Award for Technological Invention 2nd Prize, WIPO-SIPO Award for Chinese Outstanding Patented Invention, and ACS membership award.

周景文，江南大学生物工程学院教授，未来食品科学中心副主任，于2009年在江南大学获得发酵工程博士学位，2006年在华中农业大学获得微生物学硕士学位，2003年在华中农业大学获得食品科学与工程学士学位。他的研究领域包括微生物代谢工程高效合成植物天然产物和维生素等。他拥有160多篇同行评议出版物和邀请评论，并获得国家技术发明奖二等奖、中国发明金奖等科研奖励。

Biomanufacture of Artificial Meat

The so-called "artificial meat" can be generally divided into "plant protein meat" and "cell culture meat". At present, a large number of researches on artificial meat have been carried out all over the world. The key problems to be solved include the rational design and transformation of plant protein structure, flavor and nutrition, the large-scale acquisition of animal muscle cells and the large-scale low-cost culture of muscle tissue, as well as the foodization of plant protein meat and animal protein meat. Biotechnology can produce various food enzymes, protein scaffolds, nutrients, pigments, and flavor substances, which can realize the color, aroma, taste and shape of artificial meat, effectively improve the quality of artificial meat and reduce the production cost. In recent years, new resource proteins from more plants, the production of more proteins by microalgae and microorganisms, and the design and synthesis of functional proteins to improve food performance have provided more solutions to improve the quality of artificial meat and reduce production costs.

人造肉的生物制造

通常所说的“人造肉”，一般可以分为“植物蛋白肉”和“细胞培养肉”两大类。目前世界各国已经开展了大量人造肉的相关研究，亟待解决的关键问题包括植物蛋白结构、风味、营养等的理性设计与改造，动物肌肉细胞的大量获取和肌肉组织的大规模低成本培养，以及植物蛋白肉和动物蛋白肉的食品化等。利用生物技术，可以生产各种实现人造肉色、香、味、形的食品酶、蛋白支架、营养物质、色素、风味物质等，有效的提升人造肉的品质、降低生产成本。近年来，来源于更多植物的新资源蛋白、利用微藻和微生物生产更多的蛋白、设计和合成提升食品性能的功能蛋白等，为提升人造肉品质、降低生产成本，提供了更多的解决方案。

ZHANG WU YUAN

张武元

Dr.Wuyuan Zhang studied at the Delft University of Technology (TU Delft) and obtained his PhD degree in 2016 under the supervision of Prof. Isabel Arends and Dr Kristina Djanashvili. Later he spent four years as postdoctoral researcher with Prof. Frank Hollmann at TU Delft. In 2019 he joined Xi'an Jiaotong University as a principal investigator. In 2020, he moved to Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences (CAS). Currently he is leading the group of biocatalysis, with research interest focusing on photobiocatalysis, redox biocatalysis and their industrial applications. He has published more than 30 publications in peer-reviewed journals such as Nature Catalysis, Angewandte Chemie, Journal of the American Chemical Society, Nature Communications, etc.

张武元，2016 年博士毕业于荷兰代尔夫特理工大学纳米生物技术方向，师从荷兰皇家艺术和科学院院士 Isabel W.C.E. Arends。之后在该校生物催化课题组从事博士后研究，合作导师为 Frank Hollmann 教授，主要开发光酶催化在不对称合成中的应用研究。目前，已在 Nature Catalysis，Angewandte Chemie，Journal of the American Chemical Society，Nature Communications 等国际著名期刊上发表 30 多篇论文，获邀撰写 Springer 英文专著章节 1 篇，申请荷兰 / 欧洲专利 3 项。现为中科院天津工业生物技术研究所研究员，博士生导师。主要从事基于氧化还原酶的光促酶催化技术在药物及代谢物、不对称合成方面的研究。

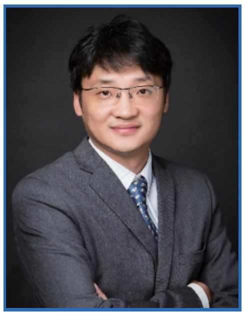
Biochemical Industry Using Biocatalysis

Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences.

According to the principles and metrics of green chemistry and sustainable development, biocatalysis is both a green and sustainable technology. In this rather short section, we will have a discussion on the recent advances of biocatalytic redox reactions. Along with this, we will also outline the important factors in designing a biocatalytic process for chemical synthesis.

基于酶催化的绿色生物化工

根据绿色化学和可持续发展的原则和指标，生物催化是一种绿色和可持续的催化技术。在这个较短的课程中，我们将讨论生物催化氧化还原反应的最新进展。与此同时，我们还将概述在设计化学合成的生物催化工艺中需要考虑的重要因素。



FEI QIANG

费强

Prof. Fei earned his Ph.D. in Biochem Eng at KAIST in 2011 under the supervision of Prof. Ho Nam Chang. From 2011-2016, he was serving as a postdoc and staff engineer at MIT and the National Renewable Energy Laboratory (NREL) respectively. Prof. Fei joined Xi’an Jiaotong University as a PI in 2016 working on the construction and development of biocatalysts for biofuel production including lipids, biodiesel, isobutanol, and single cell protein. His group has been funded by more than ten projects, including National Key R&D Programs of China, NSFC, Key R&D Program of Shaanxi Province and etc. Prof. Fei has published more than 40 peer-reviewed research papers in Biotechnol Adv, Biotechnol Biofuel, Bioresour Technol, Energ Convers Manage, etc. Currently, he is focusing on developing fermentation processes using C1 gaseous substrates and lignocellulosic biomass for the production of lipids, chemicals and nutrients as well as related techno-economic analysis (TEA) and life cycle analysis (LCA).

费强，工学博士，西安交通大学化工学院教授、博士生导师，创新团队负责人，生物化工学术带头人，陕西省特聘专家，陕西省高层次青年人才。2011 年于韩国科学技术院 (KAIST) 取得博士学位，师从韩国生物化工创始人 Ho Nam Chang 院士。2011-2016 年先后在麻省理工学院、国家实验室从事研发工作，2016 年全职回国在西安交通大学任教至今。以第一作者或通讯作者在 Biotechnol Adv、Biotechnol Biofuel、Bioresour Technol 、Energ Convers Manage、化工学报等主流期刊发表学术论文和英文专著 40 余篇。现承担国家重点研发计划、国家自然科学基金、陕西省重点研发计划等十余项国家省部级科研项目。现任中国生物工程学会一碳生物技术专委会秘书长、中国化工学会生物化工专委会委员、中国微生物学会普通微生物学专委会委员以及多个国内外知名学术期刊编委。团队现主要以甲烷、沼气等一碳气体为研究对象，通过合成生物学和高密度发酵技术将其进行高效生物转化为单细胞蛋白(饲料)、医药中间体、天然产物活性分子、航空煤油等生物基产品，并在此基础上对其商业化工艺进行技术经济可行性及全生命周期分析和评价。

Challenges and Opportunities for Bioconversion of Low-cost Biomass into Biofuels

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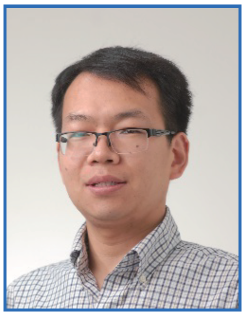
The current crisis of global warming is primarily attributed to CO2 production from the excessive use of fossil fuels during recent decades and has increased demand for renewable biofuels tremendously. Lipids are drawing considerable attention in relation to the production potential of biodiesel on the basis of their nontoxic, sustainable, and energy efficient proprieties. However, the high cost of microbial lipid produced by oleaginous microorganisms mainly stems from the high cost of glucose, which is estimated to be about 80% of the total medium cost. Therefore, considerable efforts have been directed toward minimizing the carbon source cost and finding new alternative carbon sources. Therefore, attention has begun to turn to oleaginous yeast, microalgae, and methanotrophic bacteria for biofuel production using abundant and low-cost carbon sources. In this study, several strains were investigated to obtain high cell density cultures (HCDC) using food waste, lignocellulosic biomass or natural gas as the sole carbon source. The cell growth and lipid production from different strains were studied and compared in order to elucidate the influence of culture conditions on lipid production in terms of titer, yield, content, and productivity in different culture systems. Both fermentation technologies and genetic engineering skills were applied to achieve an enhanced carbon flux toward desired products and better utilization efficiency of low-cost substrates. The fatty acid composition of lipids was analyzed and characterized for diesel fuel production. Finally, a techno-economic analysis (TEA) was projected based on the process of bioconversion of natural gas into liquid fuel (BioGTL) in order to provide the sensitivity analysis results.

生物转化低值生物质合成生物燃料的机遇与挑战

西安交通大学化工学院 邮箱：feiqiang@xjtu.edu.cn

随着我国向低碳社会和绿色经济的逐渐转变，生物燃料的研发又进入一个全新的阶段。为应对化石燃料的价格波动、航空碳税的征收压力以及航空燃料的巨大需求，国内外各大航空公司都在积极推进生物燃油的研发和生产。由于富含大量的有机质，餐厨垃圾和低劣生物质已成为可被用于生产生物能源的一种重要的生物质。通过预处理和厌氧发酵工艺，秸秆和餐厨垃圾可被转化为木质纤维素糖、挥发性脂肪酸和沼气。然而，目前大量的沼气利用还是以低品位的热利用为主，这大大降低的沼气的价值。因此随着餐厨垃圾产量的不断增加，挥发性脂肪酸和沼气的高端利用途径急需不断扩展和补充。嗜甲烷菌是一种可以将甲烷作为唯一碳源和能量源的微生物，其特有的甲烷单加氧酶可在体内将甲烷氧化为甲醇，并通过核酮糖单磷酸循环或丝氨酸循环路径完成理想产物的生物合成。但要实现高通量甲烷合成生物基产品并将该过程进行放大生产和商业化仍有许多问题亟待解决。本研究利用产油酵母菌和嗜甲烷菌作为底盘细胞，通过两阶段高密度发酵、旁路基因敲除和优化代谢途径等策略，在有效降低底物抑制作用的同时，提高了碳代谢通量和底物有效利用率，将来源于餐厨垃圾厌氧发酵过程中生产的挥发性脂肪酸混合液和沼气中的甲烷高效生物合成为生物油脂。本研究为实现生物燃料的合成路线替代和餐厨垃圾增值开发和资源化利用提供了新的研究思路。



XU PENG
徐鹏

Peng Xu, associate professor of Chemical Engineering at Technion-Guangdong, Israel Institute of Technology, co-founder and the chief scientific advisor of YaliBio (a Sanfrancisco-based synthetic biology company), He obtained his PhD in Chemical and Biological Engineering from Rensselaer Polytechnic Institute, completed his postdoc training in the Stephanopoulos lab at MIT, was an Assistant Professor (independent PI) at University of Maryland from 2106 to 2020. He has received the 2012 Chinese Government Award for Outstanding Self-financed Students Aboard, 2018 Bill & Melinda Gates Foundation Award, 2020 Biotechnology & Bioengineering Daniel IC Wang Award and 2021 Biochemical Engineering Journal Young Investigator Award. He served on the editorial board for the journal Current Opinion in Biotechnology and Metabolic Engineering. His research fields include metabolic engineering, synthetic biology, intelligent control, green manufacturing and biochemical engineering et al.

徐鹏，广东以色列理工学院化学工程系副教授，雅礼生物科技创始人兼科学主管。2016-2020年担任马里兰大学化学与生物工程系助理教授。他于2013年获取伦斯勒理工学院化学与生物工程博士，并在麻省理工学院从事三年的博士后研究，师从代谢工程泰斗Stephanopoulos教授。本科和硕士均毕业于江南大学生物工程学院。他共发表了80余篇学术文章，被引3700余次。目前担任国际知名杂志Metabolic Engineering和Current Opinion in Biotechnology编委。曾获得 2012年“国家优秀自费留学生奖学金”，2018年"盖茨-梅林达基金会奖"，2020年"王义翘生物工程与生物技术奖"。研究领域包括代谢工程、合成生物学、智能控制、生物分子绿色制造和生化工程等。

Biomanufacturing and Intelligent Control Systems

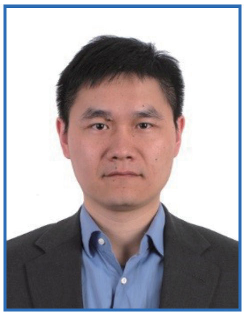
Department of Chemical Engineering, Guangdong - Technion, Israel Institute of Technology,
Shantou, China 510063

Food, energy, drugs are all derived from chemistry and biology. With increasing world population and growing resource demand, our overexploitation of nature has led to climate changes and rapid loss of ecological diversity. Metabolic engineering and synthetic biology are enabling technologies to produce the essential chemicals and drugs we use on the daily basis. Recent achievement in chemistry and biology allows us to repurpose the genetic and biocatalytic modules inside a living cell. To meet our sustainable goals, I will present our effort to reprogram biology for manufacturing applications. This effort allows us to optimize the cellular reaction networks to produce high value natural products and pharmaceuticals from low-cost feed-stocks. This effort also led us to harness genetically encoded biosensors to detect environmental pollutants and probe cellular states. Guided by intelligent design principles, I will also present our recent effort to rewire transcriptional regulation to improve and stabilize long-term cellular performance. By integrating negative autoregulation with growth addiction strategies, the engineered cell will autonomously mitigate carbon flux competition and reduce gene-expression induced strain degeneration. Engineering genetic, biocatalytic and feedback control modules in living cells will present us feasible solutions to address the most pressing challenges in health, energy and environment in the 21st century.

化学品生物制造的智能控制

广东以色列理工学院化学工程系

食物、能源、药物都来自化学和生物学。随着世界人口和资源需求的增长，我们对自然的过度开发导致了气候变化和生态多样性的迅速丧失。代谢工程和合成生物学使我们能够重新利用细胞内的遗传和生物催化模块，可持续的生产人们需要的各种化学品和药物。本课程中，我将介绍我们在生物代谢重编程和化学品生物制造智能控制方面的研究进展。这些研究使我们能够优化细胞反应网络，利用工程细胞从低成本的原料生产高价值的化学品和药物，以及利用基因编码的生物传感器来检测环境污染物和探测细胞状态。此外，在智能设计原则的指导下，通过整合负调控与生长成瘾策略，工程细胞将自主缓解碳通量竞争并避免菌株退化。菌种细胞中的工程基因、生物催化和反馈控制模块将为我们提供可行的解决方案，以应对21世纪健康、能源和环境方面最紧迫的挑战。



ZHANG XUE LI

张学礼

Zhang Xueli, PhD, Professor. He works at Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences. His researches mainly focus on three aspects, including substance metabolism, energy metabolism, and physiological metabolism, which systematically analyze the mechanism of the metabolic regulation in engineered microorganism for efficient production of compounds and provide a theoretical foundation for the construction of microbial cell factory. More than 70 SCI papers have been published. The research about novel gene editing was published in Nature Biotechnology.25 Chinese patents and 10 international patents were authorized. As the first winner, he won the first prize of China Light Industry Federation, China Patent Excellence Award, the second prize of Anhui Science and Technology Progress Award, and the second prize of Science and Technology Progress Award of China Petroleum and Chemical Industry Federation.

On the basis of theoretical researches, nearly 20 engineered strains, including L-alanine, succinic acid, D-lactic acid, valine have been developed, and 4 engineered strains have been successfully industrialized and 9 strains have completed technology transfer or entrusted development. The new output value of 2.93 billion yuan was generated, making an important contribution to the development of China's biotechnology strategic emerging industries.

张学礼，博士，中国科学院天津工业生物技术研究所研究员。主要从物质代谢、能量代谢和生理代谢三方面开展研究，系统解析了微生物高效合成化合物的代谢调控机制，为构建微生物细胞工厂奠定了理论基础。相关研究已发表在Nature Biotechnology等SCI文章70余篇，获授权中国专利25项和国际专利10项。以第一完成人获中国轻工业联合会技术发明一等奖、中国专利优秀奖、安徽省科技进步二等奖、中国石油和化工联合会科技进步奖二等奖。

在理论研究的基础上，开发出L-丙氨酸、丁二酸、D-乳酸、缬氨酸等近20个工业菌种，其中4个成功实现产业化，9个完成技术转让或委托开发，新增产值29.3亿元，为我国生物制造战略性新兴产业的发展做出了重要贡献。

Bio-based Production of Material Monomers

Content: The key points of the course are given on the construction and optimization of biosynthesis pathway of material monomers, including succinate, 1,4-butanediol, and adipic acid, which involve the strategies, optimization methods and the development of new technologies.1) The significance of bio-based synthetic material monomer ; 2) International demands for bio-based material monomer; 3) Case studies of succinic acid, 1,4-butanediol and adipic acid; 4) Strategies and principles for creating synthetic pathways, 5) calculation of maximum molar conversion of pathways and screening of the optimum pathways; 6) Approaches for pathway optimization and development of new technologies; 7) Future development needs, etc.

材料单体的生物合成

拟邀请其授课内容简述：重点讲述材料单体，包括丁二酸、1,4-丁二醇、己二酸等生物途径的创建和优化。1) 生物合成材料单体的重要意义；2) 国际对材料单体的国际需求；3) 丁二酸、1,4-丁二醇、己二酸等案例分析；4) 合成途径创建策略与原则，5) 途径最大摩尔转化的计算，最佳途径的筛选；6) 途径优化手段及新技术的开发；7) 未来的发展需求等。

于波 YU BO

Dr. Bo Yu obtained his academic training at Shandong University, China. After completion of his PhD thesis in 2006, he moved to Institute of Microbiology, Chinese Academy of Sciences (IMCAS). In 2008, he started his post-doc research for two years in Germany, funded by German Alexander von Humboldt Fellowship. From Oct. 2010, Dr. Bo Yu returned to IMCAS and leaded the research group. His research interests are in industrial biotechnology, especially in the aspect of metabolic engineering of strains for production of bio-based products via synthetic biotechnology, focusing on pharmaceutical chiral intermediates and high-value functional nutrients. In 2016, he was promoted to be the full professor in IMCAS. From 2014, Dr. Bo Yu served as the Deputy Director and later as Executive Director of CAS-TWAS Centre of Excellence for Biotechnology (CoEBio), which the center is focusing on strategic intelligence and international collaboration on bioeconomy as well as industrial biotechnology, both for developing and developed countries. Till now, he authored more than 60 scientific (peer reviewed) papers and 17 issued China patents in the fields of protein engineering, metabolic engineering and fermentation.

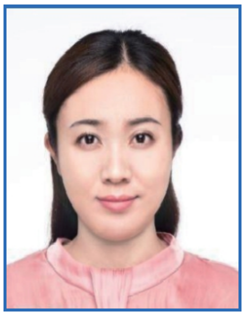
于波 博士，中国科学院微生物研究所研究员、研究组长、中科院微生物生理与代谢工程重点实验室副主任；兼任中国科学院-发展中国家科学院生物技术卓越中心（CAS-TWAS Center of Excellence for Biotechnology, CoEBio）副主任，主要从事工业生物技术领域的应用基础研究，开展合成生物学与工业微生物组等创新技术研发，侧重于医药手性中间体及高值功能营养品的绿色生物合成技术的产业化。在Trends in Microbiology, Metabolic Engineering, Bioresource Technology, ACS Synthetic Biology, Applied and Environmental Microbiology, Applied Microbiology and Biotechnology, Microbial Cell Factories等工业生物技术领域国际主流期刊发表科研论文60余篇，授权中国发明专利17项。

Synthesis of Biodegradable Plastic Polylactic Acid in the era of SynBiotech

Polylactic acid (PLA) is a biodegradable polymer, which has recently increased in global demand due to its increasing application as a bioplastic. PLA is traditionally synthesized by bio-chemical hybrid process, in which optical pure L-lactic acid or D-lactic acid as the monomer of PLA firstly is produced by microbial fermentation from renewable resources such as wheat, straw, corn, and sorghum, and then PLA is synthesized via the chemical polymerization. PLA can be completely degraded by microorganisms in nature, and finally mineralized into carbon dioxide and water. This report describes the current research progress of relevant technologies for the synthesis of PLA, including fermentative production of high optical purity lactic acid monomer as well as the PLA synthesis. The technology for the next generation of clean fermentation of lactic acid monomer and the development of polylactic acid biosynthesis will also be prospected in the coming era of synthetic biology.

生物基可降解材料聚乳酸的研究进展及技术趋势

内容：聚乳酸是一种新型聚酯材料，原料来源于淀粉、糖、纤维素等植物资源，而且生物可降解性良好，使用后能被自然界中的微生物完全降解，最终生成二氧化碳和水，不污染环境。聚乳酸具有良好的生物相容性和生物可降解性，也是目前最先实现产业化的生物基环保塑料。本报告讲述目前聚乳酸合成的相关技术研究进展，包括高光学纯乳酸单体发酵和聚乳酸合成，并将展望合成生物学时代的下一代乳酸单体清洁发酵和聚乳酸合成技术的发展。



WANG DAN
王丹

Wang Dan is an associate professor at School of Chemistry and Chemical Engineering in Chongqing University, who has gotten Chongqing outstanding youth fund. She obtained her Ph. D. degree in the Institute of Process Engineering, Chinese Academy of Sciences. She also had been a postdoctoral fellow of Rice University and a visiting scholar of Massachusetts Institute of Technology. She is the secretary general of Chongqing Strategic Alliance for Technological Innovation of New Chemical Engineering Materials, and a standing member of Biochemical Engineering Professional Committee of Chinese Chemical Engineering Society. She has long been engaged in the research of chemical process of biosynthetic chemicals and new materials, published more than 90 SCI papers, which has been cited more than 1500 times with a h-index 24. She has participated in the preparation of 5 Chinese and English books. 21 invention patents have been authorized. She serves as the editorial board of two international journals. She has won the Young Scientist Award of the World Federation of Pure and Applied Chemistry, the third prize of the science and technology progress award of the Chinese Chemical Engineering Society, the best report award of the 9th biochemical engineering technology innovation and industrial development seminar, the excellent paper award of the 5th Sino-US Chemical Engineering Conference, the excellent performance award of the president of the Chinese Academy of Sciences, etc.

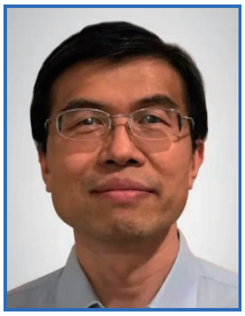
王丹，重庆大学化学化工学院副教授，重庆市杰出青年基金获得者，中国科学院过程工程研究所博士，莱斯大学博士后，麻省理工学院访问学者，重庆市化工新材料技术创新战略联盟秘书长，中国化工学会生物化工专业委员会常务委员。长期从事生物合成化学品及新材料的化工过程研究，共发表SCI论文90多篇，SCI总引1500余次，H-index　24；参与编写中英文书籍5部；授权发明专利21件。担任两个国际期刊编委。获世界纯粹与应用化学联合会青年科学家奖，中国化工学会科学技术进步奖三等奖，第九届生物化工技术创新及产业发展研讨会最佳报告奖，第五届中美化工会议优秀论文奖，中国科学院院长优秀奖等。

Key Technologies for Strengthening the Synthesis Process of Bio-based Materials

Consumers' attention to the environment and the change of values, as well as the international double carbon policy, have given birth to the germination and development of new bio-based materials industry, which is also a major demand in the field of chemistry and materials. As a subversive technology, synthetic biotechnology provides technical guarantee for the development and growth of bio-based materials on the supply side of the technology end. This course summarizes the technical progress related to bio-based materials in the field of chemistry and materials, especially the technical progress of synthetic biotechnology and microenvironment enhanced chemical processes. Taking the strain construction and process enhancement of bio-based PBS (polybutylene succinate) and bio-based nylon (polycaprolactam, polyglutaric diamine adipic acid) as examples, this report introduces 1) a new method of synergistic catalysis of biomass hydrolysis by imidazole ionic liquid and chitosan based solid acid based on the new mechanism of structure-activity regulation of green solvent ionic liquid; 2) The construction of multi enzyme system can improve the biosynthesis ability of compounds and feedback extracellular and intracellular metabolic engineering methods; 3) Application of reaction and separation coupling technology in the synthesis of bio-based materials. Through the course, students' ability to use the industrial synthesis technology to produce chemical materials will be improved, and the development of bio-based materials industry in the world will be guided.

生物基材料合成过程强化关键技术

消费者对环境的重视和价值观改变以及国际双碳政策催生生物基材料新产业的萌芽和发展，这也是化学与材料领域的重大需求。合成生物技术作为颠覆性技术，在技术端供给侧为生物基材料的发展壮大提供技术保障。本次课程综述了化学与材料领域的与生物基材料相关的技术进展，特别是生物基材料合成过程强化关键技术。以生物基PBS（聚丁二酸丁二醇酯）和生物基尼龙（聚己内酰胺、聚戊二胺己二酸）的菌种构建和过程强化为例，介绍了1）基于绿色溶剂离子液体构效调控新机理，发展的咪唑离子液体与壳聚糖基固体酸协同催化生物质水解的新方法；2）多酶体系构筑提升化合物生物合成能力，胞外反馈胞内的代谢工程方法；3）反应分离耦合技术在生物基材料合成中的应用。通过上述课程，提高学员运用工业合成技术生产化学品和化学材料的能力，引导生物基材料产业在世界范围内的发展。



YU LIANG
郁亮

Dr. Liang Yu is an assistant professor in the Department of Biological System Engineering at Washington State University (WSU). He earned a PhD in Biological and Agricultural Engineering at WSU in 2012 and a PhD in Chemical Engineering at the Institute of Process Engineering of the Chinese Academy of Sciences in 2008. He is also a licensed Professional Engineer (PE) in the state of Washington. Before he came to WSU, Dr. Yu worked in the chemical industry at the China National Petroleum Corporation (CNPC) for nine years and thus is well acquainted with most forms of petrochemical processing and related equipment. His research focuses on the development, scale-up, and integration of thermochemical and biochemical processes for biofuel production and organic waste treatment, with special emphasis on multi-scale and multi-phase process modeling via coupling of hydrodynamics, mass and heat transfer, and biochemical kinetics. Specifically, he is currently working on the development of an advanced anaerobic digestion-based biorefinery with hydrothermal pretreatment to convert animal manure, food waste, biosolids and other organic wastes into renewable natural gas (RNG), organic fertilizer, clean water and other high value bioproducts. Dr. Yu has published more than 50 papers in high-quality peer reviewed scientific journals such as Applied Energy, Bioresource Technology, Chemical Engineering Science, AIChE Journal etc. and 5 patents have been granted.

郁亮博士是华盛顿州立大学生物系统工程系助理教授，美国注册工程师。曾在中石油独山子炼油厂一线生产岗位工作9年，积累了丰富的工程和生产实践经验。先后取得国内中国科学院过程工程研究所应用化学博士学位和美国华盛顿州立大学生物与农业工程博士学位。并在美国华盛顿州立大学继续从事科研、教学和工程开发工作。主要从事于生物环境与能源及化学品生产技术研究和发展， 有机废弃物处理及养分回收技术研究和发展，设备与工厂设计，优化和放大，多尺度集成模拟包括生命周期分析、过程模拟、计算流体动力学和分子模拟等。相关研究成果发表在国际知名期刊上共发表50余篇文章及5项中美专利。

Progress of Anaerobic Digestion Technology for Biogas Production

This course will be taught to the students who intend to learn advanced progresses of anaerobic digestion (AD) to produce biogas based renewable energy. The major content will include introduction of anaerobic digestion and circular economy, process chemistry, microbiology, process parameters and reactor types, mathematical modeling. The biogas plant plays a very important role in the future circular economy. Streams of organic wastes, from industrial processes, agriculture and other human activity can be treated in biogas digesters and converted to useful renewable energy, nutrient-rich organic fertilizer and value-added chemicals. An in-depth analysis of the chemistry of anaerobic digestion will be presented and process chemistry can be used to optimize AD performance through methods that can accelerate syntrophic interactions of different microorganisms. Microbiology and molecular biology tools for AD process diagnosis and control will be reviewed. A summary of the processes underlying anaerobic digestion will be provided including commonly used measurements of anaerobic sludge, operating parameters of anaerobic digesters, and methods of acceleration and optimization used to improve process efficiency. Mathematical modelling of anaerobic digestion has a long and notable history, with eminent contributions for models including anaerobic digestion pathways and reactions, bio-chemical kinetics, black box models and phenomenological models etc. In the future bio-economy, organic wastes will be transformed to value-added chemicals, polymers, fuels, electricity and organic fertilizer etc. AD facilities will play a vital role in this development for biorefinery as the first and most basic step to decompose complex organic compounds.

厌氧生物沼气能源方面的进展

这门课是关于厌氧生物沼气能源方面的进展。主要内容包括介绍厌氧发酵技术和循环经济，化学过程，微生物群落研究，过程参数和反应器类型，以及数学模型发展。生物天然气厂在未来循环经济中占有很重要的地位。从工业过程，农业和其它人类活动中会产生一些有机废弃物，这些有机废弃物可以用厌氧发酵罐处理，生产可再生能源、含氮丰富的有机肥和高附加值化学品。厌氧发酵的化学变化将会被介绍，这些过程化学可以用来加速不同微生物之间互养关系，从而优化厌氧发酵性能。在厌氧研究中，微生物群落分析和一些分子生物工具被用到。一些常用的厌氧过程的测量参数、操作条件、以及加速和优化方法将会被用于提高过程效率。厌氧发酵的数学模型已有很长的历史，这些模型包括厌氧发酵的反应路径、生物化学动力学、黑箱模型和机理现象模型等。在未来的生物经济中，有机废弃物将被转化为高附加值化学品、聚合物、燃料、电力、有机肥等等。厌氧发酵装置将会在未来的生物炼油厂的发展中作为第一个、最基本的步骤，用于分解复杂的有机化学混合物。

ZHU ZHI GUANG

朱之光

Zhiguang Zhu, Professor at Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences. He graduated from Huazhong University of Science and Technology as a undergraduate and obtained his PhD in Biosystems Engineering from Virginia Tech on 2013. Since 2016, he has joined Tianjin Institute and started his own career. His research focuses on biocatalysis and synthetic biology. He constructs several bioelectrochemical systems including biofuel cells, biosensors, and bioelectrochemical synthesis cells. He has published more than 50 papers in journals such as Chem Rev, Nat Commun, Angew Chemie. He also takes charge of several projects and serves as guest editor and committee member in some organizations.

朱之光，中国科学院天津工业生物技术研究所研究员，博士生导师。2007年在华中科技大学获得生物技术学士学位，2013年在弗吉尼亚理工大学获得生物系统工程博士学位，2016年起在中国科学院天津工业生物技术研究所工作，获中科院人才计划支持。主要研究方向是生物电催化与合成生物学，通过研究生物电子传递机制以及强化策略，构建生物燃料电池、生物传感器、生物电合成等应用系统。已在Chem Rev, Nat Commun、Angew Chemie、Metab Engin、Biosens Bioelectron等国际知名刊物发表SCI论文50多篇，引用2000余次，申请发明专利10余项。主持包括国家重点研发计划（项目首席）、自然科学基金、中科院重点部署等10余项项目。担任国际刊物Frontiers in Bioengineering and Biotechnology编委、生物工程学会青年委员会委员、天津青年科技工作者协会副秘书长等职务。

Construction of Bioelectrochemical Systems for Bioelectricity Conversion

Enzymatic biofuel cells generate electricity as a final product from the enzymatic oxidoreduction reactions occurring at two electrodes. They are regarded as the next-generation power sources for clean electric energy, with the potential of powering multiple portable, wearable or implantable electronic devices. Challenges in such systems include how to expedite the bidirectional electron transfer between an electrode and an enzyme, the lack of “bioparts” or “bioblocks” with high catalytic efficiency and high stability, and the difficulties in assembling applicable devices.

Our group has developed several enzymatic biofuel cells based on the tool of in vitro synthetic biology and achieved the fully oxidation of multiple sugar fuels via various enzymatic pathways. Our work enables biofuel cells to have a high energy storage density and opens a door for these cells to numerous applications in powering portable/wearable/implantable electronic devices. Additionally, we have made progresses on enzyme engineering of bioparts, construction of better electron transfer module, and development of novel electrode materials, in order to further increase the power and the stability of our biofuel cells. More recently, we have further studied the interaction at the enzyme-electrode interface for appropriate enzyme immobilization and characterized the electron transfer in a hydrogenase-mediated biofuel cell.

生物电催化系统构建及在生物产电的应用

生物燃料电池是通过酶催化将化学能转化为电能的电化学装置，被认为是下一代清洁电能的来源，驱动便携式、穿戴式、植入式的电子器件。目前的挑战主要包括如何加快电极和酶之间的双向电子传递，缺乏相应的高效生物元件，以及难以组装成可应用的装置。

我们过去基于体外合成生物学，开发了一系列酶生物燃料电池，将多种底物转化为电能。我们的工作使生物燃料电池实现了高能量密度，为后续应用奠定了基础。此外，我们还通过酶工程、构建电子传递模块、开发新电极材料等方法，进一步提高了电池功率和稳定性。近期，我们还研究了酶-电极界面的相互作用，对氢酶在电极上的定向固定做了深入探讨。

XIN FENG XUE

信丰学

Dr. Fengxue Xin is a full professor in college of biotechnology and pharmaceutical engineering, Nanjing Tech University. He obtained his PhD degree from National University of Singapore. Currently, his research is mainly focusing on the bioconversion of waste organic sources into value added bio-products and construction of synthetic microbial consortia for bio-manufacturing. He has chaired more than 10 research funding supported by the National Key R&D Program of China, National Natural Science Foundation of China, Jiangsu Province Natural Science Foundation, and Jiangsu Synergetic Innovation Center for Advanced Bio-Manufacture et al. By now, he has published 67 SCI papers with first or correspondence authors in some reputational journals, including ACS Synthetic Biology, Biotechnology and Bioengineering, Trends in Biotechnology, Biotechnology Advances et al. He has also authorized 12 Chinese patents, and published 2 English book chapters. He is also the editorial member of Biotechnology for Biofuels, BioDesign Research, Frontiers in Bioengineering, and Biotechnology, Frontiers in Energy Research.

信丰学，男，博士，教授。2015年在新加坡国立大学获博士学位；2008-2016年先后在新加坡义安理工学院和新加坡国立大学担任研究工程师和博士后职位；2016年加入南京工业大学。获“侯德榜化工科学技术奖”，江苏省“双创博士”，江苏省“六大人才高峰高层次人才，江苏省“生物技术优秀青年学者”。担任Frontiers in Bioengineering and Biotechnology副主编和编委，Biotechnology for Biofuels、BioDesign Research、Frontiers in Energy Research和《生物学杂志》编委。主要从事低劣生物质的生物降解、有用化学品合成和人工混菌体系的设计、构建与功能调控。已发表68篇第一/通讯作者SCI论文；以第一发明人申请中国发明专利14项，授权4项；以第一/通讯作者撰写3部英文专著章节。主持国家自然科学基金面上、青年，国家重点研发“合成生物学”重点专项项目子课题，江苏省自然科学基金等10余项国家和省部级课题；主持中国-德国联邦教研部(BMBF)国际合作项目1项；主持企业合作横向项目3项。

Application of Synthetic Microbial Consortia for Biofuels and Natural Products Production

The development of synthetic biology is moving from optimization of genetic elements and modules to design complex metabolic circuits and complete complex tasks. The artificial mixed bacteria system can play an irreplaceable role in the fields of medicine and chemical industry because it can realize the division of metabolic functions, the utilization of complex substrates and multiple components, and the tolerance of complex environments. It has become a new direction for the development of synthetic biology. Compared with single bacteria, the research on mixed bacteria system is still in its infancy, and there are still many challenges in rational design and construction of artificial mixed bacteria system, and analysis of the interaction mechanism between microbial members. The research team realized the efficient bioconversion of lignocellulose to valuable chemicals by constructing artificial mixed bacteria systems with complementary functions. This will provide a reference for guiding the construction of a robust and stable artificial multicellular system that degrades and transforms inferior biomass.

人工混菌体系在合成生物燃料和天然产物的应用

合成生物学的发展正从优化基因元件与模块走向从头设计复杂代谢线路和完成复杂工作。人工混菌体系因可实现代谢功能分工、复杂底物多组分利用及耐受复杂环境等，在医药、化工等领域发挥不可替代的作用，并已成为合成生物学发展的新方向。与单菌相比，混菌体系研究尚处于起步阶段，理性设计与构建人工混菌体系、解析菌群间互作机制等方面还面临诸多挑战。研究团队通过构建功能互补的人工混菌体系，实现了从木质纤维素到有用化学品的合成，并未为指导构建系统鲁棒、稳定的降解转化低劣生物质的人工多细胞体系提供了借鉴和思路。

WANG YU

王钰

Dr. Yu Wang received his Ph.D. degree in Biology from Shanghai Jiao Tong University in 2016. Currently, he is an associate professor and master supervisor of Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences. He also serves as the Deputy Director of Key Laboratory of Systems Microbial Biotechnology, Chinese Academy of Sciences and the coordinator of the Joint R&D Group on Biochemicals of COMSATS Joint Center for Industrial Biotechnology. Dr. Wang's research interest includes development of enabling technologies for industrial synthetic biology and bioconversion of one-carbon feedstocks. He has published more than 30 papers in Nature Communications, Metabolic Engineering, Biosensor and Bioelectronics, Trends in Biotechnology, etc as the first or corresponding author and filed more than 20 patents.

王钰，博士，2016年于上海交通大学获得生物学博士学位，现担任中国科学院天津工业生物技术研究所副研究员，硕士生导师，中国科学院系统微生物工程重点实验室副主任，COMSATS工业生物技术联合中心生物化工方向协调人。主要从事工业合成生物学使能技术开发和一碳原料生物转化利用研究，以第一或通讯作者在Nature Communications、Metabolic Engineering、Biosensor and Bioelectronics、Trends in Biotechnology等杂志发表论文30余篇，申请专利20余项。

GUO
YAN MEI

郭艳梅

Yanmei Guo graduated from JiLin University and obtained her master degree. Currently, she is a Senior Engineer of Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences. From 2012.01, she worked as leader of high-throughput screening laboratory responsible for high-throughput gene editing and screening laboratory devices. She has rich experience in high-throughput screening equipment and high-throughput gene editing and screening technology. She participated in most of the high-throughput screening work of the institute, assisted the project team to successfully transfer and transform several high-yield strains, established many high-throughput screening models and applied them effectively in the institute. Up to now, she has published more than 10 papers about high-throughput screening with research group together.

郭艳梅，2008年于吉林大学获得硕士学位，现为中国科学院天津工业生物技术研究所高级工程师。2021年开始主要负责高通量基因编辑与筛选平台大型装备运行管理，成功协助多个研究组获得了优良高产菌株，并建立了多个高通量筛选模型，截至目前参与发表论文10余篇。

High-throughput and Automated Genome Engineering

CRISPR/Cas systems have recently been repurposed for genetic manipulation, revolutionizing the field of genome engineering due to the simplicity and efficiency. The double-stranded DNA breaks (DSBs) generated by CRISPR/Cas can be repaired through homologous recombination (HR) with DNA templates to introduce specific mutations. Base editing combines the targeted specificity of CRISPR/Cas and the catalytic activity of nucleobase deaminase to install point mutations at target loci without introducing DSBs, adding exogenous DNA, or depending on HR. Considering no editing template is required, construction and delivery of the base editor plasmid into microorganisms would be easier than methods requiring DNA templates. Therefore, base editing is more desirable for high-throughput or automatic genome engineering, which would allow researchers to systematically modify DNA in genome-scale and test large-scale genetic designs. A typical workflow of automated microbial base editing starts with gRNA design, followed by oligonucleotide synthesis, plasmid construction, transformation, strain cultivation, and genetic verification. These standardized and modular methods will be easily designed and achieved with automated biofoundries.

高通量自动化基因组编辑

CRISPR/Cas系统已经被开发为简单和高效的基因组编辑工具，广泛应用于各位生物的遗传改造。CRISPR/Cas可在靶DNA处产生双链DNA断裂，通过染色体DNA与外源DNA模板的同源重组修复，引入特定的突变。碱基编辑是一种新型的基于CRISPR/Cas基因组编辑工具，其结合了CRISPR/Cas的靶向特异性和碱基脱氨酶的催化活性，可在靶位点处引入碱基突变，该过程不产生双链DNA断裂，无需添加外源DNA模板，也不依赖于生物体的同源重组修复。考虑到碱基编辑不需要编辑模板，编辑质粒的构建和转化进入微生物相比于需要DNA模板的方法更为简易。因此，碱基编辑更适合用于高通量和自动化的基因组工程，这将使研究人员能够在基因组规模上系统地修改DNA，并进行对大规模的改造设计进行快速验证。典型的微生物碱基自动编辑流程包括gRNA设计、引物合成、质粒构建、质粒转化、菌株培养和测序验证。这些标准化和模块化的方法将很容易地在biofoundry平台实现自动化。

CAO QI CHEN

曹琦琛

Qichen Cao, Ph.D., Associate researcher, Systems Biology Centre, Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences. From 2007 to 2014, he worked as phase I clinical trial pharmacokinetic researcher at the National Drug Clinical Trial Institute of the Affiliated Hospital of Liaoning University of Traditional Chinese Medicine. He mainly conducted the detection of clinical drugs and their metabolites from human plasma, based on the MRM/SRM technology of mass spectrometry. From 2011 to 2014, he studied at Beijing Proteomics Research Center for his Ph.D. He worked for the projects of "Large-scale identification of core-fucosylated proteome" and "Large-scale identification of 2-Hydroxyisobutyrylation from Saccharomyces cerevisiae". He joined Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences in 2014. His main research are focused on the large-scale quantitative research of industrial microbial proteome based on SWATH/DIA technology and the study of dynamic change of industrial strains' proteome during the fermentation process.

曹琦琛，博士，中国科学院天津工业生物技术研究所，系统生物学中心，副研究员。 2004年至2014年于辽宁中医药大学附属医院国家药物临床试验机构从事I期临床试验药动学研究。主要开展基于质谱MRM/SRM方法的血浆药物及其代谢物的检测工作。2011-20174年于北京蛋白质组学研究中心攻读博士学位。主要期间主要开展“核心岩藻糖化修饰蛋白质组的大规模鉴定”及“酵母2-羟基异丁酰化修饰蛋白质组”等研究。2014年加入中科院天津工生所，主要开展基于质谱SWATH/DIA技术的工业微生物蛋白质组大规模定量研究。利用蛋白质组学手段解析工业菌株发酵过程。

Technology of Systems Biology in Metabolic Engineering

Understanding life and measuring life activities are the prerequisite and basis for the transformation and utilization of life. Systems biology is the discipline that studies the composition and interrelationship of all components in a biological system, including genes, proteins, metabolites, etc. Using the technology of systems biology to understand industrial lives and exploring the structure and operating principles of the molecular machines will play an important role in improving the development capabilities of industrial strains! Through this course, you will learn about systems biology, and learn the principles and basic experimental operations of genomics, transcriptomics, proteomics, metabolomics, and interactomics.

代谢过程中的系统生物学技术

认识生命、测量生命活动，是改造和利用生命的前提和基础。系统生物学是研究生物系统中所有组分的构成和相互关系的学科。它研究所有基因、蛋白、代谢物等生物组分间的所有相互关系。采用系统生物学技术认识工业生命，探索其分子机器的构造和运行原理，对于提升工业菌株开发能力具有重要的推动作用！ 通过本课程将了解系统生物学，学习基因组学、转录组学、蛋白质组学、代谢组学、相互作用组学的原理及基本实验操作。

LIU WEI DONG

刘卫东

Weidong Liu got his Ph.D. degree from Nanjing Agricultural University in 2010 and joined TIB since then. Now he is a Professor of Tianjin Institute of Industrial Biotechnology (TIB), Chinese Academy of Sciences (CAS), responsible for Structural Biology Platform Laboratory. Currently, he is mainly engaged in the study of the structure and function of enzyme that are useful in biocatalysts by X-ray crystallography.

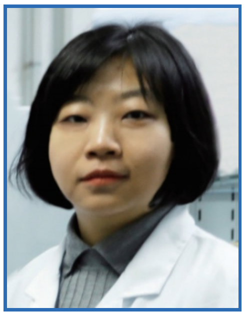
刘卫东，2010年毕业于南京农业大学，获博士学位。2010年加入中国科学院天津工业技术研究所，现为中国科学院天津工业生物技术研究所研究员，结构生物学平台实验室负责人。目前主要开展利用X-射线晶体学技术对酶类重要生物催化剂进行结构功能研究方面的工作。

X-ray Protein Crystal Structure Determination

Protein plays a very important role in various activities of life, and the study of its structure and function is the core of life science research. The protein structure biology platform of Tianjin Institute of industrial biotechnology, Chinese Academy of Sciences, focuses on the study of protein structure and function. Using X-ray crystallography as core technique, we carries out protein expression, purification, crystal screening, X-ray diffraction and structure determine studies on important proteins, to understand their catalytic mechanism and characteristics, and provide important structural basis for rational and semi rational design for improvement of their characters such as expanding substrate spectrum, improving enzyme activity and temperature resistance.

X-射线蛋白质结构解析

蛋白质在生命的各项活动中起到非常重要的作用，对其结构功能研究是生命研究的核心。中国科学院天津工业生物技术研究所蛋白质结构生物学平台，主要X-射线晶体学技术位核心，进行从表达、纯化、晶体筛选、X射线衍射等全流程工作，了解相关催化剂的机理以及特性，为后续进行理性、半理性设计改进酶的效能，如拓展底物谱、提高酶活、耐温性能等提供理论依据。



FENG MIAO

冯淼

Miao Feng, Ph.D., Associate investigator, Tianjin Institute of Industrial Biotechnology, CAS. She received her Ph.D. in polymer science from Nankai University in 2011. In the same year, she joined Tianjin Institute of Industrial Biotechnology. Her team in technology support center works on the development and application of DNA synthesis technology.

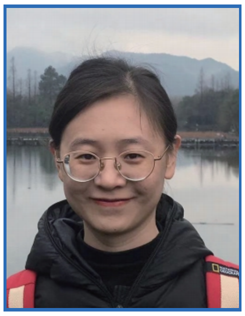
冯淼，博士，中国科学院天津工业技术研究所，副研究员。2011年，获得南开大学博士学位，同年进入中国科学院天津工业生物技术研究所工作。所在的研究所技术支撑中心团队主要从事DNA合成技术的开发和应用。

Introduction to DNA synthesis

DNA synthesis is the most basic and most widely used technology in synthetic biology. Synthetic DNA is applied to a broad range of applications in metabolic engineering, gene circuit design and genome synthesis. This section will provide a brief introduction to DNA synthesis through demonstration experiments in TIB.

DNA合成技术简介

DNA合成是合成生物学最基础、最常用的技术，合成DNA是构建代谢途径、基因通路、合成基因组的原材料。本实验课程简要介绍DNA合成方法以及中科院天津工业生物技术研究所DNA合成平台的工作流程。



YUAN QIAN QIAN

袁倩倩

Qianqian Yuan, female, associate researcher, leader of the metabolic network reconstruction and pathway design team of the BioDesign Center. She joined the Tianjin Institute of Industrial Biotechnology of the Chinese Academy of Sciences in 2017, undertook one National Natural Science Foundation project, participated in two national key research and development programs as the backbone of the subject, and published 12 papers in international journals such as Nature Biotechnology and Metabolic engineering.

袁倩倩，女，副研究员，生物设计中心代谢网络模型构建及途径设计团队组长。2017年加入中科院天津工业生物技术研究所，承担国家自然科学基金项目1项，作为课题骨干参与国家重点研发计划2项，在Nature Biotechnology、Metabolic engineering等国际刊物发表论文12篇。

Design of Metabolic Pathways Based on the Genome-Scale Metabolic Network

The goal of industrial strain construction is to maximize the conversion of substrates to target products, but the process of strain evolution does not aim at maximization of product. Therefore, many natural pathways are not optimal, and there are defects such as multiple reaction steps and high energy consumption. Therefore, pathway design is needed to obtain new pathways to avoid the defects of natural pathways. The reconstruction of genome-scale metabolic network model (GEM) is becoming a powerful tool for pathway design. GEM can be built based on reaction stoichiometry matrix and mass balance equations. It does not require complex data such as regulatory information and enzyme kinetics information and it is relatively easy to obtain. This course will introduce how to construct GEM, and conduct pathway calculation analysis through rational pathway design based on GEM.

基于基因组尺度代谢网络模型的产品最优合成途径预测

工业菌株改造的核心目标是将底物最大化的转化为目标产物，但是菌株进化过程并不是以产品最大化为目标。因此，导致很多天然途径并不是最优的途径，存在途径复杂、能耗高等缺陷。为此，需要进行途径设计来得到规避天然途径缺陷的新途径。由基因组构建细胞全局规模的代谢网络模型正成为一途径设计的有力工具。基因组规模代谢网络模型（genome-scale metabolic network，GEM）是途径设计的有力工具，GEM只需要基于反应计量关系和质量平衡方程就可以建模，不需要调控信息以及酶动力学信息等复杂数据，因此比较容易获得。本课程将具体介绍如何构建GEM，并通过理性途径设计方法进行途径计算分析。

XIA JIAN YE

夏建业

Jianye Xia，Ph.D. Professor，Director of Intelligent Biomanufacturing Center. He got PhD degree on Bioengineering from East China University of Science and Technology in 2008, from 2018 to 2021, he worked at ECUST, School of Biotechnology, National Center of Bio-Engineering & Technology (Shanghai). In 2016, he got the grant from the government as one year visiting scholar to be work at Chalmers University of Technology. July, 2021 he officially moved to TIB as PI. His research work mainly focus on development of theory and application techniques for bioprocess optimization and scale up. He have been in charge of several research project of Chinese Ministry of Science and Technology, and research projects of National Natural Science Foundation of China. He also has cooperated with several big bio-pharmaceutical corporations in China to do real application research work, and has applied the research of flow field in bioreactors to carry out modification and optimization of industrial bioreactors, which have been successfully applied in more than 10 fermentation factories. He was therefore awarded the 2011 National Prize for Progress in Science and Technology and several other Science and Technology awards. And he published more than 30 SCI papers on the bioprocess field.

夏建业，博士，研究员，智能生物制造平台实验室主任。2008年毕业于华东理工大学获得博士学位，2008年-2021年就职于华东理工大学生物工程学院、国家生化工程技术研究中心(上海)。2016年赴瑞典查尔姆斯理工大学公派访问学者一年。2021年7月正式就职中科院天津工业生物技术研究所。主要研究领域为生物过程优化与放大的理论与应用技术研究，先后承担973项目、863计划项目、科技部支撑计划项目、国家自然科学基金委青年基金和面上基金项目、绿色生物制造重点研发计划项目等多项国家级科研项目；先后在国内多家大型生物制药企业进行横向课题合作，成功应用生物反应器流场研究进行工业规模反应器的改造和优化，在国内10余家发酵企业获得成功应用，获得2011年国家科技进步二等奖及多项省部级科技奖项，发表SCI研究论文30余篇。

Intelligent Fermentation Technology

This course will focus on the key common technologies of the biological manufacturing process, and the basic principles of the fermentation process and the cutting-edge research fields for bioprocess optimization and scale up are mainly introduced, including the basic steps in a standard fermentation process, three typical operation modes of the fermentation process, and fermentation reaction kinetics, the flow field of the bioreactor and the bioprocess scale up, the scale-down-based fermentation process scale up researches, etc. After the brief introduction of the above basic principles, an actual fermentation process will be demonstrated: the activation of the bacteria to the seed culture, the sterilization of the fermentation medium, and the basic operation of the shake flask culture, the fermentor structure, installation and usage, the operation modes, followed finally by a quick demonstration of operations carried out for scaling up from laboratory scale to the pilot scale bioreactor in an fully automated bioreactor system. Finally, a simple principle introduction and practical demonstration of operation of the preliminary tubular centrifugal separation of the intracellular metabolites of the microbial cells and the high-pressure homogenizer for concentrated bacterial liquid are given.

智能发酵技术

本节课程将围绕生物制造过程的关键共性技术，重点讲解发酵过程的基本原理与生物工程优化与放大技术的前沿研究领域，包括发酵过程的基本流程，发酵过程的三种典型的操作方式，发酵过程反应动力学，生物反应器流场与生物过程放大，基于scale-down的发酵过程放大研究等。简单介绍完以上基本原理后，会通过实际发酵过程的演示具体讲解从菌种活化到种子培养、发酵培养基灭菌，及摇瓶培养的基本操作、发酵罐的组成、安装及使用、发酵过程的操作方式、以及从实验室规模向中试规模放大过程中的自动化发酵过程的操作方法展示。最后针对微生物细胞胞内代谢产物的初步的管式离心分离及浓缩菌液的高压均质破碎仪的操作做简单的原理介绍与实际操作演示。

Introduction to TIB

Tianjin Institute of Industrial Biotechnology (TIB) is jointly established by the Chinese Academy of Sciences (CAS) and Tianjin Municipal Government in 2012, committed to promoting eco-friendly development in industrial sectors by innovative biotechnology. TIB has set up its mission to substitute renewable carbon resources for fossil resources, to replace traditional chemical processing with green bioprocessing, and to upgrade traditional industries through modern biotechnology. Accordingly, the industrial protein science and biocatalytic engineering, synthetic biology and microbial manufacturing engineering, biological systems and bioprocess engineering, are defined as TIB's core research areas.

Presently, over 400 employees including over 100 senior professionals are working at TIB supported by state-of-the-art core facilities such as high-throughput screening, systems biotechnology, genome synthesis, fermentation process optimization and scaling-up. Targeting at the global and regional challenges on energy, resource and environment, numerous cutting-edge cell factories and green bioprocesses were developed here and industrialized. TIB is one of the leading institutes in China, pioneering the cost-efficient microbial production of bulk chemicals, pharmaceuticals, food/feed and materials. TIB is well-connected to the industry. Over 200 enterprises from all over China have built partnership with TIB. In addition, TIB has established a national professional incubator, named BIOINN Maker Space, which is the home for dozens of start-up companies.

Currently, as the lead Institute, TIB is putting great efforts to build the "National Center of Technology Innovation for Synthetic Biology", which is intended to build a bridge connecting scientific research of synthetic biology with the development of synthetic biotechnology, and promoting the industrialization of scientific and technological achievements by converging the talents of CAS and the academia, political and financial support of the central and local government, the public and private capitals and the industry via open and innovative mechanisms.

TIB is recognized as the National Base for International S&T Cooperation. It has established partnerships with over 50 world renowned organizations via versatile manners such as international joint centers, R&D projects, international conferences/workshops, academic exchange and training programs, and etc. We are looking forward to working together with more organizations and talent individuals worldwide to welcome the arrival of bioeconomy era for a greener, healthier and more prosperous world.

中国科学院天津工业生物技术研究所简介

中国科学院天津工业生物技术研究所（以下简称天津工业生物所）是由中国科学院和天津市人民政府共建、从事生物技术创新推动工业领域生态发展的科研机构，2012年3月获中央机构编制委员会批准成立，2012年11月29日通过验收，正式成为中国科学院序列研究所。

天津工业生物所肩负着建立我国工业生物技术创新体系、促进工业绿色升级的历史使命，其战略定位是：面向国民经济主战场，以新生物学为基础，以“人工生物”设计创建为核心，发展生命科学，创新生物技术，引领我国工业生物科技进步，构建工业经济发展的生态路线，打通科技创新价值链，服务于社会经济可持续发展。天津工业生物所以天津市及我国社会经济发展的重大需求为目标，围绕“以可再生碳资源替代化石资源、以清洁生物加工方式替代传统化学加工方式、以现代生物技术提升产业水平”的三大战略主题，重点开展“工业蛋白质科学与生物催化工程、合成生物学与微生物制造工程、生物系统与生物工艺工程”三个领域方向的基础研究和应用基础研究，发展新生物学指导下的工业蛋白质科学、工业系统生物学、工业合成生物学、工业发酵科学等学科体系，构建“科学研究、技术创新、产业培育、研究生教育”四位一体的发展模式，实行“研究组—总体研究部—平台实验室”三维科技管理机制，实现“出成果、出人才、出思想”的战略使命。

天津工业生物所建有工业酶国家工程实验室、中国科学院系统微生物工程重点实验室、天津市工业生物系统与过程工程重点实验室、天津市生物催化技术工程中心等创新平台，建有高通量筛选平台、系统生物技术平台、发酵过程优化与中试平台等先进的技术装备体系，建有国家级国际科技合作基地和“生物技术国家专业化众创空间”BIOINN。2019年11月，由中国科学院与天津市政府共建，天津工业生物所牵头建设的“国家合成生物技术创新中心”获得科技部批复。

截至2021年10月，天津工业生物所共有研发队伍857人，其中在职职工435人，研究生422人；研究员85%来自海外。承担了各类科研项目约700项。在生物医药、化工产业、纺织、发酵等领域与28个省市211家企业签署许可、委托、合作等协议317项，合同金额总计超12.9亿元，申请/授权专利运营率分别26%、48.3%。已获得中国产学研合作创新成果奖、中国科技产业化促进会科学技术奖科技创新一等奖等省部级及以上奖项20余项。

天津工业生物所坐落在环境优美的天津滨海新区空港经济区，一期建设已经形成4.3万平米的科研大楼与占地60亩科技园区。研究所将积极完善科研条件，不断提升科技创新能力和转化能力，以生物技术推动农业工业化、工业绿色化、产业国际化，把研究所建设成为在工业生物技术领域具有强大国际竞争力和重要影响力的、特色鲜明、不可替代的现代化研究所，努力在贯彻国家创新驱动战略、国家创新体系建设中发挥重要作用。

Introduction to CCIB

Nowadays, with the great challenge of global economic and social development, sustainable development has become the call of the times. Industrial biotechnology is one of the most important routes for green, low-carbon and sustainable development with brand-new solutions to the major issues in resources, human health, energy, environment and security.

On April 14, 2021, TIB and COMSATS jointly established the "COMSATS Joint Center for Industrial Biotechnology" abbreviated as CCIB, under the framework of the National Center of Technology Innovation for Synthetic Biology (NC SynBio) to build an open, shared, and innovative cooperation platform thus to promote the development of biotechnology and bioindustry in COMSATS member states and the "Belt and Road" countries.

Currently, CCIB has made some progress in joint R&D, academic exchanges, talent training, strategic consulting and tech transfer. Six Joint R&D Groups on biomedicine, bio-agriculture, future food, biochemical, bio-based materials and bioenergy have been set up for further promoting the exchange and cooperation, and some Joint R&D programs are being conducted. The first workshop focused on 'Technical Innovation in Traditional Plant Medicine' has been hosted in this October. Besides, Over 10 young scholars from member states and the "Belt and Road" countries are funded to work at TIB for a period of 2 months to 2 years. Moreover, 5 organizations from Pakistan, Egypt, Iran, Belarus, Kazakhstan have joined the network of Biomanufacturing Industry (Talent) Alliance in the platform of CCIB.

In the next three years, CCIB is expected to be a hub for "industry-university-research" cooperation platform preliminarily, and become the benchmark and flagship for cooperation among the COMSATS member states and the "Belt and Road" countries by 2030.

We welcome scientists to carry on collaborations in the platform of CCIB. Contact: Ms. Qianqian Chai, CCIB Coordinator and the International Cooperation Officer, TIB-CAS, chai_qq@tib.cas.cn, ccib@tib.cas.cn

To join the Joint R&D Groups, contact the coordinators:

Joint R&D Group	Coordinator	E-mail
Biomedicine	Prof. Huifeng Jiang	jiang_hf@tib.cas.cn
Bio-agriculture	Prof. Zhiyong Huang	huang_zy@tib.cas.cn
Future Food	Dr. Ting Shi	shi_ting@tib.cas.cn
Bio-chemicals	Dr. Yu Wang	wang_y@tib.cas.cn
Bio-based Materials	Prof. Wenqin Bai	baiwq@tib.cas.cn
Bioenergy	Dr. Demao Li	li_dm@tib.cas.cn

COMSATS工业生物技术联合中心简介

当前，全球经济与社会面临巨大挑战，可持续发展成为时代的要求。工业生物技术可以为人类社会发展面临的资源、健康、能源、环境和安全等重大问题提供全新解决方案，是实现绿色低碳可持续发展、助力联合国2030议程实现的重要途径。

2021年4月14日，在科技部、天津市和中科院的支持下，天津工业生物所和南方科技促进可持续发展委员会（COMSATS）共同组建工业生物技术联合中心（以下简称“联合中心”）。联合中心旨在围绕成员国经济社会可持续发展需求，在国家合成生物技术创新中心框架下，建设一个开放共享的、集合作研发、学术交流、人才培养、成果转化和战略咨询为一体的工业生物技术创新合作平台，加强COMSATS成员间的交流合作，推动成员国暨“一带一路”国家生物技术进步和产业发展。

目前，联合中心已在组织联合研发、开展学术交流、人才培养、高端智库建设等方面取得积极进展。在生物医药、生物农业、未来食品、生物化工、生物基材料、生物能源等方面组建六个联合研发组，并围绕植物天然产物异源合成、有机废弃物厌氧处理新型生物工艺优化及示范等方向联合成员国多个优势机构开展联合研发与产业示范；以“传统植物药的技术创新”为主题，召开了首期专题学术研讨会，为组建植物天然产物领域联合研究团队、开展高水平联合研究奠定了良好基础；依托天津市合成生物技术创新能力提升行动“一带一路”国际人才发展项目，资助十余名来自成员国暨“一带一路”沿线国家的青年科技人员来所开展为期2两个月到两年的合作研究；吸引来自巴基斯坦、埃及、伊朗、白俄罗斯、哈萨克斯坦等五个国家的优势机构加入生物制造产业（人才）联盟，初步调研了成员国工业生物技术发展现状，组建了高端人才库，并正在调研成员国成果转移转化政策，为开展需求导向的联合研发、推动适用技术“走出去”提供支撑。

通过3年筹建期，联合中心将初步搭建起一个聚焦COMSATS成员国、辐射“一带一路”国家的产学研合作平台，形成实质性、高水平、可持续的国际科技合作新局面和合作模式与合作机制的“示范”，为促进成员国生物技术和产业发展发挥积极作用。预期到2030年，联合中心将全面成为中国对其他成员国工业生物技术交流合作的窗口，在促进成员国暨“一带一路”国家生物技术和产业发展方面发挥重要作用，为推动“一带一路”高质量建设和科技创新共同体作出重要贡献。

欢迎成员国及“一带一路”沿线国家科技人员参与联合中心建设。联系人：联合中心协调人暨天津工业生物所国际合作主管柴倩倩，chai_qq@tib.cas.cn，ccib@tib.cas.cn

申请加入联合中心相关联合研发组，请与各联合研发组协调人联系。

联合研发组	协调人	联系邮箱
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生物能源	李德茂	li_dm@tib.cas.cn

Introduction to ANSO

ANSO is a non-profit and non-government international scientific organization founded in 2018 by 37 international science and education institutions from around the world. ANSO came into being under the principles of joint consultation, joint effort and shared benefits championed by the "Belt and Road Initiative". ANSO is committed to promoting shared sustainable development and the advancement of the UN Sustainable Development Goals (SDGs) through catalyzing and implementing concrete international cooperative initiatives in Science, Technology, Innovation and Capacity Building (STIC). ANSO focuses on the most urgent regional and global challenges through STIC. This focus includes addressing needs and supporting scientific capacity building, particularly of the Global South, through partnerships and cooperation with member countries and institutions. ANSO is an international organization designed to gain global recognition and support through sound scientific programs and actions, continuous activities, and success in addressing global needs and challenges. There are 30 newly endorsed members by the GB Meeting at the end of 2021.

“一带一路”国际科学组织联盟（以下简称ANSO）成立于2018年11月4日，是在“一带一路”倡议框架下，首个由“带路”沿线国家科研机构、大学与国际组织共同发起成立的综合性、实质性国际科技组织，是民政部注册的非政府间、非营利性国际性社团法人。ANSO是推动“一带一路”地区及全球社会经济可持续发展的科技网络，是推动中国与世界在科学、技术、创新和能力建设方面的国际合作平台，亦是最佳配置全球资源推动科技合作和创新平台及与世界共享中国科技成果、展示科技软实力的平台。ANSO创始成员37家，近两年收到30家新单位申请，新申请已通过理事会审议，目前ANSO在全球共有67家成员单位。

The Second International Training Course on
Industrial Synthetic Biotechnology