IB2B2015

2015 International Workshop on

Advanced Industrial Biotechnology and Bioengineering for Sustainable Bioindustry

Final Program

Hohhot, Inner Mongolia Autonomous Region of China
(24th to 28th, July, 2015)

Welcome to IB2B2015

We would like to take this opportunity to express our warm welcome for IB2B2015 held at Hohhot, Inner Mongolia Autonomous Region of China during 24th and 28th, 2015. This workshop will bring together scientists in the field of Biotechnology and Bioengineering in Asia, including biomedical and biopharmaceutical technology, bio-fuels and bio-energy technology, bio-production engineering, encouraging communications between biological science and industry use. The IB2B2015 provided platforms and ample time for oral contributed presentations (30 min). After the workshop, an industry trip to Shen Zhou Biological & Technology Co., Ltd and pilot plant for microalgae culture of ENN group co., LTD will allow the delegates to find out the requirements from bio-industry.

It's a great opportunity to meet the old friends, and make new collaboration partners. We wish the bridge of IB2B2015 can truly connect fundamental researches and engineering practices. We look forward to meeting you and wish you all a pleasant and fruitful stay in Inner Mongolia.

Organizers：

Key Laboratory for Industrial Biocatalysis, MOE, Institute of Biochemical Engineering, Department of Chemical Engineering, Tsinghua University

Shen Zhou Biology & Technology Co., Ltd

Tokyo Institute of Technology

Sponsor：

Japan Society for the Promotion of Science

Workshop Agenda

Arrangement of 24th, July		
Workshop Participants Registration, Address: Uiles Hotel, No.89 of East Xinhua Street, Xincheng District, Hohhot. （地址： 维力斯大酒店 呼和浩特 新城区 新华东街 89 号）		
Arrangement of 25th, July Address: Press Hall (新闻发布厅), The 14 th floor, Uiles Hotel		
Time	**Event**	***Discussion Unit/* Chairman**
8:15-8:45	Opening Ceremony/ Group Photo	Pro. Xin-Hui Xing
8:45-9:15	Development of microbial cell factories for biorefinery **Prof. Akihiko Kondo (Kobe University)**	*Microbial Cell Factory/Biorefinery/* Prof. Ikuo Fujii
9:15-9:45	Sequential control of biosynthetic path ways for balanced utilization of metabolic intermediates in *Saccharomy cescerevisiae* **Prof. Hongwei Yu (Zhejiang University)**	
9:45-10:00	Coffee Break	
10:00-10:30	A new and highly effective immobilization method using the bacterionanofiber protein AtaA for microbial cell factory **Prof.Katsutoshi Hori (Nagoya University)**	*Microbial Cell Factory/Biorefinery/* Prof. Min Jiang
10:30-11:00	Evolution breeding of microbial cell factories by ARTP (atmospheric and room temperature plasma) mutation system **Prof. Xin-Hui Xing (Tsinghua University)**	
11:00-11:30	Development of thermophilic aerobic pre- or post-treatment process for the mesophilic anaerobic digestion and the enhancement of methane production **Prof. Jong Moon Park (Pohang University of Science and Technology)**	
11:30-12:00	Introduction of Space Biotechnology Group **Dr. Kan- Yan Xu (Space Microbiology)**	
12:00-13:30	Working Lunch	
13:30-14:00	Holoabzyme: Catalytic antibodies with antigen-combining sites for artificial catalytic components **Prof. Ikuo Fujii (Osaka Prefecture University)**	*Medical Biotechnology/* Prof. Akihiko Kondo
14:00-14:30	Two Types of Ionic Liquid Type Activating Agents for Lipase-catalyzed Asymmetric Transesterification **Prof. Toshiyuki Itoh (Tottori University)**	
14:30-15:00	High- and multi-functional in vitro liver model derived from mouse ES/iPS cells on micro-fluidic device – Animal experiment alternative – **Prof. Yoh-ichi Tagawa (Tokyo Institute of Technology)**	
15:00-15:30	Non-stress Culture System for Controlling Stem Cell Fate and Regenerative Medicine **Prof. Bayer Hexig (Inner Mongolia University)**	*Medical Biotechnology/* Prof. Hongwei Yu
15:30-16:00	The study on the lipid metabolism of pathogenic fungi **Prof. Susumu Kajiwara (Tokyo Institute of Technology)**	
16:00-16:15	Coffee Break	
16:15-16:45	Metabolic engineering of *E. coli* for the production of neurotransmitter precursor 5-hydroxytryptophan **Prof. Qi-Peng Yuan (Beijing University of Chemical Technology)**	*Microbial Cell Factory/Bioproduction/*

16:45-17:15	Production of methanol from methane by methane monooxygenase from *M. trichosporium OB3b* **Prof. Toshiaki Kamachi (Tokyo Institute of Technology)**	Prof. Chun Li
17:15-17:45	Microalgae-based engineering for the development of commercially viable products **Prof. Jo-Shu Chang (National Cheng Kong University)**	*Microbial Cell Factory/Bioproduction/* Prof. Katsutoshi Hori
17:45-18:15	Development of Algae-based biofuels at CPC Corporation, Taiwan **Dr. Ai-Ling Kao (CPC Corporation)**	
18:15-18:45	One-step, Green and Economic Synthesis of Water-Soluble Photoluminescent Carbon Dots by Hydrothermal Treatment of Wheat Straw and Their Bio-applications in Labeling, Imaging and Sensing **Prof. Feng Zhang (Inner Mongolia Agricultural University)**	
18:45-	Dinner	
Arrangement of 26th Morning , July Address: No. 2 Meeting Room (二号会议室), The 14 th floor, Uiles Hotel		
Time	**Event**	***DiscussionUnit/* Chairman**
9:00-9:30	Production of optically pure L-lactic acid from renewable resources **Dr. Jinchuan Wu (Institute of Chemical and Engineering Sciences, A*SATR)**	*Microbial Cell Factory/Bioproduction/* Prof. Jong Moon Park
9:30-10:00	Modification of glycolytic pathways and co-production of hydrogen and ethanol from glucose by *Escherichia coli* **Prof. Sunghoon Park (Pusan National University)**	
10:00-10:15	Coffee Break	
10:15-10:45	Enhanced production of biofuel by engineered Clostridium from renewable resources **Prof. Min Jiang (Nanjing Tech University)**	*Microbial Cell Factory/Bioproduction/* Dr. Jinchuan Wu
10:45-11:15	Microalgae to Bioenergy of ENN **Dr. Min-Sheng Liu (Xin'ao Group Co. Ltd.)**	
11:15-11:35	Systematic regulation of endogenous promiscuous phosphatases in *E. coli* for enhanced production of terpenoids **Jia-Hui Guo (Tsinghua University)**	
11:35-11:50	Closing Remarks	Pro. Xin-Hui Xing
12:00-13:00	Working Lunch	
Arrangement from 26th afternoon-27th, July		
Industry Visit		

Route

We will arrange pick-up/see off Services for you. Please see the contact information below. During the time in Hohhot, we will accommodate here.

Contact Information

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Curriculum Vitae of Speakers
(According to the reporting order)

Prof. Akihiko Kondo

Professor, Director of Biorefinery Center, Kobe University; Team Leader, Cell Factory Research Team, Center for Sustainable Resource Science, RIKEN (Yokohama)

Department of Chemical Science and Engineering,
Graduate School of Engineering, Kobe University
Rokkodaicho, Nada, Kobe 657-8501, Japan
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Education and Working Experience:

Kondo got his Ph.D. in Chemical Engineering, Kyoto University in 1988. He started his academic career at Department of Applied Chemistry, Kyushu Institute of Technology in Japan as an associate professor. Then he moved Kobe University in 1995 and he was full professor in 2003.

He has developed cell surface engineering and synthetic bioengineering as core technology, and promoted extensive research. In 2007, Kobe University established Biorefinery Center headed by A. Kondo as a director, and he is also leading the Biomass Engineering Program at RIKEN as a team leader from 2012. He also launched a big project “Innovative BioProduction Kobe” as vice director, which is supported by Special Coordination Funds for Promoting Science and Technology, Creation of Innovation Centers for Advanced Interdisciplinary Research Areas, MEXT, Japan. From 2010,

A. Kondo was appointed as editor of the Journal of Biotechnology and editorial board members of several journals such as Biotechnology for Biofuels, Bioresource Technology, Microbial Cell Factories, FEMS Yeast Research, Journal of Biological Engineering, Metabolic Engineering Communications, etc.

A. Kondo have published more than 450 peer reviewed international papers and cited more than 9500 times (Thomson Reuters).

Prof. Hongwei Yu

Professor Yu obtained his Bachelor degree in 1995 and Master degree in 1998 in Chemical Engineering from Tsinghua University, China and his Ph.D in 2002 in Chemical Engineering from National University of Singapore, Singapore， supervised by Prof. Ching Chi Bun. After working in National University of Singapore, Nanyang Technological University and California Institute of Technology, he went back China and took the professorship in Zhejiang University in 2007. Professor Yu had studied chiral drug separation technologies for many years, including chromatographic technologies (simulated moving bed) and enzymatic resolution of racemic mixture. His research interests are now focused on improving enzyme activity and enantioselectivity by genetic engineering to produce chiral compounds. In recent years, his research interests are expanded to biosynthesis of natural products by metabolic engineering.

Prof. Katsutoshi Hori

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Working Experience

1994-1995 Researcher, Petrochemical Research Center, Sumitomo Chemical Corporation
1995 Ph. D. (Engineering), Tokyo Institute of Technology
1995-1998 Director, Environmental analytical laboratory, Green Blue Corporation
1998-2004 Assistant Professor, Department of Bioengineering, Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology
2004-2011 Associate Professor, Department of Materials Science and Engineering, Nagoya Institute of Technology, Nagoya, Japan
2006-2010 Research Fellow, PRESTO (Precursory Research for Embryonic Science and Technology), JST (Japan Science and Technology Agency)
2008-2011 Director, Project Research Center for Interfacial Microbiology, Nagoya Institute of Technology, (Concurrently)
2010 Invited Professor, Chemical Engineering, Tsinghua University, (Concurrently)
2010-2011 Invited Associate Professor, EcoTopia Science Institute, Nagoya University, (Concurrently)
2011- Full Professor, Department of Biotechnology, Graduate School of Engineering, Nagoya University

Research Interest and Keywards

Interfacial microbiology, Synthetic biology, Nanobiotechnology, Protein engineering

Prof. Xin-Hui Xing

Professor and Vice Chair,
Department of Chemical Engineering,
Director of Institute of Biochemical Engineering,
Tsinghua University,
Beijing 100084, China
Email: xhxing@tsinghua.edu.cn

Education :

1985: B.S. in Chemistry, South China University of Technology
1989: M.S. in Applied Chemistry, Utsunomiya University
1992: Ph.D. in Chemical Engineering, Tokyo Institute of Technology

Work Experience :

1992-1998: Assistant Professor, Dept. of Bioengineering, Tokyo Institute of Technology
1998-2001: Lecturer and Associate Professor, Dept. of Material Science and Chemical Engineering, Yokohama National University
2001- present: Bairen-Program Professor, Dept. of Chemical Engineering, Tsinghua University
2002-present: Director of Institute of Biochemical Engineering
2009-now: Department Vice Chair

Research Interests:

Biochemical Engineering, Environmental Biotechnology, Bioenergy and Biofuel Technology, Enzyme Engineering, Microbial Evolution and Pathway Engineering

Prof. Jong Moon Park

Distinguished Professor
Director,
Advanced Environmental Biotechnology Research Center
Department of Chemical Engineering
School of Environmental Science and Engineering
Pohang University of Science and Technology
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Education:

B.S. Chemical Technology, Seoul National University, Seoul, Korea 1979
M.S. Chemical Technology, Seoul National University, Seoul, Korea 1981
Ph.D. Chemical Engineering, University of Manchester Institute of Science and Technology, Manchester, UK 1986

Working Experience:

1988-1989: Senior Engineer, Section Leader, Vipont Research Laboratories, Inc., U.S.A.
1989- :Professor, Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, Korea
1997-1998: Visiting Professor, Department of Chemical Engineering, McGill University, Canada
1999-2000: Visiting Scholar, Department of Chemical Engineering, Cambridge University, U.K.
2000-2003: Honorary Visiting Reader, Department of Chemical Engineering, University of Manchester Institute of Science and Technology, Manchester, UK
2003-2012: Director, Advanced Environmental Biotechnology Research Center, Pohang, Korea
2004-2007: Head, School of Environmental Engineering, POSTECH, Pohang, Korea
2014- : Vice President of Research and Industry Affairs, POSTECH, Pohang, Korea

Research Interests:

Environmental Biotechnology; Advanced Wastewater Treatment; Metabolic Engineering and Synthetic Biology for Biological Hydrogen Production; Development of Platform Technology for the Production of Bio-based Material; Marine Biorefinery; Process Monitoring and Modeling

Dr. Kan-Yan Xu

The Supervisor of the Laboratory of Space Microbiology

Dr Xu graduated from Fudan University in 1996, and got PhD degree from Institute of Biochemistry and molecular biology, Chinese Academy of Sciences in 2002. From 2002-2011, Dr Xu had been working in University of California at San Francisco and the University of Pennsylvania as postdoctoral fellow and senior research investigator.

In 2011, Dr. Xu went back to China and was recruited as expert of Young overseas high-level talents introduction plan.

The major research interest of Dr. Xu is Drosophila behavior, especially on circadian rhythm, sleep and neurodegenerative diseases. After he had come back to China, he began to investigate the influence of space on animal behavior. In 2013, he became the supervisor of the Laboratory of Space Microbiology and started the research on space microbial protection technology and microbial space mutation.

Prof. Ikuo Fujii

He earned his Ph.D. on pharmaceutical science under the direction of Prof. K. Kanematsu at Kyushu University (Fukuoka) in 1986, and then he was an assistant professor at Kyushu University. He was a postdoctoral associate in the laboratory of Professor E. T. Kaiser at the Rockefeller University (New York) from 1988-1989. He moved to The Scripps Research Institute (San Diego) to work with Professors R. A. Lerner and K. D. Janda in 1989.

In 1991, he was appointed to a senior research scientist to direct the antibody engineering group in Protein Engineering Research Institute. In 2003, he was appointed to a professor of department of biological science in Osaka Prefecture University. At present, he is the dean of school of science.

In 2013, he received the 5th Monodzukuri Nippon Grand Award.

Prof. Toshiyuki Itoh

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Education and Working Experience:

He graduated Tokyo University of Education in 1976. After working as a chemistry teacher in High Schools in his hometown (Mie prefecture), he decided to back to University and received his PhD in 1986 from the University of Tokyo (under supervision of Prof. T. Mukaiyama). He was appointed as an Assistant Professor of Okayama University in 1987, then promoted to associate Professor in 1990. He worked with Professor Anthony G. M. Barrett as a visiting scholar at Colorado State University in 1990-1991 and moved to Tottori University in 2002, then, he was promoted to full professor in 2004.

He is the recipient of the Society of Synthetic Organic Chemistry Japan Award (2010), and The 8th Green and Sustainable Chemistry Award (2009). He is now serving the president of the Society of Fluorine Chemistry, Japan. His current research interests are development of new and useful synthetic methodologies based on Green Chemistry.

Prof. Yoh-ichi Tagawa

D.Sc, Associate Professor, Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology
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Education:

1989: Faculty of Engineering, the University of Tokyo
1991: Graduate School of Engineering, the University of Tokyo
1994: Graduate School of Science, the University of Tokyo
Doctor of Science, 1997

Working Experience:

1994 – 1997: Assistant Researcher, the Institute of Medical Science, the University of Tokyo, Japan
1997 – 1999: Postdoctoral Fellow, Rega Institute, University of Leuven, Belgium
1998 – 2001: Assistant Professor, Shinshu University School of Medicine, Japan
2001 – 2003: Lecturer, Shinshu University School of Medicine, Japan
2003–2005: Associate Professor, Research Center for Human and Environmental Sciences, Shinshu University, Japan (2004-2005: Concurrent Position)
2004 – 2005: Associate Professor, Shinshu University Graduate School of Medicine
2005 - 2007: Associate Professor, Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology
2006- 2010: Researcher, Basic Research Programs PRESTO, Japan Science & Technology Agency
2007- 2010: Associate Professor, Frontier Research Center, Tokyo Institute of Technology, Japan
2010-present: Associate Professor, Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology

Prof. Bayer Hexig

Ph.D/Professor
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Education:

2005 Ph.D. in Biomolecular Engineering, Tokyo Institute of Technology, Japan
2001 M.Sc. in Biological & Chemical Engineering, Gunma University, Japan
1994 B.Sc. in Physics, Inner Mongolia Normal University, China

Working Experience:

2012-Present Professor, Research Center for Laboratory Animal Science & College of Life Science, Inner Mongolia University, P. R. China
2008 – 2012 Assistant professor, Graduate School of Bioscience and Biotechnology & Frontier Research Center, Tokyo Institute of Technology, Japan, Evolving Education and Research Center for Spatio-Temporal Biological Network
2007 – 2008 Researcher, Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology, Japan Evolving Education and Research Center for Spatio-Temporal Biological Network
2005-2007 Postdoctoral Researcher, Division of Medical Devices, National Institute of Health Science, Japan, Health and Labor Sciences Grants for Research on Advanced Medical Technology and Risk Analysis on Foods and Pharmaceuticals by Ministry of Health, Labor and Welfare

Prof. Susumu Kajiwara

Vice Dean and Professor, Ph. D.
Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology 4259-J3-7, Nagatsuta, Yokohama, 226-8501, Japan

Education:

PhD in Life Sciences, Tokyo Institute of Technology, Yokohama, Japan (1993)
M.Sci in Life Science, Tokyo Institute of Technology, Yokohama, Japan (1990)
B.Eng. in Chemical Engineering, Tokyo Institute of Technology, Tokyo, Japan (1988)

Working Experience:

2015-present: Chief Director, Organization for Life Design and Engineering, Tokyo Institute of Technology, Tokyo, Japan (concurrent post)
2012-present: Advisor to the President, Tokyo Institute of Technology, Tokyo, Japan (concurrent post)
2012-present: Professor, Core Division of Advanced Research, Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology, Yokohama, Japan
2008-present: Member, Research Strategy Office, Tokyo Institute of Technology, Tokyo, Japan (concurrent post)
2008-2011: Deputy Director, Center for Public Relations, Tokyo Institute of Technology, Tokyo, Japan (concurrent post)
2005 - 2007: Advisor to the President, Tokyo Institute of Technology, Tokyo, Japan (concurrent post)
2002-2005: Deputy Director, Council for Science and Technology Policy (CSTP), Cabinet Office, Japan government (concurrent post)
2006 -2007: Visiting research fellow, University of Otago, Dunedin, New Zealand
1998-2012: Associate Professor, Department of Life Science, Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology, Yokohama, Japan
1995-1998: Assistant Professor, Department of Chemical Engineering, Graduate School of Science and Technology, Tokyo Institute of Technology, Tokyo, Japan
1993 - 1995: Researcher, Central Laboratories for Key Technology, Kirin Brewery Co., Ltd., Yokohama, Japan

Prof. Qi-Peng Yuan

Dr. Qipeng YUAN, Professor, Dean of the College of Life Science and Technology, Beijing University of Chemical Technology (BUCT), Cheung Kong Professor appointed by Ministry of Education, visiting professor of Honking Polytechnic University, Adjunct Professor of University of Ballarat in Australia. Dr. Yuan obtained his Ph.D. degree in Bioengineering from Tianjin University in 1997. Dr. Yuan worked as a post-doctorial scholar in Bathroom 1997 to 1999 and as a visiting scholar in University of New South Wales from1999 to 2001. Dr. Yuan worked on Traditional Chinese Herbal Medicine in Hong Kong Polytechnic University from 2001 to 2003. His research work focuses on the R&D of biopharmacy, natural products and genetic drugs. Over 180 articles were published and 123 of them were indexed by SCI. Fourty patents have been applied for and 27of them have been authorized. Dr. Yuan obtained the second grade award of National Science and Technology Progress in China, the first grade award of Beijing Government and the second grade award of Ministry of Education in China, and ranking first in all lists of contributors. Three programs have passed the appraisement by Ministry of Science and Technology in China. Many of research work have been industrialized, which brings a profit over 1000 million RMB. In the recent five years, 25 million RMB has been granted by Natural Science Foundation of China, Hong Kong Bureau of Innovative Industry, Beijing government, Ministry of Science and Technology of China and some companies, which provides a strong financial support for the research developed by over 20 graduate students supervised.

Prof. Toshiaki Kamachi

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Education

1986-1990 Graduate studies with Prof. Okura at Department of Bioengineering, Tokyo Institute of Technology;

1990-1992 Master course studies with Prof. Okura at Department of Bioengineering, Tokyo Institute of Technology;

1995-2001 Doctor course studies with Prof. Okura at Department of Bioengineering, Tokyo Institute of Technology.

Working Experience

1995-2002 Assistant Professor of Department of Bioengineering at Tokyo Institute of Technology
2001-2007 Associate Professor of Department of Bioengineering at Tokyo Institute of Technology
2007-2010 Associate Professor of Department of Molecular Design and Engineering at Nagoya University
since 2010 Associate professor of Department of Bioengineering at Tokyo Institute of Technology

Prof. Jo-Shu Chang

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Educational Qualifications

Ph.D. in Chemical/Biochemical Engineering (1993) University of California, Irvine, CA, USA
M.S. in Chemical Engineering (1987) University of Colorado, Boulder, CO, USA
B.S. in Chemical Engineering (1983) Tunghai University, Taiwan

Working Experiences

Deputy Director, Center for Bioscience and Biotechnology, National Cheng Kung University, Taiwan (May, 2009 to Jan. 2015)
Distinguished Professor, National Cheng Kung University, Taiwan (August, 2006 to now)
Professor, National Cheng Kung University, Department of Chemical Engineering, Taiwan (August, 2001 to now)
Professor, Feng Chia University, Department of Chemical Engineering, Taiwan (1998 to 2001)
Associate Professor, Feng Chia University, Department of Chemical Engineering, Taiwan (1993 to 1998)

Dr. Ai-Ling Kao

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Education

Ph.D., Institute of Microbiology and Biochemistry, College of Life Science, National Taiwan University, Taipei, Taiwan, 2003 – 2010
M.S., Biochemistry Laboratory, Institute of Agricultural Chemistry), B.S., National Taiwan University, Taipei, Taiwan, 2000 – 2002
School of Nutrition and Health Scinces, Taipei Medical University, Taiwan, 1996-2000

Working Experience

2010-2011 Department of Biochemical Science and Technology, College of Life Science, National Taiwan University, Taipei, Taiwan, Adviser: Dr. Yang, Chien-Chih

Prof. Feng Zhang

Professor, Professor in Inner Mongolia Agricultural University

Education

1996.9-2000.7: B.S. in Biology, Inner Mongolia University;
2000.9-2006.3: Ph.D in Chemistry, Shanghai Institute of Applied Physics, Chinese Academy of Sciences;

Work Experience

2006.3-2006.12: Assistant Researcher in Shanghai Institute of Applied Physics, Chinese Academy of Sciences;
2007.1-2007.5: Postdoc fellow in Germany Munich University, Physics Department (Nano Center, Prof. Dr. Hermann E. Gaub);
2007.6-2010.2: Group leader in Germany Marburg University, Physics Department (Prof. Wolfgang Parak);
2010.3-2011.2: Senior Researcher in USA University of Washington, Bioengineering Department (Prof. Xiaohu Gao);
2011.3-2011.6: Lecture in Inner Mongolia University, Chemistry and Chemical Engineering School;
2011.6 till now: Professor in Inner Mongolia Agricultural University, Biology School.

Dr. Wu Jinchuan

Dr. Jinchuan Wu is a Senior Scientist and Head of the Industrial Biotechnology Division at the Institute of Chemical & Engineering Sciences (ICES), Agency for Science, Technology and Research (A*STAR), Singapore. He got his PhD from Tianjin University in 1994 and had worked in Kanazawa University as an Associate Professor in 1998-2000 and in Tianjin University as a Professor before he joined ICES in 2002. His current research of interest includes biomass conversion to fuels and chemicals, microbial fermentation, protein engineering, metabolic engineering and bioprocess development.

Prof. Sunghoon Park

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Education:

Seoul National Univ., Korea B.S. Chemical Technology 1976 - 1980
Seoul National Univ., Korea M.S. Chemical Technology 1980 - 1982
Univ. of California, Davis, CA Ph.D. Chemical Engineering 1984 - 1988

Working Experience:

03 /1991 - present: Professor of Chemical and Biomolecular Engineering, Pusan National University, Korea
08 /2008 - 8/2011: Dean, Office of International Affairs, PNU
01 /2009 – 12/2014: Editor-in-Chief, Biotechnology and Bioprocess Engineering (BBE)
08 /2010 - present: Senior Editor, J. Industrial Microbiology & Biotechnology
11 /2006 - 07/2008: Director, Institute for Environmental Studies, PNU
06 /2002 - 05/2005: Director, Institute for Environmental Technology and Industry
10 /1988 - 02/1991: Research Staff, Chemical and Biomedical Sciences Division,Lawrence Livermore National Laboratory, CA
10 /1982 - 08/1984: Research Engineer, CKD pharmaceutical Co., Seoul, Korea

Research Interest:

Metabolic engineering, enzyme engineering, system biology and microbial fermentation for: Biological production of 3-hydroxypropionic acid (3-HP) and 1,3-propanediol from glycerol; and biological hydrogen production

Prof. Min Jiang

Dr. Min jiang, Chemical Engineering Doctor, now is a professor of Biology Engineering, the party secretary of college of Biotechnology and Pharmaceutical Engineering, Nanjing Tech University, assistant secretary-general of Bio-technology Council of Jiang Su. He got his B Sc in Biology Engineering, Ph.D.in Chemical Engineering at Nanjing University of Technology, and Postdoc at KAIST, Korea, 2002, and in 2010, coordinator for Cooperation in Biotechnology between Kanogawa and Nanjing. Currently Dr. Min Jiang's researches focus on Fermentation Engineering, Genetic Engineering, Metabolic Engineering, Production of Biopolymers, Utilization of Biomass resources and Biosynthesis of Organic acids and Biofuel.

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Dr. Min-Sheng Liu

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Dr. LIU Minsheng is the founding director of Bioenergy Institute which focusing on algae based bioenergy of ENN. He got his PhD degree in Tsinghua university of China, and ever been a visit scholar of University of Michigan, USA. He has set up a pilot scale algae farm using flu gas to produce biodiesel. Most of his interests are in flu gas utilization, large scale algae cultivation/ harvest/ oil extraction, and PBR simulation/design/ manufacture. He obtained funding from 5 national and 2 provincial projects, and published over 100 patents (20 PCT).

Jiahui Guo

Tsinghua University B.E., Chemical Engineering, 2011-2015; 10/2014-06/2015: graduation project “Systematic regulation of endogenous promiscuous phosphatases in E. coli for enhanced production of terpenoids”, LEB, Tsinghua University

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Presentation Abstracts
(According to the reporting order)

Development of microbial cell factories for biorefinery

Akihiko Kondo[1,2*]
1Organization of Advances Science and Technology, Kobe University, 2 Biomass Engineering Program, RIKEN, 1-7-22 Suehiro-cho, Tsurumi-ku, Yokohama, Kanagawa 230-0045, Japan

The biorefinery manufacturing process for producing chemicals and liquid fuels from biomass is a promising approach for securing energy and resources. Establishing economically feasible fermentation processes requires markedly increasing final product titers due to the high energy demands of subsequent product recovery steps, as well as the capital and production costs associated with biorefinery equipment. Although high-yield production of target compounds by metabolically optimized microbes is necessary, achieving higher titers inevitably requires increased loading of solid lignocellulose in the SSF and CBP processes. Increase in the solid concentration results in corresponding increases in chemical production. However, by increasing the lignocellulose content in the bioreactor, the concentration of fermentation inhibitors released during the pretreatment of biomass would reach higher levels. Accordingly, microorganisms that are resistant to inhibitors are a prerequisite for the high-titer production of fuels and chemical products. To further engineer cellulolytic recombinant and native strains for use in CBP, system-wide modifications of intracellular metabolic pathways using advanced engineering tools such as minimal hosts, vectors, genetic controllers, and characterized enzymes are needed, which would improve the potential of not only target productivities but cell growth and viability during the fermentation. The integration of cellulolytic capabilities with metabolic systems specified for targeted chemical production will allow customized CBP microorganisms to be developed using advanced gene manipulation technologies.

Sequential control of biosynthetic path ways for balanced utilization of metabolic intermediates in *Saccharomy cescerevisiae*

Hongwei Yu
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Balanced utilization of metabolic intermediates and controllable expression of genes in biosynthetic pathways are key issues for the effective production of value-added chemicals in microbes. An inducer/ repressor-free sequential control strategy regulated by glucose concentration in the growth environment was proposed to address these issues, and its efficiency was validated using heterologous beta-carotenoid biosynthesis in *Saccharomy cescerevisiae* as anexample. Through sequential control of the downstream, upstream, and competitive pathways of farnesyl diphosphate(FPP), the crucial metabolic node in the biosynthesis of terpenoids, in a predetermined order, a carotenoid production of 1156mg/L (20.79 mg/gDCW) was achieved by high-cell density fermentation. Quantitative PCR analysis of the regulated genes demonstrated that the transcription patterns were controlled in a sequential manner as expected. The inducer/repressor-free nature of this strategy offers a both practical and economically efficient approach to improved biosynthetic production of value-added chemicals.

A new and highly effective immobilization method using the bacterionanofiber protein AtaA for microbial cell factory

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The toluene-degrading bacterium *Acinetobacter sp. Tol 5* was previously isolated from a biofiltration process originally inoculated with activated sludge[1]. Tol 5 exhibits an autoagglutinating nature and noteworthy adhesiveness to various abiotic surfaces from hydrophobic plastics to hydrophilic glass and stainless steel [2]. Electron-microscopy revealed that Tol 5 cells have at least three types of peritrichate bacterionanofibers [3]. These are type 1 fimbria, Fil fimbria, and the novel trimeric autotransporter adhesin (TAA) designated AtaA (*Acinetobacter* TAA). Among them, AtaA is responsible for the adhesive nature of Tol 5 [4].

AtaA consists of 3,630 amino acid residues, which makes it one of the largest TAAs known to date. Although AtaA follows the general N-terminus-head-stalk-anchor-C-terminus organization of TAAs, an additional head domain localizes in the C-terminal region. The stalk domain of AtaA is notably longer than that of other TAAs and contains peptide repeats that are mosaically arranged.

By using AtaA, we have developed a novel microbial immobilization strategy, which can be alternated with conventional immobilization via gel entrapment and chemical bonding. We introduced *ataA* gene into a dye-producing bacterium, immobilized the transformant cells onto a polyurethane support, and demonstrated the usefulness of the new method for a chemical conversion; the immobilization enhanced cell tolerance to the toxic substrate and greatly improved the production rate and productivity compared with suspension culture [5]. The effectiveness of our immobilization method was also demonstrated using esterase-producing strain *Acinetobacter* sp. ADP1 in terms of simple producers of cell immobilization, increase in cell concentration, employment in repetitive reaction, and so on [6]. We also introduced *ataA* gene into a hydrogen producing bacterium, *Enterobacter aerogenes*. We demonstrated that the immobilized *Enterobacter* cells on polyurethane foam efficiently produced hydrogen in a repeated batch process.

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Evolution breeding of microbial cell factories by ARTP (atmospheric and room temperature plasma) mutation system

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ARTP (atmospheric and room temperature plasma) mutation system developed by our group can directly cause complex genome mutation including chain break and bases mutation via an unique mechanism, and has proved to be a rapid and powerful mutation tool for strain improvement and evolutionary biology.

Since DNA damage levels and the subsequent SOS responses have some relationships when mutation occurs, the improvement of screening efficiency of mutants can be expected for construction of the mutation libraries by analysis of the DNA damage level and SOS response, as well as mutation rate. In order to systematically elucidate the mechanisms of the ARTP mutation system, ARTP mutagenesis was compared with other traditional mutagenesis methods, including UV and chemicals of NQO and MNNG. For quantification of DNA damage levels, *Umu* test based on SOS response system of a model microbial strain was modified to quantify the SOS response of living cells after the ARTP mutation. Di-β-D-galactopyranoside (FDG) was used as a fluorescent substrate to quantify the expression of LacZ which is responsible for SOS system due to the DNA damage, and propidium iodide (PI) was used as a fluorescent dye for dead cells to exclude the effects of the dead cells. Using flow cytometry with the two fluorescent dyes enabled the SOS response by different mutations to be comparatively analyzed in terms of induction factor (Fi) for the living cells. Results showed that with increasing in mutagens dosage, Fi increased at the beginning, and then, reached to a maximum value. Among the four mutation methods used in this study, ARTP exhibited the highest maximum value of Fi, indicating that ARTP has the strongest damage to bacterial DNA, thereby contributing to the efficient mutation (evaluated by mutation rate per generation) by this new method. Based on theses mechanistic studies, a number of microbial cell factories have been improved in terms of different phenotypes by ARTP mutation system as a directed evolution breeding platform.

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Key words: ARTP, evolution, microbial cell factory, mutation, screening, strain improvement

Development of thermophilic aerobic pre- or post-treatment process for the mesophilic anaerobic digestion and the enhancement of methane production

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Over the past decade, with the marked increment of population and living standards, a large amount of municipal solid waste (MSW), such as sludge and food waste, has been generated in worldwide and become a prominent environmental concern. Anaerobic digestion (AD) is a practical and widely-used technology for the stabilization and reduction of the organic fraction of MSW (OFMSW). AD also produces methane and residues which can be used as an energy source and fertilizer, respectively. Although AD has been widely applied and studied, it is not always economically feasible, mainly due to slowly biodegradable materials, toxic chemicals and insufficient nutrients; these limitations result in low biogas yield compared to other methods of managing OFMSW. To achieve an effective mesophilic anaerobic digestion (MAD), thermophilic aerobic pre- or post-treatment process was developed. Using thermophilic aerobic digestion (TAD) as a biological pre-treatment of waste activated sludge (WAS), the total volatile suspended solid reduction and methane production rate in the MAD reactor were significantly improved. In addition, TAD pretreatment using a relatively short solid retention time of 1 day showed highly increased soluble organic products and positively affected an increment of bacteria populations which performed interrelated microbial metabolisms with methanogenic species in the MAD. Also we developed a novel combined biological process which consists of MAD combined with TAD post-treatment solid and separation units for treating high-strength food wastewater (FWW). During the overall digestion, all reactors showed high stability without pH control. The combined process demonstrated significantly higher organic matter removal efficiencies (over 90%) of TS, VS and COD and methane production than single-stage MAD (without post-treatment). Experimental results show that TAD is a promising strategy for efficient treatment of WAS and FWW, especially for methane production. Further studies regarding cost and energy balance should be conducted to confirm the economic benefits of using TAD pre- or post-treatment.

Introduction of Shenzhou Space Biotechnology Group

Kan-Yan Xu

Shenzhou Space Biotechnology Group has the unique space resource provided by China Academy of Space Technology, and has been developing an open platform for space biotechnical research and industrial product development during the last twenty years, the major research interests of the laboratory of space microbiology include: (1) Microbial space mutation and breeding: we are using space mutation technique and modern microbial strain improvement technology to carry out research on microbial mutation, screening and fermentation process. Core products include blood-lipid lowering drug "Tianqu" and Raw material of Coenzyme Q10. In the future, we are planning to develop a serious of space mutation platform to conduct more microbial space mutation experiments which have industrial application value. (2) Research on microbial protection technology for space use, including the development of the surface disinfectant and the antibacterial material (3) Construction of genetically modified bacteria, including the construction of an *E. Coli* expressing system which can produce Coenzyme Q10. (4) Study on the technology of controlled ecological life support system, focusing on the metabolic waste recycling technology using coprophagrous animals.

Holoabzyme: Catalytic antibodies with antigen-combining sites for artificial catalytic components

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Enzymatic reactions enlist amino acid residues and cofactors during the catalytic process. In designed biocatalysts such as catalytic antibodies (abzymes), stereoelectronic complementarity between the antibody and hapten has been used to elicit catalytic amino acid residues in the antigen-combining site. These amino acids are involved in transition-state stabilization, approximation, general acid/base reactions, and covalent-bond catalysis. The introduction of small molecule cofactors acting as "chemical teeth" into antibodies would broaden their catalytic versatility. Here, we demonstrate a single antibody catalyzing multiple chemical transformations by the generation of antigen-combining site that function as an apoprotein for binding functionalized small non-protein components. We immunized mice with a hapten designed to induce both a substrate- and cofactor-binding site, and isolated two antibodies, which catalyze an acyl-transfer reaction by using an alcohol cofactor. Replacement of this cofactor with acidic and amino cofactors enabled the antibodies to catalyze β-elimination, decarboxylation and aldol reactions with large rate accelerations. These results demonstrate a new strategy for generating catalytic antibodies, namely, by controlling the reactivity and mechanism of the antibody using designed artificial cofactors. This approach promises to both broaden the scope of catalytic antibodies and push back the boundaries of protein-based catalysis.

Keywords: Catalytic Antibodies, Co-factors, Acyl-tansfer, β-eliminations, Aldol reactions, Decarboxylations

Two Types of Ionic Liquid Type Activating Agents for Lipase-catalyzed Asymmetric Transesterification

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Lipases are the most widely used enzymes applicable for organic synthesis.[1] Ionic liquids (ILs) are now well recognized as suitable for use in organic reactions and as providing potential for improvement in control of product distribution, enhanced reactivity, ease of product recovery, catalyst immobilization, and recycling.[2] We have been investigating the use of ionic liquids (ILs) in lipase-catalyzed reactions and reported the first example of lipase-catalyzed asymmetric transesterification in a pure IL solvent system.[3] Ionic liquids have now emerged as useful non-aqueous reaction media for biochemical reactions, particularly for lipase-catalyzed transesterifications.[4] We next established a powerful means of activating lipase by coating it with 1-butyl-2,3-dimethylimidazolium alkyl PEG sulfate ionic liquid: the ionic liquid coated Burkholderia cepacia lipase (IL1-PS) displayed excellent reactivity for many substrates in conventional organic solvents.[5] Although the results depend on the substrates, IL1-PS displayed a remarkable acceleration compare to that of commercial lipase PS while maintaining perfect enantioselectivity.[5] Furthermore, it allows recyclable use of the IL1-PS when the reactions were conducted in ionic liquid solvents, though it was essential to choose an appropriate ionic liquid when using IL1-PS in the IL solvents.[6]

We have recently developed two types of novel ionic liquid type coating materials for a lipase: One is (methoxyethoxymethyl)tributylphosphonium PEG sulfate ([P444MEM][cetyl (OCH2CH2)10SO4] (PL1) and 1-butyl-3-methyltriazolium PEG sulfate ([bmtz][cetyl $(OCH2CH2)_{10}SO_4$] (Tz1). These ionic liquids coated lipase PS (PL1-PS and Tz1-PS) worked as excellent catalysts for enantioselective transesterification of secondary alcohols in ionic liquids as reaction media. Interestingly, acyaltion took place very smoothly when PL1-PS was used as catalyst in a phosphonium IL, [P444MP][Tf2N] as a solvent. On the other hand, Tz1-PS worked the best in an ammonium IL, [N221MEM][Tf2N] as solvent. Using the systems, we succeeded in demonstrating recyclable use of the catalyst without any loss of reactivity.

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High- and multi-functional in vitro liver model derived from mouse ES/iPS cells on micro-fluidic device – Animal experiment alternative –

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Animal experiment alternatives, i.e., in vitro systems, are urgently required for drug, cosmetic, and functional dietary developments. The liver is a vital and multiple functional organ involved in metabolism, detoxification and protein synthesis. However, it has been impossible to maintain multiple hepatic functions during a long culture of primary hepatocytes (PHeps) and also to keep structural hepatic polarity.

We established a unique system of in vitro liver model derived from murine ES/iPS cells, i.e., IVLmES/iPS. The IVLmES/iPS, consisting of not only hepatocytes, but also endothelial networks, together with cardiac mesoderm differentiation, was induced after the embryoid body formation. IVLmES/iPS has expression of liver-specific genes, potential of ammonia degradation, and activities of cytochrome P450s.

To confirm cellular polarities of the IVLmES/iPS, first, dichlorofluorescein diacetate (CDFDA), which is incorporated into hepatocytes via organic anion-transporting polypeptide 2 (OATP2) in the basal side, hydrolyzed to green fluorescent CDF by cytoplasmic esterase, and then excreted to bile canaliculus via multidrug resistance-associated protein 2 (MRP2) in the apical side, was added into the IVLmES/iPS. Green fluorescent CDF was observed to be accumulated along the boundary of the cells in the IVLmES/iPS, but not in PHeps, suggesting that MRP2 and OATP2 were confirmed to be functional in the IVLmES, but not in PHeps. Second, we tried to activate urea cycle by the addition of L-ornithine in the IVLmES/iPS or liver perfusion system. Urea production increased and ammonia concentration decreased in a dose-dependent manner with respect to the amount of L-ornithine both in the IVLmES/iPS and the liver perfusion system, but not in PHeps, indicating that architectural and functional properties in the IVLmES/iPS were quite similar to those in the liver perfusion system, but different from those in PHeps. Third, we made an in vitro flow system to culture the IVLmES/iPS on a micro-fluidic device (IVLmES/iPS chip). Hepatic activities were much higher in the culture of primary hepatocytes with flow than that without flow, furthermore the activity of the IVLmES/iPS chip with flow was the highest in others. The IVLmES/iPS chip has great promise to be useful for drug metabolism and pharmacokinetics in liver as an alternative to animal experiments.

Non-stress Culture System for Controlling Stem Cell Fate and Regenerative Medicine

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Embryonic stem cells (ES cell) and induced pluripotent stem cells (iPS) which have characteristics such as self-renewal and pluripotency, are considered to hold great promise in regenerative medicine and drug design for pharmacological evaluation systems. In the past few years, many types of iPS cells have been generated from multiple somatic cell sources, by using different transcription factors combination and different selection methods. Furthermore, many studies have been reported on differentiation of ES and iPS cells into somatic cells such as hepatic linage, neural cells, cardiomyocytes, and so on. Very recently, the possibility of patient-derived iPS cells for defining the pathogenic mechanism also has been reported. However, most of the studies reported that proliferation of undifferentiated state and induced differentiation to somatic cells from ES and iPS cells have been based on cell-cell aggregated colony culture system. In colony culturing system, stimulating factors fail to interact with all cells homogeneously and directly in the same time, leading to generate heterogeneous cell population system. However, for the application of ES and iPS cells in the regenerative medicine or other pharmaceutical fields, it is important and necessary to develop large scale culture systems for the proliferation of genetically homogenous ES and iPS cells. In present work, we will report a uniform and non-stress single cell level culture system for large scale proliferation of ES and iPS cells was established.

The study on the lipid metabolism of pathogenic fungi

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Fungi is a kingdom belong to eukaryotes, like as animals and plants. These three kingdoms have very similar metabolism of lipids each other but there are also many different points in the lipid metabolism. For example, animals, fungi, and plants are able to synthesize squalene via mevalonate pathway while they synthesize different sterol, ergosterol, cholesterol and phytosterol, respectively. These sterols are used for the component of cell membrane and as molecules for signal transduction and so on. The difference of sterol metabolic pathway between animals and fungi played a role for the development of anifungal drugs. Azole agents such as fluconazole and itraconazole inhibit a lanosterol 14 alpha-demethylase, Erg11p, necessary for ergosterol synthesis whereas animals do not have this enzyme and synthesize ergosterol then azoles are little toxic to these organisms. On the other hand, although a few differences on the fatty acid metabolism between animals and fungi were observed, studies about the metabolism of fatty acids in pathogenic fungi have been little reported yet. Interestingly, it was known that most of fungi except *Saccharomyces cerevisiae* can synthesize polyunsaturated fatty acids (PUFAs) such as linoleic acid and linolenic acid but human cannot synthesize these fatty acids. Therefore, our group has studied about PUFA metabolism of a pathogenic fungus, *Candida albicans*.

Fungi have two different ways to utilize PUFAs: (i) biosynthesis from saturated fatty acids by fatty acid desaturases (FADs), (ii) uptake of PUFAs from outside of cells. Then, we identified two genes encoding an oleic acyl-CoA desaturase and a linoleic acyl-CoA desaturase, FAD2 and FAD3, and clarified the function of these enzymes. And also, we constructed a *fad2* disruptant of *C. albicans* and confirmed that this mutant cannot synthesize any PUFAs. Next, a gene related with uptake of PUFAs, FAA4 encoding a fatty acyl-CoA synthase, was identified and the faa4 disruptant of *C. albicans* was constructed. This mutant was unable to take linoleic acid and linolenic acid from outside of the cells.

Finally, we constructed a *faa4* and *fad2* double mutant incapable of utilizing PUFAs and observed several physiological phenomena such as transition from yeast cells to mycelia and biofilm formation. This double mutant of *C. albicans* showed the delay of induction of filamentous cells to unicellular cells and reduction of the biofilm formation in compared with the wild type cells. Therefore, PUFAs are suggested to play some roles in the pathogenicity of this fungus.

Metabolic engineering of *E. coli* for the production of neurotransmitter precursor 5-hydroxytryptophan

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5-Hydroxytryptophan (5-HTP) is a drug that is clinically effective against depression, insomnia, obesity, chronic headaches, etc. It is only commercially produced by the extraction from the seeds of Griffonia simplicifolia because of a lack of synthetic methods. Here, we report the design of two distinct strategies for efficient microbial production of 5-HTP. In the first strategy, we engineered a bacterial phenylalanine 4-hydroxylase by sequence- and structure-based protein engineering and dramatically shifted its substrate preference, allowing for efficient conversion of tryptophan to 5-HTP. Importantly, E. coli endogenous tetrahydromonapterin (MH4) could be utilized as the coenzyme, when a foreign MH4 recycling mechanism was introduced. Whole-cell bioconversion allowed the high-level production of 5-HTP (1.1−1.2 g/L) from tryptophan in shake flasks. On this basis, metabolic engineering efforts were further made to achieve the de novo 5-HTP biosynthesis from glucose. In the second strategy, a novel biosynthetic pathway was designed and verified reversely, taking advantage of the relaxed substrate selectivities of relevant enzymes without employing the unstable tryptophan 5-hydroxylase. First, high-titer of 5-HTP was produced from 5-hydroxyanthranilate (5-HI) by the catalysis of *E. coli* TrpDCBA. Then, a novel salicylate 5-hydroxylase was used to convert the non-natural substrate anthranilate to 5-HI. After that, the production of 5-HI from glucose was achieved and optimized with modular optimization. In the end, we combined the full pathway and adopted a two-stage strategy to realize the de novo production of 5-HTP. This work demonstrates a strategy for expanding the native metabolism of microorganisms and the application of enzyme promiscuity in non-natural pathway design.

Keywords: antidepressant, 5-hydroxytryptophan, phenylalanine 4-hydroxylase, protein engineering, salicylate 5-hydroxylase, precursor-directed biosynthesis

Production of methanol from methane by methane monooxygenase from *M. trichosporium OB3b*

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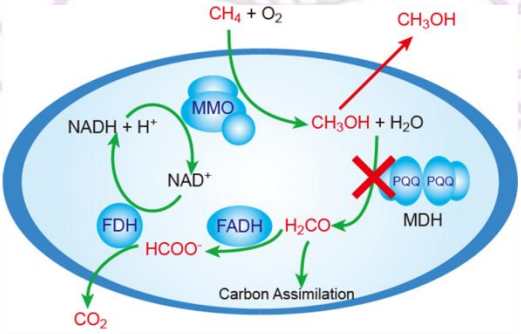
Direct oxidation of methane to methanol is a highly attractive process compared to the current process consisting of energy intensive conversion of methane by steam into synthesis gas. Methane monooxygenase (MMO) catalyzes single-step oxidation of methane to methanol. But MMO could not be used in methanol synthesis, because of instability. Thus methanol production from methane was tried with methanotroph. *Methylosinus trichosporium OB3b*, a methanotrophic bacterium, contains MMO and catalyzes hydroxylation of methane to methanol.

When the methane is oxidized, produced methanol is subsequently oxidized by methanol dehydrogenase containing in the same bacterium. To prevent further oxidation of methanol, the cell suspension was treated by cyclopropanol, which was found to be an irreversible inhibitor for methanol dehydrogenase by the previous study, leading to extracellular methanol accumulation. The purpose of this research is to increase methanol production and to improve methanol yield and the efficiency.

The batch type of methanol synthesis by *M. trichosporium OB3b* is terminated at c.a. 6 mM of methanol, because MMO is inhibited by increasing methanol concentration. For prolonged methanol accumulation, a semicontinuous process was carried out in this study. A standard 50 mL ultrafiltration (UF) cell was used as semi-continuous reactor. The solution containing cyclopropanol treated cell suspension and sodium formate in phosphate buffer was introduced in to the UF cell attached with ultrafilter (Diaflo ultrafilter YM-100, Amicon, Inc.). The UF cell was incubated for 5 min at 30 ℃, and the reaction was initiated by injecting methane into the UF cell with a gas-tight syringe. After incubation at 30 ℃ for 90 min, the reaction mixture was filtrated by nitrogen pressure, leading to separate a produced methanol from cell suspension. The methanol synthesis was repeated five times and stationary rate was 3.17 μmol h^{-1} mg^{-1}. The total produced methanol was 36.1 μmol, which is about twice amount of methanol produced by batch reaction under the same condition.



MMO: Methane monooxygenase, MDH: Methanol dehydrogenase,
FADH: Formaldehyde dehydrogenase, FDH: Formate dehydrogenase,
PQQ: Pyrroquinoline quinone

Development of Algae-based biofuels at CPC Corporation, Taiwan

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CPC Corporation, Taiwan (CPC) is the foremost energy enterprise in Taiwan. Its operations today include the import, exploration, development, refining, transport, marketing and sale of petroleum and natural gas, as well as the production and supply of petrochemicals, and its service facilities are located throughout Taiwan. CPC's total capital now stands at NT$130.1 billion and its revenues in 2013 amounted to a record NT$1.2 trillion. In recent years, CPC has energetically sought opportunities to cooperate with major international oil companies in upstream exploration and production, petrochemicals development and marketing channel ventures – all with the aim of enlarging its business scope, expanding its presence in international markets and increasing corporate sustainability. CPC aims, in this way, to become an integrated international energy group encompassing oil and gas exploration and production, petrochemicals and high-tech operations. In March 2012, CPC formally established the Green Technology Research Institute, the company's research and development of renewable energy center. The R & D business is divided into four departments including the renewable energy department, the biotechnology department, the material technology department, and the environmental technology department. The major goal of our biotechnology department in feedstock development is to obtain suitable species for biofuel production. Microalgae are a potential candidate for biodiesel production.

Chlamydomonas orbicularis CPC1 isolated from the southern coast of Taiwan by CPC showed a high lipid content which is up to 43% of dry weight, and the average lipid content of 20 to 30% in outdoor cultivation by using 50 L photobioreactor. To enhance the lipid productivity of CPC1 in outdoor cultivation, CPC1 was conducted by ultraviolet induced mutation. Through the three-stage culture and screening of lipid productivity, the highest lipid-producing mutant, CPC1215, was obtained. CPC1215 has several properties including low adhesion and rapid gravity sedimentation. Our study showed that *C. orbicularis* CPC1215 would be a great candidate in commercial and industrial algal oil producer according to its high lipid productivity under marine salinity, low adhesion, and easily collected by gravity sedimentation.

One-step, Green and Economic Synthesis of Water-Soluble Photoluminescent Carbon Dots by Hydrothermal Treatment of Wheat Straw and Their Bio-applications in Labeling, Imaging and Sensing

Feng Zhang

Utilization of biomass as renewable and sustainable energy source has called attention from politics and R&D facilities around the world. Agricultural straw acts as a typical kind of biowastes which still needs highly effective recycling to save the bio-mass urgently in nowadays. Photoluminescent carbon dots (C-dots) as a novel biocompatible nanomaterial which have been proved to be produced from many carbon-abundant matters and hold great promise for the modern nanobiomedicine. To realize a "One Stone Two Birds" strategy, here we report a green, economic, one-pot method for synthesizing photoluminescent C-dots by hydrothermal treatment of wheat straw. By using XPS and XRD, we show the as-prepared C-dots are amorphous in structure and mainly composed of C element. Their tiny size (< 2 nm) combined with the characteristic excitation dependent relatively bright emission, and robust photostability all made them be a kind of potential biocompatible nanomaterial for bio-applications. We have experimentally demonstrated their potential applications in biomedical labeling, imaging and sensing/detecting, respectively. The high yield ~ 20% of C-dots from wheat straw may show a new economic strategy for recycling bio-waste.

Production of optically pure L-lactic acid from renewable resources

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The demand for optically pure lactic acid is increasing owing to the rapid growth of poly lactic acid (PLA) industry. Lactic acid is currently produced by microbial fermentation from starchy materials. To avoid the competition with the supply of foods and feeds, it is essential to produce lactic acid from lignocellulose, the most abundant renewable resource on earth.

Oil palm empty fruit bunch (EFB) was hydrolyzed to get hemicellulose sugars by the combined use of dilute H_2SO_4 and H_3PO_4 in a 2-step process without any additional concentration steps, giving >110 g/L of total sugars in the hydrolysate. Furfural, 5-hydroxymethyl furfural and acetic acid in hydrolysate were sequentially degraded by simply adding the whole cells of the bacteria that were isolated from nature. Thermophilic *Bacillus coagulans* strains were isolated from the natural environment and used to convert all lignocellulose sugars to L-lactic acid at 50 ℃ without the requirement of sterilizing the medium before fermentation. In a simultaneous detoxification, saccharification and co-fermentation process, 80.6 g/L of L-lactic acid was obtained at a productivity of 3.4 g/L/h from total EFB including both hemicellulosic and cellulosic fractions. A 1-pot, 1-step process for simultaneous saccharification and fermentation (SSF) was developed to convert starch to L-lactic acid at 50 ℃ under non-sterilized condition, giving 202 g/L of L-lactic acid from 200 g/L of corn starch. To reduce the nitrogen source cost for fermentation, expensive yeast extract was replaced with the same amount of cheap dry yeast achieving almost the same lactic acid titer, productivity and yield. $Ca(OH)_2$ was found to be a better neutralizing agent to control the pH during fermentation than NaOH and NH4OH in terms of the higher lactic acid titer and productivity.

Modification of glycolytic pathways and co-production of hydrogen and ethanol from glucose by *Escherichia coli*

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Biologically, hydrogen (H_2) can be produced from glucose through dark fermentation and photo-fermentation. Hydrogen production by dark fermentation is fast and simple, but gives low theoretical yield of 2-4 mol H_2/mol glucose. Co-production of H2 and ethanol, both of which are good biofuels, has been suggested as a solution to this problem. To this end, using *Escherichia coli*, glucose assimilation was modified by eliminating phosphofructokinase (pfkA) or phosphoglucose isomerase (pgi) in Embden-Meyhof-Parnas (EMP) pathway and/or 6-phosphogluconate dehydratase (edd) and/or 2-keto-3deoxy-6-phosphogluconate aldolase (eda) in Entner-Doudoroff (ED) pathway. Furthermore, the pentose-phosphate (PP) pathway, which can generate more NADPH than the EMP or ED pathway, was strengthened by overexpressing two key enzymes in the branch nodes of glycolytic pathway, Zwf and Gnd. The strains without overexpression of Zwf and/or Gnd did not produce H_2 and ethanol at high levels because glucose metabolism stopped at the pyruvate node. In comparison, when one or both of these enzymes were overexpressed in E. coli strains devoid of pfkA, pgi, edd-eda and/or pta-ack, co-production of H2 and ethanol was significantly improved with the concomitant reduction of pyruvate secretion. Gene expression and metabolic flux analyses showed that, upon overexpression of Zwf and Gnd, role of the PP pathway for glucose assimilation relative to that of EMP or ED pathway was greatly enhanced. The maximum co-production yields were 1.71 mol H_2/mol glucose and 1.41 mol ethanol/mol glucose, respectively. It is noted that the robust central carbon metabolisms and the amount of NAD(P)H formed under anaerobic conditions can be altered by modifying (the activity of) several key enzymes.

Enhanced production of biofuel by engineered Clostridium from renewable resources

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Biomass has been an important contributor to world economy for its sustainability and universality. In China, there is abundant agricultural biomass, such as, corn stalks, wheat straw, bagasse, and cassava. Using renewable biomass as substrate is an attractive proposition for introducing an economically competitive biological process. The biological production of acetone/butanol/ethanol (ABE) has prompted a great deal of interest in the light of diminishing oil resources worldwide and unpredictable fluctuations in petroleum price. Currently, however, no microorganism can produce butanol efficiently from lignocellulosic biomass because of a range of toxic compounds. Weak acids, furan derivatives, and phenolic compounds, are generated during the hydrolysis of lignocellulosic materials.

A high inhibitor-tolerance *Clostridium beijerinckii* IT66 was obtained by atmospheric and room temperature plasmas and metabolic evolution. When non-detoxified hemicellulosic hydrolysate of corn fiber treated with dilute sulfuric acid (SAHHC) was used as substrate, applying one two-stage controlled-pH fed-batch with the optimum composition, the ABE titer, yield, and productivity reached 13.9 g/L(3.4 g/L acetone, 10.1 g/L butanol and 0.4 g/L ethanol), 0.38 g/g sugar and 0.23 g/l ħ, respectively.

In addition, *Clostridia* species were known as classical acid producers and usually ferment glucose to solvents production, butyrate, acetate, carbon dioxide, and molecular hydrogen, but little is known about their ability to produce hydrogen. In this study, hydrogen production performance of *this* high inhibitor-tolerance mutant was obtained by H2scan (HY-OPTIMA™700). Besides, the off-gases from the pure culture of C.beijerinckii IT66 were used for co-production of succinic acid by Actinobacillus succinogenes NJ113. The results of by-production and co-production appear promising for economic-ABE production from lignocellulosic materials.

Key words: Butanol; Clostridium; Biological process; Lignocelluloses

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Microalgae to Bio-energy of ENN

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The shortage of fossil fuels will become a large problem in this century. One possible way is get bio-diesel from micro-algae, like the mother nature once did millions of years ago.

As the largest private energy companies in China, The goal of ENN's algae research at Algal Bioenergy Technology Center (ABTC) can be summarized as C4F© – Carbon Fixation for Food, Feed and Fuel. ABTC covers the technical areas from algae strains, to low cost photo-bioreactors and culturing systems, harvesting and post processing systems, engineering scale up and commercialization. ABTC also leads the algal bioenergy research effort by a team of research institutes in China supported by China Ministry of Science and Technology under the national "863" research program. The sub-areas of the "863"* research effort includes genetic modification of algae strains, local algae strain collection and evaluation, optimization of culturing process, photobioreator design and system integration, industrial demo and commercialization.

The focus of ABTC's algae bioenergy research effort is on high productivity and low operation cost. ABTC's effort is carried out in labs of basic research, scaleing up greenhouse, industrial demo units, and filed tests and commercialization platform in northern and southern China.

ABTC is also a crucial part of the National Lab of Low Carbon Energy at ENN, responsible of developing low cost carbon fixation technologies for applications including the coal-based power generation industry in China.

ENN is the leading clean energy company in China with technologies and products ranging from underground coal gasification (UCG), catalytic coal gasification (CCG), utilization of carbon dioxide, thin-film PV solar BIPV panels, energy efficiency and systems.

Systematic regulation of endogenous promiscuous phosphatases in *E. coli* for enhanced production of terpenoids

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Engineering of microbial cell factory for target product synthesis from biomass feedstocks has become one of the spotlight fields in green biomanufacturing technology. The traditional approach to construct microbial cell factory is rational design. However, the bottleneck is that the complicated relevance between target pathway of metabolic engineering and metabolic network of the host cells. In recent years, a few researches have indicated that many endogenous enzymes possess substrate non-specifity and show promiscuous reactions inside the cells. The promiscuous enzymes may thus have significant impact on metabolic network in the microorganisms to decrease the target productivities.

The terpenoids are a class of hydrocarbon and oxygenated derivatives based on five-carbon isoprene units. Biosynthetic pathway of terpenoids consists of MEP pathway and mevalonate pathway . As one of the main target products in metabolic engineering, terpenoids have been paid much attention. Although the terpenoid biosynthesis pathway has been studied extensively, there still exists a large gap between the actually reachable and theoretical yield of terpenoid. Moreover, there are a series of phosphorylated intermediates in MEP pathway, which can presumably be consumed by the endogenous promiscuous phosphatases.

In this thesis, we chose lycopene as the model terpenoid for its biosynthesis in Escherichia coli DH1 as host strain. First, the gene cluster of lycopene synthesis was constructed and integrated into the chromosome of *E.coli* DH1.The expressions of this gene cluster and rate-limiting steps in the endogenous MEP pathway were enhanced by constitutive promoter library modulation for the improved lycopene production. Lycopene-producing kickoff strain was established. Secondly, endogenous promiscuous phosphatases.

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