June 30
2022

2021–2022

中日高层次科学家研讨交流活动（能源转型）

日中ハイレベル研究者交流会（エネルギー転換）

China-Japan High-level Expert Symposium on Energy Transition

Hosts: Department of Foreign Expert Services,
Ministry of Science and Technology of the People's Republic of China
Sakura Science Program Headquarters,
Japan Science and Technology Agency

Organizers: Foreign Talent Research Center,
Ministry of Science and Technology of the People's Republic of China
Zhejiang University
Zhejiang University of Technology

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China-Japan High-level Expert Symposium on Energy Transition

Introduction

The second China-Japan High-level Expert Symposium in the field of Carbon-neutral Development with the topic of *Energy Transition* will focus on energy low carbon transition, hydrogen energy and energy storage technology, and zero carbon energy. Top scientists and experts from China and Japan are invited for presentations and dialogues on cutting-edge research and practice of energy transition, and explore the best way to achieve carbon neutrality in the energy field. A joint initiative will be proposed, based on the expected consensus of the participants, to provide a consultation and reference for the policymaking and industrial development in China, Japan, and other countries as well.

Chairs

Gao Xiang
Academician, Chinese Academy of Engineering
Dean, College of Energy Engineering, Zhejiang University

Ishihara Keiichi
Professor, Graduate School of Energy Science, Kyoto University

Hosts

Department of Foreign Expert Services, Ministry of Science and Technology of the People's Republic of China

Sakura Science Program Headquarters, Japan Science and Technology Agency

Organizers

Foreign Talent Research Center, Ministry of Science and Technology of the People's Republic of China

Zhejiang University

Zhejiang University of Technology

Contacts

Zhu Ruilin, College of Energy Engineering, Zhejiang University
Tel: 0086-0571-87952382 0086-18818080910
Email: rlzhu@zju.edu.cn

Lou Yujiao, Foreign Talent Research Center, Ministry of Science and Technology of the People's Republic of China
Tel: 0086-010-58882404 0086-18032417113
Email: louyujiao@ftrcmost.cn

Shan Gu, Department of Planning and Management, Sakura Science Program Headquarters, Japan Science and Technology Agency
Tel: 0081-90-15490556 0081-3-52148288
Email: shan@jst.go.ip

Foreign Talent Research Center, MOST

The Foreign Talent Research Center, Ministry of Science and Technology of the People's Republic of China, a public institution directly affiliated to China's Ministry of Science and Technology, is mainly responsible for: carrying out research on the development of foreign talent and the theories, strategies, policies, and development status of scientific and technological innovation; developing foreign talent think-tanks and promoting networks of theoretical achievements during overseas expertise introduction; undertaking the construction, operation, maintenance and development of foreign talent resource pools; providing resources, platforms and other services for the overseas expertise introduction; editing and publishing professional media articles for the overseas expertise introduction, and undertaking the publicity work entrusted by the Ministry; organizing professional meetings and major events for overseas expertise introduction as well as scientific and technological exchanges; providing services including evaluation, consultation, introduction, information, and training for foreign talent; managing the China Society for Research on International Exchange and Personnel Development; and undertaking other tasks assigned by the CPC Leading Group, MOST and leaders of the Ministry and tasks entrusted by relevant departments and bureaus.

Sakura Science Program Headquarters, JST

Japan Science and Technology Agency (JST) plays a central role in Japan's Science and Technology Basic Plan. Based on science and technology targets issued by the government, we fund strategic basic research, academia-industry collaboration and technology transfer. In recent years, we promote international joint research and the fostering of next generation human resources. JST also provides information services to support R & D activities. Our comprehensive contribution stimulates substantive progress in science and technology and helps tackle a variety of social issues.

JST continues to strengthen our close relationship with universities, research institutes and industry in and outside Japan, create collaborative science and technology innovation and ensure sustainable development of our society.

Sakura Science Program invites talented young people from other countries and regions to Japan in a form of industry-academia-government collaboration, to introduce and offer experience in science and technology. Beginning in 2014, over 33,000 young people have visited Japan through this program.

By exchanging ideas in the field of science and technology among the participants of Sakura Science Program, we:

-Support the development of talented people overseas who have the potential to contribute to the innovation in science and technology; and support continuous interaction between Japan and other countries and regions.

-Promote globalization of Japanese educational and research institutes.

-Strengthen good relationship between Japan and other countries and regions and ultimately pursue the development of science and technology in Japan and worldwide.

Zhejiang University

Zhejiang University (ZJU), located in Hangzhou, is one of China's top higher education institutions. It is organized across 7 faculties and 39 schools and home to 4,383 full-time faculty members, including 61 Academicians of Chinese Academy of Engineering and Chinese Academy of Sciences. Laying claim to several areas of research strength, ZJU currently ranks among the top three on Chinese mainland and within the top 100 in the Times Higher Education World University Rankings and QS World University Rankings. 18 disciplines of ZJU have been selected for "Double First-Class" Initiative, and 39 disciplines graded A in the recent national assessment.

ZJU is committed to transforming China and the world through active engagement. Major innovative developments include the creation of a high-level platform for intellectual property exchange, as well as the formation of a number of think-tanks, including the China Academy of West Region Development, the National Research Center for Agricultural and Rural Development, and the Institute for Public Policy, which exist to extend the scope of ZJU's research in social sciences.

ZJU has partnerships in place with more than 200 institutions from more than 30 countries worldwide. With a cohort of 5,609 international students, and around 8,000 faculty and students who participate annually in various overseas mobility programs, ZJU fully harnesses its extensive network to nurture talent with a global outlook.

College of Energy Engineering, Zhejiang University

The College of Energy Engineering, Zhejiang University was originally established in 1978. Through more than four decades of exploration and development, the College of Energy Engineering has established a great platform for innovation, strongly supported by Ph.D. programs in first-tier discipline, State Key Laboratory, National Engineering Research Center, "National 2011 Plan" Collaborative Innovation Center, National Global Science and Technology Cooperation Center, National Demonstration Center for Experimental Education, etc.

The college consists of 5 institutes, covering Thermal Power Engineering, Process Equipment, Refrigeration and Cryogenics, Power Machinery and Vehicle Engineering, and Thermal Science & Power System and has 9 sub-disciplines. At present, the College has 3 Academicians of Chinese Academy of Engineering, 5 Special Experts of Zhejiang Province, 8 Chang Jiang Scholars and many other talents of various categories.

The college also owns research teams that awarded "Chang Jiang Scholars and Innovative Research Team" by Ministry of Education of the People's Republic of China, and "Innovative Research Group" by National Natural Science Foundation of China.

The college has been undertaking important research projects, including the National Key R&D Program of China, the National Science Fund for Distinguished Young Scholars, international cooperation programs, as well as major crossing programs, with total research fund over 1 billion in the past three years.

Zhejiang University of Technology

Zhejiang University of Technology (ZJUT) is a comprehensive key university of Zhejiang Province, co-established by the Zhejiang Provincial government and the Ministry of Education of the People's Republic of China. It offers programs in a variety of subjects including engineering, science, liberal, arts, law, economics, pharmaceutics, management, education, and so on. It has 28 colleges and 1 department, including 70 undergraduate programs, 34 master's degree programs and 10 doctor's degree programs. ZJUT has 3 Academicians of Chinese Academy of Engineering, 4 Academicians of Chinese Academy of Engineering and Chinese Academy of Sciences whom ZJUT shares with other institutions. Having established interscholastic cooperative relationship with about 180 colleges and universities from America, England, France, German, Japan, etc., and more than 10 colleges and universities from Hong Kong, Macao and Taiwan, ZJUT becomes more and more active in external exchange, and makes great progress in many aspects, such as dual culture of students, academic exchange between teachers and scientific research, running schools with foreign countries, introduction of overseas intelligence, education of overseas students, teaching Chinese as foreign language, etc.

Zhejiang Carbon Neutral Innovation Institute

Zhejiang Carbon Neutral Innovation Institute was established in 2021. It is the member of the National Environmental Monitoring Instrument Industry Metrology and Testing Alliance, and also the member of the Zhejiang Carbon Peak Carbon Neutral Science and Technology Innovation Consortium. It integrates the research resources of Zhejiang University of Technology and its

partners in the field of "greenhouse gas sources/sinks assessment and reduction", aiming to support the double carbon goals. The institute has three research centers, which focus on greenhouse gas monitoring, carbon dioxide conversion and application, and double carbon goals strategic policy, respectively. The research centers are all committed to conducting research covering the entire innovation chain and industrial chain of carbon neutralization, focusing on major scientific and technological issues in the field of carbon neutralization. Through the activity of science, technology, innovation and application, it can provide solutions for the green transformation and development of enterprises, lead the overall construction of a green, low carbon and circular development economic system, and finally support the double carbon goals in Zhejiang province as well as in China.

Agenda **UTC+8**

June 30th, 2022	
Opening Ceremony	
Moderator: Yu Zitao	
08:30-09:00	**Opening Address** ● Li Xin, Deputy Director General, Department of Foreign Expert Services, Ministry of Science and Technology of the People's Republic of China ● Kishi Teruo, Director General, Sakura Science Program Headquarters, Japan Science and Technology Agency ● Yan Jianhua, Vice President, Zhejiang University ● Tokitoh Norihiro, Executive Vice President, Kyoto University
09:00-09:05	**Group Photo**
Session I **Energy Low Carbon Transition**	
Moderator: Ueda Kimi	
09:05-09:25	Keynote Speech 1: Perspective on Energy Technology Innovation at Zhejiang University ● Gao Xiang
09:25-09:45	Keynote Speech 2: Carbon Neutral Scenario in Japan ● Ishihara Keiichi
09:45-10:05	Keynote Speech 3: China's Pathways and Policies for Realizing Carbon Neutrality Vision ● Li Zheng
10:05-10:25	Keynote Speech 4: Carbon Neutrality and Mineral Resources ● Benjamin C. McLellan
10:25-10:35	**Break**

Session II Hydrogen Energy and Energy Storage Technology	
Moderator: Xiao Gang	
10:35-10:55	Keynote Speech 5: State of the Art and Knowledge Gaps in Storage of High Pressure Gaseous Hydrogen ● Zheng Jinyang
10:55-11:15	Keynote Speech 6: Visible Light Responsive Photocatalysts toward Solar Hydrogen Production ● Abe Ryu
11:15-11:35	Keynote Speech 7: Magnetic Fusion Energy and Gyrokinetic Turbulence Simulation ● Xiao Yong
11:35-11:55	Keynote Speech 8: Dielectric Particle Dispersion Technique for NASICON-type Structured Lithium-ion Conductors ● Takai Shigeomi
11:55-13:30	**Lunch**
Session III Zero Carbon Energy	
Moderator: Qu Chen	
13:30-13:50	Keynote Speech 9: Carbon Neutral Development Path of Petrochemical Industry under the Vision of Low-carbon/Zero-carbon Energy Evolution ● Wu Tao
13:50-14:10	Keynote Speech 10: CO_2 Fixation with Microalgae Biomass from Coal-fired Flue Gas ● Cheng Jun
14:10-14:30	Keynote Speech 11: Fusion Business-a New Trend of Fusion Development and the Role of Startups ● Konishi Satoshi
14:30-14:50	Keynote Speech 12: Stabilization of Lithium Electrodeposition via Enhanced Lithium-ion Transport Properties at the Electrode/Electrolyte Interface ● Lu Yingying
14:50-15:10	Keynote Speech 13: Sustainable Catalysis for the Chemical Conversion of CO_2 ● Jang Hye-young
15:10-15:30	Keynote Speech 14: Energy Transition with Ocean Renewable Energies ● Bahareh Kamranzad
15:30-15:40	**Break**

Virtual Research	
Moderator: Wu Xuecheng	
15:40-16:00	**Japanese Pioneer Case Research** Introduction of SPERA Hydrogen™ System for Massive Hydrogen Storage and Transportation Okada Yoshimi, Chiyoda Corporation
16:00-16:20	**Chinese Pioneer Case Research** Renewable Energy Projects in Zhejiang Provincial Energy Group Co., Ltd. Fang Kai, Zhejiang Energy R&D
Roundtable Discussion	
Moderator: Wu Xuecheng	
16:20-17:30	● Energy Low Carbon Transition Fang Kai, Ishihara Keiichi, Agamuthu Pariatamby, Benjamin C. McLellan, Wu Xuecheng, Yabutsuka Takeshi, Chen Linghong, Okazaki Yutaka, Zheng Chenghang ● Hydrogen Energy and Energy Storage Technology Wang Zhihua, Abe Ryu, Shi Jianfeng, Takai Shigeomi, Liang Chu ● Zero Carbon Energy Jiang Fangdan, Konishi Satoshi, Zhang Xiao, Jang Hye-young, Yan Mi, Bahareh Kamranzad, Wang Lei, Takada Masatsugu, Zhang Hao
Closing Ceremony	
Moderator: Huang Qunxing	
17:30-18:00	**Concluding Remarks and Joint Initiative** ● Jin Tao, Deputy Dean, Professor, College of Energy Engineering, Zhejiang University ● Ishihara Keiichi, Graduate School of Energy Science, Kyoto University

Chairs

Gao Xiang

Academician, Chinese Academy of Engineering
Dean, College of Energy Engineering, Zhejiang University

Gao Xiang is the Rotating President of the China Association of Machinery Industry for Environmental Protection (CAMIE), the Chairman of the Professional Committee of Environment and Thermal Energy Utilization of Chinese Society for Environmental Sciences, and the Chairman of the Technical Committee 7 on Environmental Protection Machinery Standardization of China Machinery Industry Federation (CMIF/TC7). He has long been engaged in research and industrial deployment on emission reduction of pollutants and greenhouse gases in energy and environmental engineering. He is the inventor of more than 70 domestic invention patents and 7 international patents. He has presided over or participated in the formulation of 70 national and industrial standards. He is the author of more than 260 peer-reviewed papers. He has been awarded the Prize of Science and Technology Innovation of Ho Leung Ho Lee Foundation, as well as the first and second prizes of the National Technology Invention Awards.

Ishihara Keiichi

Professor, Graduate School of Energy Science, Kyoto University

Ishihara Keiichi graduated from the Department of Metal Science and Technology, Faculty of Engineering, Kyoto University, and received his Ph.D. in Metastable Materials. After moving to the Graduate School of Energy Science, he started working on energy system analysis and planning. He led a team of zero-emission scenarios from 2008 to 2013 and published the *world zero-emission scenarios*. Since then, he has been researching the development of new materials for energy and environment.

Principals

Yan Jianhua

Vice President, Zhejiang University
Director, State Key Laboratory of Clean Energy Utilization, Zhejiang University

Yan Jianhua has long been committed to the research of efficient and clean energy utilization of combustible waste. He has established the theoretical and technical system of circulating fluidized bed combustion for complex solid waste, invented the thermal transformation technology of rotary multi-stage pyrolysis and incineration of hazardous waste, and proposed a new method for online detection of dioxins coupled with the whole-process control. The above research has been applied to more than 150 waste incineration waste-to-energy projects, sludge drying incineration, and hazardous waste harmless disposal projects, contributing to the annual treatment of more than 26 million tons of solid waste. He has been granted 3 second prizes of the National Science and Technology Progress Award, 1 second prize of the National Technology Invention Award, and 1 first prize and 1 second prize of the National Teaching Achievement Award. He has published 481 SCI papers and 8 monographs in Chinese and English, granted 94 invention patents, compiled 6 national or industry standards and guidelines, and made 10 invited reports for international conferences.

Tokitoh Norihiro

Executive Vice President, Kyoto University
Specially Appointed Professor, Institute for Chemical Research, Kyoto University

Tokitoh Norihiro is the Director of the Center for the Promotion of Interdisciplinary Education and Research, and the President of the Society of Physical Organic Chemistry, Japan. He serves as the Member of international advisory boards of International Conference on Heteroatom Chemistry (ICHAC), International Symposium on Silicon Chemistry (ISOS), International Symposium on Inorganic Ring Systems (IRIS), International Conference on the Coordination and Organometallic Chemistry of Germanium, Tin, and Lead (ICCOC-GTL), and Asian Silicon Symposium (ASiS). His main research interests include main group and organometallic chemistry, especially the creation of novel bondings and structures of heavier main group elements and the elucidation of their unique and novel structures and properties. He has been a recipient of many awards including the Alexander von Humboldt Research Awards, the Society of Silicon Chemistry Award, the Chemical Society of Japan Award, etc.

Moderators

Yu Zitao

Vice Dean, Professor, College of Energy Engineering, Zhejiang University

Yu Zitao is mainly engaged in the research of enhanced heat transfer theory of high-performance heat transfer elements and advanced heat transfer fluids, as well as industrial waste heat utilization technology, absorption heat pump technology, solar thermal utilization technology, and distributed energy system optimization. In the past three years, he has been in charge of a number of national and provincial projects, including the National Key R&D Program of China, the Major Consulting Project of the Chinese Academy of Engineering, the National Natural Science Foundation of China, the Natural Science Foundation of Zhejiang Province, etc. In addition, he has been in charge of more than 20 R&D consulting projects for enterprises in key industries such as electric power, environmental protection and thermal power.

Ueda Kimi

Assistant Professor, Graduate School of Energy Science, Kyoto University

Ueda Kimi received her bachelor's degree in Electrical and Electronic Engineering from Kyoto University in 2016, and her master's and doctor's degree from Graduate School of Energy Science of Kyoto University in 2018 and 2021. She was awarded the Research Fellowship for Young Scientists of Japan Society for the Promotion of Science (JSPS) during her Ph.D. Her research interests include workplace environment, intellectual work performance, cognitive psychology and behavioral induction.

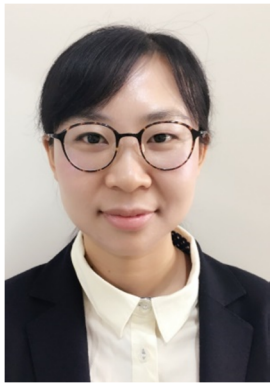
Xiao Gang

Vice Dean, College of Energy Engineering, Zhejiang University

Xiao Gang is the Vice Chairman of China Solar Thermal Alliance, the Vice Director of the Key Laboratory of Clean Energy and Carbon Neutralization of Zhejiang Province, and the Director of Chinese Society of Power Engineering. He was the Principle Investigator of 5 projects of the National Natural Science Foundations of China, 1 international cooperation project of the National Key R&D Program of China, and over 30 other projects. As the first inventor, he has 6 American patents, 3 Japanese patents, 45 Chinese patents and 11 software copyright. He has published more than 100 papers as the first or corresponding author and edited a textbook of *Solar Energy*, which was adopted by more than 40 universities and enterprises and won the prize of High-quality Textbook for Energy and Power Majors in China Association of Electric Power Education. He is the Subject Editor of SCI Journal *Applied Thermal Engineering*, and also one of the main writers of two national standards of *Technical Requirements for Receiver of Solar Power Tower Plant* and *Test Method for Receiver of Solar Power Tower Plant*. He has won the Science and Technology Progress Award of the Ministry of Education of the People's Republic of China, the Excellent Youth Science and Technology Talent Awards of China Renewable Energy Society, and the scholarship of Zhejiang Outstanding Youth Fund. He has been engaged in teaching and scientific research of solar thermal power generation, high temperature thermochemical heat storage, Brayton cycle, and integrated energy system. He has established a Megawatt Thermal solar tower demonstration platform for research and teaching.

Qu Chen

Project Specific Assistant Professor, Graduate School of Energy Science, Kyoto University



Qu Chen obtained her Ph.D. in University of Toyama. Her research interests are the conversion of biomass to bioenergy and valuable chemicals, and the characterization of plant cell walls chemical composition using nuclear magnetic resonance method. She has published 11 original papers as the first or corresponding author, which have been cited hundreds of times.

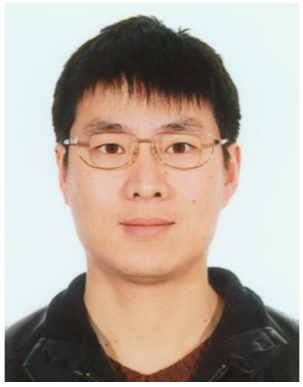
Wu Xuecheng

Director, Energy and Environmental Engineering Laboratory, Zhejiang University

Wu Xuecheng is the Professor and Doctoral Supervisor of Zhejiang University. He is the President of the Energy Design and Research Institute of Zhejiang University, and the President of the Energy Branch of Zhejiang University, Ningbo. He also serves as the Young Director of Chinese Society of Particuology, and the Executive Director of Zhejiang Society of Engineering Thermophysics. His main research interests include complex multiphase flow and reaction system testing and diagnosis, flue gas pollutant monitoring and technical evaluation, and energy utilization process operation monitoring and optimization. He has been in charge of more than 40 scientific research projects, such as projects of the National Key R&D Program of China, projects of the National Natural Science Foundation of China, and enterprise joint R&D projects. He has been granted more than 20 national patents, published 1 monograph and more than 150 peer-review papers, and participated in the compilation of 4 National Standards and 1 Association Standard. He has been awarded multiple national and provincial Teaching and Scientific Research Achievement Awards, and won the Youth Award of Chinese Society of Particuology.

Huang Qunxing

Vice Dean, Professor, College of Energy Engineering, Zhejiang University



Huang Qunxing is the Visiting Scholar at the Combustion Laboratory of the University of Illinois at Urbana-Champaign. He serves as the Chief Scientist of National Key R&D Program of China, the Representative of Waste-to-Energy Research and Technology (WTERT) in China. He is mainly engaged in the research of combustion process diagnosis, waste oxygen-controlled thermal transformation theory, rural waste disposal technology, and oily sludge treatment technology. He has undertaken and completed more than 20 projects, including the National Natural Science Foundation of China, the 973 Program, the National Science and Technology Support Project, and the National Environmental Protection Public Welfare Project. He has won 2 second prizes of the National Science and Technology Progress Award and 2 first prizes of the Science and Technology Progress Award of Zhejiang Province.

Jin Tao

Deputy Dean, Professor, College of Energy Engineering, Zhejiang University

Jin Tao received his Ph.D. from Zhejiang University in 2001, and then worked as the Postdoctoral Researcher in Nanjing University. He served as the Associate Professor in Zhejiang University in 2003 and was promoted as the Full Professor in 2008. He was appointed as the Distinguished Professor of Chang Jiang Scholar since 2020, and was selected as the Outstanding Talents in the New Century by Ministry of Education of the People's Republic of China in 2013. He currently serves as the Member of Commission A1 of International Institute of Refrigeration (IIR). He is one of a few scholars pioneering in the field of thermoacoustics in China and has been devoted continuously to this research topic. Besides, cryogenic refrigeration and cryogenic heat transfer are also his research interests. He has published over 150 peer-reviewed papers in the scientific journals. He was awarded several national or provincial technical awards for research achievements. He won the Peter Kapitza Award from the IIR in 2007 which is for outstanding research in Cryophysics performed by young scholars under 35 years old, and also the Outstanding Young Researcher from Chinese Association of Refrigeration in 2015.

Speakers

Gao Xiang

Academician, Chinese Academy of Engineering
Dean, College of Energy Engineering, Zhejiang University

Gao Xiang is the Rotating President of the China Association of Machinery Industry for Environmental Protection (CAMIE), the Chairman of the Professional Committee of Environment and Thermal Energy Utilization of Chinese Society for Environmental Sciences, and the Chairman of the Technical Committee 7 on Environmental Protection Machinery Standardization of China Machinery Industry Federation (CMIF/TC7). He has long been engaged in research and industrial deployment on emission reduction of pollutants and greenhouse gases in energy and environmental engineering. He is the inventor of more than 70 domestic invention patents and 7 international patents. He has presided over or participated in the formulation of 70 national and industrial standards. He is the author of more than 260 peer-reviewed papers. He has been awarded the Prize of Science and Technology Innovation of Ho Leung Ho Lee Foundation, as well as the first and second prizes of the National Technology Invention Award, etc.

Title: Perspective on Energy Technology Innovation at Zhejiang University

Abstract

Energy is the foundation of the social and economic development worldwide. It is also the driving force for scientific and technological advancement. The rapid rise in energy consumption has led to significant environmental concerns, including the emission of greenhouse gases. Carbon dioxide (CO_2) is the primary greenhouse gas contributing to anthropogenic climate change. In 2020, the global total CO_2 emission reached 38 billion tonnes. In response to the global climate challenge, China pledges to achieve CO_2 emissions peak before 2030 and carbon neutrality before 2060. In the meantime, after COP26, most nations worldwide have either submitted or updated their nationally determined contributions, covered approximately 90% of global GDP and 88% of global emissions. Currently, the main source of the carbon emission comes from burning fossil fuels to meet the increasing energy demand, and the energy sector is the largest emission contributor. Hence, there is a global demand for secure, clean, low carbon and cost-effective energy to fuel current and future development. This makes carbon neutrality in the energy sector through energy transition a crucial enabler of sustainable development. In this presentation, the perspective on energy technology innovation and the recent advancement at Zhejiang University supporting energy transition are introduced, including renewable energy, clean and efficient utilization of carbon-based energy, energy storage, CCUS (carbon capture, utilization, and storage), and monitoring and assessment technology.

Ishihara Keiichi

Professor, Graduate School of Energy Science, Kyoto University

Ishihara Keiichi graduated from the Department of Metal Science and Technology, Faculty of Engineering, Kyoto University, and received his Ph.D. in Metastable Materials. After moving to the Graduate School of Energy Science, he started working on energy system analysis and planning. He led a team of zero-emission scenarios from 2008 to 2013 and published the *world zero-emission scenarios*. Since then, he has been researching the development of new materials for energy and environment.

Title: Carbon Neutral Scenario in Japan

Abstract

The Japanese government has set a goal of carbon neutrality by 2050. In this regard, the Team at Kyoto University researched the situation of achieving carbon neutrality from 2008 to 2013, and published scenarios for achieving it in 2100. According to population projections, it will reduce to about 60 million in 2100, almost halving. If per capita energy consumption is constant, Japan's energy demand would be nearly half. At that time, it was considered possible to achieve carbon neutrality in 2100 from the viewpoint of renewable energy potential. The barriers to the early achievement of the 2050 goals will be discussed in this report.

In 2020, Japan's energy-derived carbon dioxide emissions are about 1 billion tons, 37% of which are in the power sector. In addition, steelmaking, chemical industry, transportation, residential, commercial, and non-energy sectors account for 83% of the total. Achieving carbon neutrality in these seven sectors will be focused on.

Introducing renewable energy, especially solar, is necessary for the power sector. However, baseload power is also needed at night and in case of rain, and nuclear is essential. Batteries and hydrogen are necessary for power storage. From the cost and decarbonization of the transportation sector, it is essential to consider the shift to electrical vehicles for private cars and the storage of electrical vehicle batteries. In addition, for long-term stabilization, such as seasonal variation, it is necessary to promote hydrogen infrastructure in consideration of the decarbonization of freight transport. Decarbonization is possible in residential and commercial sectors by promoting electrification. In the chemical industry, emissions are expected to be reduced by reducing petroleum products. Still, developing technologies for manufacturing chemical products other than fuels, such as plastics using biomass, is essential. Additional sectors can be addressed by focusing on the cement industry.

Li Zheng

Executive Vice President, Institute of Climate Change and Sustainable Development, Tsinghua University

Li Zheng is the Chang Jiang Scholars, and the Director of the Laboratory of Low Carbon Energy, Tsinghua University. He is also the Secretary General of Global Alliance of Universities on Climate (GAUC). His researches include energy system modeling and transition analysis, low carbon development and strategies as well as modeling and optimization of thermal power systems. He is leading several national and international research projects on energy/climate policies and technologies.

Title: China's Pathways and Policies for Realizing Carbon Neutrality Vision

Abstract

China's carbon peaking and carbon neutrality pledge has become an overall national strategy that conforms to the trend of global low carbon development and forces China's economy to move towards high-quality development. Compared with developed countries, China is facing greater challenges to decarbonize its growing economy. The energy system should first undergo profound changes and transform its energy system from one with coal and fossil energy dominating into a new one with non-fossil energy dominating. At the same time, it also requires the joint efforts of other sectors of society to reduce carbon emissions in all aspects. The low carbon transformation of the economy and society requires huge investment costs, but it will also bring new economic growth opportunities and a larger number of employment to support the high-quality development of the economy.

Benjamin C. McLellan

Professor, Graduate School of Energy Science, Kyoto University

Since 2010, Benjamin C. McLellan has been working at the Graduate School of Energy Science, Kyoto University. He graduated in Chemical Engineering from the University of Queensland in 2002, continued to the Ph.D. in the same department, and then moved to the Sustainable Minerals Institute, where he was the Postdoctoral Fellow through to Researcher, and retains the Honorary Role. His research since 2003 has been focused on the sustainable use and production of mineral resources and energy, including technological, social, economic and environmental perspectives. Notably, he has interests in the social and environmental implications of deep ocean mining and hydrogen economy technologies.

Title: Carbon Neutrality and Mineral Resources

Abstract

Carbon neutrality by 2050 has been set as a target by many countries. Although the need to achieve this target is significant, and there are serious concerns about the level of real political commitment to achieving it, one point is clear--in any scenario, there is an essential need to expand our use of mineral resources. Over the past decade, many studies have emerged to evaluate the "criticality" of minerals, with a large proportion of these studies focused on minerals that are essential for energy technologies. There are a variety of estimates from both the demand side and the supply side, with determination of whether or not a mineral has supply risks being mixed. Supply risks are subject not only to the geological availability, but also to the social and environmental impacts and demand, which may limit or encourage mineral production. This presentation will examine some of the recent estimates, limitations and opportunities in the provision of minerals for energy technologies, with a focus on emerging energy technologies.

Zheng Jinyang

Academician, Chinese Academy of Engineering
Professor, College of Energy Engineering, Zhejiang University

Zheng Jinyang is the Special Advisor of the Technical Committee of Hydrogen Technologies in the International Standard Organization (ISO/TC197), the Chair of the International Association for Hydrogen Energy Codes and Standards Division (IAHE CSD), the Chair of the Technical Committee of Gas Cylinders/High Pressure Vehicle Fuel Tanks (SAC/TC31/SC8), etc. His research focuses on hydrogen storage and safety, and has made a series of achievements in high pressure hydrogen storage. He has published more than 300 articles, 14 books and obtained 95 patents. He was also responsible for the development of 2 national regulations and 11 national standards. He has received many awards from government as well as industry federation so far, including 1 first prize and 2 second prizes of the National Science and Technology Progress Award, 6 first prizes of the Provincial and Ministerial Science and Technology Progress Award, 2 first prizes of the Provincial and the Ministerial Teaching Achievement Award, 2 Chinese Excellent Patents and 3 Chinese Standard Innovation Contribution Awards.

Title: State of the Art and Knowledge Gaps in Storage of High Pressure Gaseous Hydrogen

Abstract

Deployment and investment in hydrogen energy have accelerated rapidly in response to government commitments to carbon neutrality and establishing hydrogen as a key component in the energy transition. Efficient and safe storage of hydrogen is crucial for the success of hydrogen energy markets. Hydrogen can be stored in the form of gas, liquid or hydrides. The storage of hydrogen in compressed gaseous hydrogen has become the most popular and most highly developed hydrogen storage method. This presentation gives an overview of pressure equipment for storage and transportation of gaseous hydrogen with pressure over 35MPa. Knowledge gaps in safety, light weight, and cost reduction are also discussed.

Abe Ryu

Professor, Department of Energy and Hydrocarbon Chemistry, Graduate School of Engineering, Kyoto University

Abe Ryu received his bachelor's, master's and doctor's degrees from Tokyo Institute of Technology. He then worked as the Postdoctoral Fellow and as the Researcher at the National Institute of Advanced Industrial Science and Technology (AIST), Japan. He started his academic career as the Associate Professor at the Catalysis Research Center, Hokkaido University in 2005. Then, he was promoted to the Professor of Graduate School of Engineering, Kyoto University in 2012. He serves as the Associate Editor of *Chemistry Letters*, *J. Photochem. Photobiol. A: Chem.*, and *Sustainable Energy & Fuels*. His research is mainly focused on the development of new photocatalysts for water splitting and environmental purification.

Title: Visible Light Responsive Photocatalysts toward Solar Hydrogen Production

Abstract

Photo-induced water splitting using semiconductor photocatalysts has attracted considerable attention as one of the promising technologies for clean and cost-effective H_2 production. Although a number of metal oxides have been reported to be active photocatalysts for the water-splitting reaction, most of them only function under UV light owing to the large band gap energy of the materials (> 3 eV). Because almost half of all incident solar energy at the Earth's surface falls in the visible region, the effective utilization of visible light is imperative to achieve the desired solar-to-hydrogen conversion efficiency for practical applications.

We have developed a new type of photocatalytic water splitting system, mimicking the mechanism of photosynthesis in green plants. This two-step system can reduce the energy required to drive each photocatalysis process, allowing visible light to be utilized more efficiently than in conventional water splitting system.

Meanwhile, various mixed-anion compounds such as oxynitrides, oxysulfides, and oxyhalides have been extensively studied as promising photocatalysts for visible light-induced water splitting, because their Valence Band Maximum (VBM) values are generally more negative than those of conventional oxides, endowing them both narrow bandgaps and appropriate band levels for visible-light-induced water splitting. We have recently demonstrated that Sillén–Aurivillius type perovskite oxyhalides such as Bi_4NbO_8Cl can stably and efficiently oxidize water to O_2 under visible light without any surface modifications, and also exhibits a stable Z-scheme water splitting when coupled with a H_2-evolving photocatalyst. These results provide new strategies for developing durable materials for water splitting. We have extended this strategy to other oxyhalides with multiple perovskite layers or with simpler Sillén type structures.

Xiao Yong

Professor, Institute for Fusion Theory and Simulation, Department of Physics, Zhejiang University

Xiao Yong received his Ph.D. from Massachusetts Institute of Technology in 2006. His main research interests are focused on computational and theoretical plasma physics, as well as magnetic fusion energy science. He has been developing advanced numerical algorithms and massively parallel gyrokinetic codes to investigate turbulent transport and burning plasma physics in fusion devices such as tokamaks.

Title: Magnetic Fusion Energy and Gyrokinetic Turbulence Simulation

Abstract

Fusion energy is a virtually limitless and environmentally friendly energy source that harnesses the power of sun. One of the key physics issues in building a fusion power reactor is how to confine the hot fuel plasmas in a magnetic bottle for a sufficiently long time. The prevailing electromagnetic fluctuations or turbulence is generally believed to account for the major loss of heat and particles in fusion device. Therefore, the associated turbulent transport is crucial in determining the duration of plasma confinement. First-principles gyrokinetic simulations using supercomputers have been developed in the past three decades to investigate turbulence and associated transport in magnetic fusion community. This report will give a survey of current status of magnetic fusion energy and show how fusion researchers develop sophisticated gyrokinetic simulations and use the state-of-the-art technology in high performance computing to tackle the forbiddingly complex turbulent transport problem in tokamaks. The report will also address what we have learned or achieved so far and what we are going to do next.

Takai Shigeomi

Associate Professor, Graduate School of Energy Science, Kyoto University

Takai Shigeomi received his Ph.D. in Engineering from Tokyo Institute of Technology in 1995. He worked as the Research Assistant at the Faculty of Engineering, Tottori University from 1993 to 2008, the Assistant Professor at the Graduate School of Engineering, Tottori University from 2008 to 2012, and the Associate Professor at the Graduate School of Energy Science, Kyoto University since 2012. His main research interests are ionic conductors, battery, fuel cell, and inorganic solid-state chemistry.

Title: Dielectric Particle Dispersion Technique for NASICON-type Structured Lithium-ion Conductors

Abstract

Widely spreading of electric vehicles and mobile devices has brought about the large progress in battery technology. All-solid-state battery employing lithium-ion conductor as solid electrolyte is one of the promising battery systems, which enables the cell design safer and more compact. The drawbacks of oxide-based solid electrolytes are lower ionic conductivity as well as poorer electrolyte/electrode contact in comparison with sulfide-based ones. To improve the ionic conductivity of oxide-based lithium-ion conductors, we adopted dielectric particle dispersion technique, the mechanism of which has been explained by Maier's model, where the local ion mobility is increased for the space charge layer formed at the matrix/dielectric particle interface. While the conductivity enhancement of Al_2O_3-particle dispersing LiI composite has been reported in 1970s, only few reports have been published other than halide-based composites.

In recent year, we have successfully improved the ionic conductivity of NASICON-type structured LATP by dispersing $LaPO_4$ dielectric particles. This composite was synthesized at first by co-sintering LATP precursor with LLTO powder to decompose and to react into $LaPO_4$ particles during the sintering. The conductivity is three-times larger than pristine LATP at room temperature, and the lithium-ion conduction was confirmed by using blocking-electrode cells. Even when the starting particle is altered to La_2O_3 instead of LLTO, the conductivity enhancement phenomenon due to $LaPO_4$ dispersion is also observed. The results of Transmission Electron Microscope (TEM) and 6Li/7Li tracer diffusion measurements using neutron radiography technique are represented in this report.

Wu Tao

Vice Provost, University of Nottingham Ningbo, China
Dean, Faculty of Science and Engineering, University of Nottingham Ningbo, China

Wu Tao is the Full Professor in Chemical Engineering. He serves as the Fellow of the Royal Society of Chemistry, the Fellow of the Institute of Materials, Minerals and Mining, the Deputy Director of the Professional Committee of Environment and Thermal Energy Utilization of Chinese Society for Environmental Sciences, the President of Ningbo Society for Environmental Sciences, and the Director of the Key Laboratory of Carbonaceous Wastes and Process Intensification of Zhejiang Province. He has extensive research experiences in clean energy conversion, energy saving and environmental protection technologies, and energy and environmental materials. To date, as the Principal Investigator or Coordinating Investigator, he has competed or is conducting more than 40 externally funded research projects. He published more than 100 SCI journal papers in the past five years, has been granted more than 10 patents and won a number of prestigious awards for his contribution to the advancement of science and technology.

Title: Carbon Neutral Development Path of Petrochemical Industry under the Vision of Low-carbon/Zero-carbon Energy Evolution

Abstract

To achieve the carbon peaking and carbon neutrality goal, the low/zero carbon transformation has become imminent for petrochemical industry in China and is facing significant challenges. Low/zero carbon energy transition, product transformation, synergistic development of upstream and downstream industrial chains, etc., are essential for the green development of petrochemical industrial sector. In this report, life-cycle analysis approach is adopted to study the carbon emission of a typical oil refinery with a focus on the influence of energy decarbonization and product mix on product carbon footprint. Based on the study of the entire process and individual units, units with high energy emission have been identified and strategies for carbon footprint control are explored. Moreover, aiming at carbon neutrality in 2060, the influence of low/zero carbon energy development in China on the carbon emission of China’s petrochemical industrial sector is studied. The impacts of electrification and industrial symbiosis on carbon emission have also been investigated in great detail. A route toward low/zero carbon emission for petrochemical industrial sector is subsequently proposed.

Cheng Jun

Professor, College of Energy Engineering, Zhejiang University

Cheng Jun is the Distinguished Professor of Chang Jiang Scholar, and the Leading Talent of Young and Middle-aged Science and Technology Innovation of MOST. He serves as the Vice Chairman of China Technology Innovation Strategic Alliance for Environment-Enhancing Industry, and the Associate Editor-in-Chief of *Carbon Resources Conversion*. He has published over 300 academic papers on international journals, has been authorized over 60 invention patents and got 2 second prizes of the National Science and Technology Progress Award. His main research fields include carbon neutrality, smart energy, energy storage, new energy, energy saving and environmental protection, CO_2 conversion and utilization, renewable synthetic fuels, hydrogen energy, biomass energy, and solar energy.

Title: CO_2 Fixation with Microalgae Biomass from Coal-fired Flue Gas

Abstract

China has developed advanced microalgae technology with efficient photosynthesis reactions to utilize flue-gas CO_2 from coal-fired power plants and coal-chemical plants. Leading universities cooperated with pioneer companies have made breakthrough in developing cost-efficient photosynthetic reactors with robust microalgae species such as Spirulina, Chlorella and Nannochloropsis. An industrial demonstration with an annual CO_2 fixation capacity of 10000 tons by microalgae has been built in Erdos of Inner Mongolia. This project uses food-grade CO_2 with $\geqslant$99.95% concentration purified from coal chemical plants for cultivating Spirulina biomass. Another industrial demonstration with an annual CO_2 fixation capacity of 1000 tons by microalgae has been built in Yantai of Shandong Province. This project directly uses original flue-gas CO_2 with $\leqslant$12% concentration from coal-fired power plants for cultivating Nannochloropsis biomass. Several central state-owned enterprises including China Resources Co., Ltd. and Guangdong Energy Group Co., Ltd. have largely invested in CO_2 reduction projects with microalgae from coal-fired flue-gas. The commercial operation of flue-gas CO_2 reduction with microalgae has been realized to sell microalgae biomass as nutritious food, functional feed and organic fertilizer. This brings significant environmental, social and economic benefits to green sustainable development.

Konishi Satoshi

Emeritus Professor, Kyoto University
Founder, Chief Fusioneer, Kyoto Fusioneering Ltd.

Konishi Satoshi graduated from the University of Tokyo in 1979. He continued study in the Graduate School of Engineering, the University of Tokyo and started his carrier in the Japan Atomic Energy Research Institute in 1981. In 2003 he became the Professor of the Institute of Advanced Energy in Kyoto University, and worked till his retirement in 2022. He also took a responsibility of the Director of the Unit for Sustainability Science, where 7 institutes and schools in the university have organized the interdisciplinary studies on the sustainable development. He worked as the Board Member of Atomic Energy Society of Japan and Japan Society of Plasma Science and Nuclear Fusion Research, and also assigned as the Committee Member of American Nuclear Society Fusion Energy Division. He served as the Editor of *Fusion Engineering and Design* for 10 years. He has been involved in the International Thermonuclear Experimental Reactor (ITER) project since 1980s, and chaired the ITER Test Blanket Module Program Committee of the ITER Council for four years and still serves as the Representative of Japanese government. He founded Kyoto Fusioneering Ltd. in 2019. His major is fusion engineering, covering fusion energy conversion, tritium processing, blanket, diverter and in-vessel components, plant engineering, socio-economic, and environmental and safety assessments.

Title: Fusion Business-a New Trend of Fusion Development and the Role of Startups

Fusion has been studied as a national project in the world until recently. However, a number of start-up companies were founded in the past 20 year, and rapid progress has been observed in the development of commercial fusion energy. Kyoto Fusioneering Ltd., the first company with the aim of commercializing fusion energy and its industrialization, was established in October 2019 in Japan. This report will discuss the role of start-up companies in the current development of fusion engineering and its methodology based on a concrete example of this company.

Lu Yingying

Professor, College of Chemical and Biological Engineering, Zhejiang University

Lu Yingying received her Ph.D. in Chemical and Biomolecular Engineering at Cornell University in 2014. Then she worked as the Postdoctoral Researcher in the Department of Materials Science and Engineering at Stanford University from 2014 to 2015. She joined Zhejiang University as the Tenure-track Professor in 2015 and became the Professor in 2022. She also serves as the Young Director of Chinese Society of Particuology, and the Editorial Board of *The Chinese Journal of Process Engineering*, *Green Energy & Environment*, etc. She received the Qiu Shi Outstanding Young Scholar Award from the Qiu Shi Science & Technologies Foundation, Hong Kong in 2018. Her research interests include electrolyte design in secondary batteries and materials design for solving safety problems in lithium-based batteries. She has published several SCI journal papers in *Nat. Mater.*, *Sci. Adv.*, *Nat. Commun.*, etc.

Title: Stabilization of Lithium Electrodeposition via Enhanced Lithium-ion Transport Properties at the Electrode/Electrolyte Interface

Abstract

High energy and safe electrochemical storage is a critical component in multiple emerging fields of technology where portability is a requirement for performance and large-scale deployment. From advanced robotics, autonomous aircraft to hybrid electric vehicles, increasing number of technologies are demanding advanced electrochemical storage solutions. The rechargeable Lithium Ion Battery (LIB) has received considerable attention because of its high operating voltages, low internal resistance and minimal memory effects. Unfortunately LIBs are currently operating close to their theoretical performance limits due to the relatively low capacity of the anode LiC_6 and the lithiated cathode materials ($LiCoO_2$ and $LiFePO_4$) in widespread commercial use. It has long been understood that a rechargeable Lithium Metal Battery (LMB), which eschews the use of a carbon host at the anode can lead to as much as a ten-fold improvement in anode storage capacity, and would open up opportunities for high energy un-lithiated cathode materials such as sulfur and oxygen. Together, these advances would lead to rechargeable batteries with step-change improvements in storage capacity relative to today's state of the art LIBs.

A grand challenge in the field concerns the development of electrolytes, electrode, and battery system configurations that prevent uneven electrodeposition of lithium and other metal anodes, and thereby eliminate dendrites at the nucleation step. LIBs are designed to remove these risks by hosting the lithium in a conductive carbon host at the anode. However, the small potential difference that lithium inserting into or plating onto carbon can potentially lead to similar failure modes in an overcharged or too quickly charged LIB. Thus, the need for materials that prevent non-uniform electrodeposition of metals such as Li is also implicit in new fast charging LIB technology targeted for electric-drive vehicles.

Jang Hye-young

Professor, Department of Energy Systems Research, Ajou University

Jang Hye-young is the Department Chair and the Leader of Carbon-zero Renewable Energy Program of the 4th Brain Korea 21. She received her bachelor's degree in Chemistry and master's degree in Inorganic Chemistry from Seoul National University. She received her Ph.D. in Organic Chemistry from the University of Texas at Austin in 2005. Her research group has been developing new sustainable catalytic processes using renewable resources such as CO, CO_2, and biomass. Her research results have been published in internationally renowned journals such as *ACS Sustainable Chem. Eng.*, *J. Org. Chem.*, *Catalysts*, etc.

Title: Sustainable Catalysis for the Chemical Conversion of CO_2

Abstract

Due to the global warming induced by increased CO_2 concentration in the air, chemical reactions converting non-fossil fuel-based feedstock to value-added chemicals have received significant attention, resulting in the development of sustainable catalysis using renewable resources.

The catalytic activity of transition-metal catalysts is modulated by varying the ligand around the metal ion. Since we have developed the carbon-coordinating ligands, N-heterocyclic carbenes (NHC), multi-dentate NHC ligands were attempted to form complexes with iridium ions and copper ions. Because NHC ligands are strong electron donors, NHC-coordinated metal catalysts show the electron-rich property and stability during the catalytic reaction. To use the unique property of NHC ligands, we synthesized bisNHC and triNHC ligand-coordinated metal complexes. In this presentation, we would like to show the Ir(bisNHC) and Ir(triNHC)-catalyzed transfer hydrogenation of CO_2 and Cu(triNHC)-catalyzed synthesis of carbonates and carbamates using CO_2.

Ir-NHC-catalyzed transfer hydrogenation of sustainable C1 sources with a green hydrogen source, glycerol, was conducted to form formate and lactate with high Turnover Numbers (TONs). Ir catalysts modified with various bisNHC ligands and triNHC ligands were employed, and the structure of NHC ligands and the reaction conditions affected the TONs of products. Discrete Fourier Transform (DFT) calculations were conducted to propose the reaction mechanism and exploit the correlation between ligand structure and catalytic activity.

Cu(triNHC)-catalyzed fixation of CO_2 with alcohols and amines was conducted to afford various carbonates and carbamates with good yields. Synthetically challenged direct reaction of alcohols and amines with CO_2 was realized by the protocol involving α-alkylidene carbonates. The reaction mechanism, including the dissociation of one of the carbene ligands from the Cu(triNHC) complex, was presented along with mechanistic study results.

Bahareh Kamranzad

Assistant Professor, the Hakubi Center for Advanced Research, Kyoto University

Bahareh Kamranzad is the Assistant Professor of the Hakubi Center for Advanced Research and Graduate School of Advanced Integrated Studies in Human Survivability (GSAIS), Kyoto University, the Visiting Researcher of the Faculty of Natural Sciences, Imperial College London, and the Co-founder and Chair of the International Integrated Wave Energy Research (IIWER) Group. Her major is Coastal Engineering, and her research activities focus on climate change impacts, ocean renewable energies, ocean dynamics, wave modeling, coastal protection, and extreme events, using various methods such as numerical modeling and Machine Learning (ML). She has achieved highly competitive positions, including Japan Society for the Promotion of Science (JSPS) Postdoctoral Research Fellowship, and Hakubi Global Type faculty position at Kyoto University, and has secured several national and international competitive fundings for her projects as the Principal Investigator.

Title: Energy Transition with Ocean Renewable Energies

Abstract

The energy crisis in the world and the consequences of global warming and climate change due to the usage of fossil fuels have led many countries to commit to net-zero emissions by the near future. For this purpose, renewable energies have become more attractive for researchers, developers, investors, and decision-makers, while efforts to reduce costs and increase efficiency are still ongoing. Ocean Renewable Energies (OREs) such as wind, wave, tidal, current, salinity gradient (blue energy) and ocean thermal energy conversion are infinite and predictable energy sources in the areas exposed to open water bodies and oceans, and hence, can be a promising alternative to fossil fuels. Such areas range from major cities to remote islands, where the energy supply is challenging for the growing population.

Although OREs are advantageous in reducing the negative impacts of climate change, they are highly affected by climate change. Climate change will alter atmospheric and oceanic conditions and their interaction by changing temperature, wind patterns, and, consequently, wave climate and sea-level rise. Hence, resource assessment can be associated with uncertainties due to climate change. It is crucial to consider the impact of changing climate in line with Sustainable Development Goals (SDGs).

Virtual Research and Roundtable Discussion Attendees

Fang Kai

Senior Researcher, Zhejiang Energy R&D

Fang Kai studied in Refrigeration and Cryogenic Engineering at Zhejiang University since 2005, and got his Ph.D. in 2015. From 2016 to 2020, he was employed in SUMUTOMO Heavy Industries in Japan, working on the development of cryogenic system and 4K cryocooler. He returned to China in 2021, and joined Zhejiang Energy R&D, working on the development of hydrogen liquefaction, LH_2 storage and transportation technology.

Okada Yoshimi

Fellow, Chiyoda Corporation

Okada Yoshimi is the Visiting Professor of Yokohama National University and the Board Member of Hydrogen Energy Systems Society of Japan. He received his Bachelor's and master's degree at Yokohama National University, and entered Chiyoda Corporation in 1986. He worked at R&D Center as the Researcher for 27 years majored in catalyst development. In 2005, he received his Ph.D. from Yokohama National University. He has worked for the development of Liquid Organic Hydrogen Carrier (LOHC) system for massive hydrogen storage and transportation technology from 2002, and succeeded novel dehydrogenation catalyst for Methylcyclohexane (MCH). Chiyoda Corporation established the system technology through the pilot demonstration in 2014, and the system named SPERA Hydrogen^{TM} system. It is progressed to the commercialization phase through the completion of an international hydrogen supply chain project in which more than 100 tons of hydrogen was transported from Brunei Darussalam to Kawasaki, Japan in 2020 successfully. His work is awarded as the Jules Verne Award from International Association for Hydrogen Energy, the Japan Institute of Energy (JIE) Award in Technical Division, and the Nikkei Global Environmental Technology Award, etc.

Agamuthu Pariatamby

Associate Dean, School of Interdisciplinary Studies, Sunway University
Visiting Professor, Zhejiang University of Technology

Agamutu Pariatamby is the Professor at the Jeffrey Sachs Center on Sustainable Development specializing in Solid and Hazardous Waste Management. Before joining Sunway University, he spent 44 years as the Senior Professor at University of Malaya. He is also the Vice President and International Advisory Board Member of the Society of Solid Waste Management Experts in Asia and Pacific Islands (SWAPI), the Fellow of the Academy of Sciences, Malaysia, the Chairman of the Organization for Climate Change (OFCC), the Honorary Life Member of International Solid Waste Association (ISWA), and the Member of the DeTao Masters Academy. He serves as the Senior Editor in Chief of *Waste Management & Research*, and the Editor of *Journal of Material Cycles and Waste Management*.

Wu Xuecheng

Director, Energy and Environmental Engineering Laboratory, Zhejiang University

Wu Xuecheng is the Professor and Doctoral Supervisor of Zhejiang University. He is the President of the Energy Design and Research Institute of Zhejiang University, and the President of the Energy Branch of Zhejiang University, Ningbo. He also serves as the Young Director of Chinese Society of Particuology, and the Executive Director of Zhejiang Society of Engineering Thermophysics. His main research interests include complex multiphase flow and reaction system testing and diagnosis, flue gas pollutant monitoring and technical evaluation, and energy utilization process operation monitoring and optimization. He has been in charge of more than 40 scientific research projects, such as projects of the National Key R&D Program of China, projects of the National Natural Science Foundation of China, and enterprise joint R&D projects. He has been granted more than 20 national patents, published 1 monograph and more than 150 peer-review papers, and participated in the compilation of 4 National Standards and 1 Association Standard. He has been awarded multiple national and provincial Teaching and Scientific Research Achievement Awards, and won the Youth Award of Chinese Society of Particuology.

Yabutsuka Takeshi

Junior Associate Professor, Graduate School of Energy Science, Kyoto University

Yabutsuka Takeshi was the Assistant Professor from 2009 to 2021 in the Graduate School of Energy Science, Kyoto University before becoming the Junior Associate Professor. He specializes in inorganic solid-state materials chemistry, including ceramic biomaterial science. In recent years, he has been awarded several academic awards, including the Encouragement Award of Japanese Association of Inorganic Phosphorus Chemistry, the GC Corporation Award of the Japanese Society for Dental Materials and Devices, and so on. In addition, he has held several academic symposiums, including the 24th Symposium on Ceramics in Medicine, Biology, and Biomimetic, and the Special Session on Advanced Ceramic Biomaterials in the Ceramic Society of Japan Fall Meetings as the Representative Organizer. He focuses on the materials process of that inorganic bio-tissue, including calcium phosphate, is spontaneously synthesized at ordinary temperature and pressure in living organisms, and is working on the development of biomimetic ceramic materials and their composite with metallic and polymeric ones that can express various material functions in a biological environment for environmental and biomedical applications.

Chen Linghong

Professor, College of Energy Engineering, Zhejiang University
Director, International Cooperation Center, College of Energy engineering, Zhejiang University

Chen Linghong is the Professor and Doctoral Supervisor of Zhejiang University. She serves as the Member of the Professional Committee of Ozone Pollution Control of Chinese Society for Environmental Sciences, the Council Member of Zhejiang Society for Electric Power, and the Executive Manager and Deputy Secretary General of Hangzhou Society for Environmental Sciences. She has visited the University of Tennessee, U.S. Environmental Protection Agency, CORIA National Laboratory, Lund University, KTH Royal Institute of Technology, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and University of Patras for academic exchanges. She has long been engaged in fundamental research on clean combustion of fossil energy, formation mechanism and laser diagnostics of PM2.5 and related pollutants, prevention and control of air pollution, and carbon reduction. She has published more than 70 academic papers, hosted and participated in more than 30 projects of scientific research, including National Key R&D Program of China, 973 Program, the National Natural Science Foundation of China, Consultative Project by Chinese Academy of Engineering, Provincial Key R&D Program, etc. She has obtained more than 10 national invention patents and software copyrights.

Okazaki Yutaka

Assistant Professor, Graduate School of Energy Science, Kyoto University

Okazaki Yutaka got his master's degree in 2010 at Kumamoto University. He was then engaged in the research of thermosetting polymers in Nippon Steel Chemical Co., Ltd. He started doctor course in 2013 and got his Ph.D. in 2016 at Kumamoto University. He worked as the Japan Society for the Promotion of Science (JSPS) Research Fellow at Kumamoto University, and as the JSPS Oversea Research Fellow at University of Bordeaux. His research interests are molecular assembly, nano-fabrication, chirality induction, circular polarization, and light energy conversion.

Zheng Chenghang

Professor, College of Energy Engineering, Zhejiang University

Zheng Chenghang was selected as the Young Scholar of Chang Jiang Scholar Award Program. He serves as the Deputy Director of the National Environmental Protection Coal-fired Air Pollution Control Engineering Technology Center, the Associate Editor of *Frontiers in Energy Research*, the Associate Editor of *Power Science & Technology and Environmental Protection*, and the Reviewer of *Environmental Science & Technology* and *Applied Energy*. He is interested in Ultra-low emission of multiple pollutants from flue gas, efficient removal of flue gas pollutants and greenhouse gases, low-carbon power generation system and its intelligent regulation method. He has published over 140 SCI peer-reviewed papers, 30 authorized patents and 10 industrial standards. He has won the first prize of the National Technology Invention Award, the first prize of China Machinery Industry Science and Technology Award, the Golden Award of Patent of Zhejiang Province, etc.

Wang Zhihua

Professor, College of Energy Engineering, Zhejiang University

Wang Zhihua received his Ph.D. from Zhejiang University in 2005, and his doctoral thesis was nominated as the National Outstanding Doctoral Dissertation in 2008. He was awarded the National Science Fund for Distinguished Young Scholars in 2021 and the National Natural Science Outstanding Youth Fund in 2014. He is mainly engaged in the research of clean combustion and emission control of coal and gaseous fuels, laser diagnostic for combustion and hydrogen energy. He has undertaken more than 10 projects of the 863 Program, the National Natural Science Foundation of China, the 973 Program, the Zhejiang Provincial Natural Science Foundation, etc. He is holding more than 20 patents. He has published 3 monographs, and more than 220 SCI peer-reviewed journal papers with totally citation over 7900 times, H index 44, and 3 ESI high cited papers. .

Shi Jianfeng

Professor, College of Energy Engineering, Zhejiang University

Shi Jianfeng is the Young Scholar of Chang Jiang Scholar Award Program. He serves as the Deputy Director of Chemical Machinery Research Institute of Zhejiang University, the Director of the Professional Committee of Experimental Mechanics of Zhejiang Mechanical Society, the Secretary General of High Pressure Process Equipment and Safety Engineering Research Center, the Senior Member of Chinese Mechanical Engineering Society, etc. As the Person in Charge, he has undertaken more than 30 vertical and horizontal projects such as the National Key R&D Program of China. He has been engaged in design, manufacture and non-destructive safety evaluation of non-metallic and composite pressure-bearing equipment, safety of hydrogen energy storage and transmission equipment, and extremes and intelligence of non-metallic pressure-bearing equipment.

Liang Chu

Assistant Dean, Professor, Zhejiang Carbon Neutral Innovation Institute, Zhejiang University of Technology

Liang Chu worked as the Visiting Scholar at the University of Maryland, College Park, USA from 2018 to 2019. He served as the Lead Guest Editor of *Journal of Chemistry* and the Guest Associate Editor of *Frontiers in Chemistry*. He has been employed as the Guest Professor of the State Key Laboratory of Silicon Materials, Zhejiang University since 2020. His research interests include solid-state hydrogen storage materials of light metal hydrides and complex hydrides, key materials for the secondary batteries, and chemical conversion of CO_2 and its applications. He has published more than 130 academic papers and holds more than 50 authorized invent patents in China.

Jiang Fangdan

Director, Technology Research Institute of CSI Solar

Jiang Fangdan received his bachelor's degree and Ph.D. in Materials Science and Engineering from Tsinghua University. He was serving as the Postdoctoral Researcher in Tokyo Institute of Technology from 2008 to 2009. Since joining the photovoltaic industry in 2009, he has focused on developing high efficiency and low cost crystalline silicon photovoltaic cell technology. He joins CSI Solar Co., Ltd. since 2016, and is in charge of numerous technical projects including mono-Si and multi-Si Passivated Emitter and Rear Cell (PERC), bifacial cells, n-type cells, etc. He is also working on next generation Heterojunction with Intrinsic Thin-layer (HJT) cell technology and perovskite technology. He is the Subject Leader of one project of National Key R&D Program of China, and also the Registered Expert of International Electrotechnical Commission Technical Committee 82 (IEC TC 82) work group, leading the development of 2 important IEC standards on Si photovoltaic cells.

Zhang Xiao

Professor, College of Energy Engineering, Zhejiang University

Zhang Xiao is the "Hundred-Talent Program" Research Fellow of the College of Energy Engineering, Zhejiang University. He serves as the Member of the Professional Committee of Environment and Thermal Energy Utilization of Chinese Society for Environmental Sciences. He received his bachelor's degree from Tsinghua University in 2012 and his Ph.D. from Duke University in 2017. Afterwards, he worked at Stanford University as the Postdoctoral Researcher until joining Zhejiang University in 2020. His research focuses on catalytic CO_2 conversion, air pollutant control, and water electrolysis. He has published several papers as the first or corresponding author on high-impact journals, including *Nat. Energy*, *Nat. Commun.*, *J. Am. Chem. Soc.*, *J. Mater. Chem. A*, *Nano Lett.*, and *CCS Chem.*, and been invited as speakers for international conferences.

Yan Mi

Associate Dean, Associate Professor, Zhejiang Carbon Neutral Innovation Institute, Zhejiang University of Technology

Yan Mi received his Ph.D. from Zhejiang University in 2012. He spend one year in Columbia University in the City of New York as the visiting student during his Ph.D. study. After graduation, he started career in Zhejiang University of Technology, and became the Associate Professor in 2016. He serves as the Editorial Board of international journals such as *Waste Management & Research* and *Waste Disposal & Sustainable Energy*. Since 2007, he has been engaged in research of converting organic solid waste into energy and fuel, including municipal solid waste incineration, supercritical water gasification of sludge and food waste, and syngas purification by CO_2 capture. He has trained 7 international graduate students. His research is granted by over 10 provincial and ministerial scientific projects. In the past five years, he has published 49 SCI papers as the first or corresponding author, with a cumulative impact factor of over 290, including 2 highly cited papers.

Wang Lei

Professor, College of Energy Engineering, Zhejiang University

Wang Lei is the "Hundred-Talent Program" Research Fellow, the National Excellent Young Scholar, and the Humboldt Fellow of the College of Energy Engineering, Zhejiang University. He obtained his Ph.D. from The Hong Kong Polytechnic University in 2018. His research interests include sustainable waste-to-energy technologies, low carbon hazardous waste treatment, CO_2 sequestration and utilization in minerals. He has published 5 hot papers, 15 highly cited papers, 1 co-edited book, 6 contributed chapters and over 70 SCI journal papers, including more than 40 papers as the first or corresponding author. He serves as the Associate Editor of *Soil Use and Manage.*, the Editorial Board of *J. Hazard. Mater.*, and the Guest Editor of 9 leading SCI journals. He is recognized as the Top Peer Reviewer by Publons and the Outstanding Reviewer by Elsevier.

Takada Masatsugu

Assistant Professor, Tokyo University of Agriculture and Technology

Takada Masatsugu received his Ph.D. in Energy Science from Kyoto University in 2017. After one year of postdoctoral research at Kyoto University and two years at University of British Columbia in Canada, respectively, he worked as the Program-specific Assistant Professor at Kyoto University. Then he moved to Tokyo University of Agriculture and Technology in 2022. His research interest focuses on the conversion of biomass cell wall component into energy and valuable materials, especially the lignin.

Zhang Hao

Research Associate Professor, State Key Laboratory of Clean Energy Utilization, Zhejiang University

Zhang Hao received his Ph.D. in 2016 and then worked as the Postdoctoral Researcher from 2017 to 2019 at Zhejiang University. He joined the group of Professor Katharina Kohse-Höinghaus at Bielefeld University as the Humboldt Fellow from 2019 to 2020, and continued his research at German Aerospace Center from 2020 to 2022. His research interests cover from the utilization of greenhouse gases and municipal solid waste, plasma chemistry, combustion chemistry, etc. He has been granted several national projects from the Alexander von Humboldt Foundation, the National Natural Science Foundation of China, the National Key R&D Program of China, etc. He has published over 50 high quality peer-reviewed journal papers in leading journals such as *Chem. Eng. J.*, *J. Hazard. Mater.*, and *Combust. Flame*, with 26 as the first or corresponding author, 1 as the ESI Hot & Highly Cited paper, and 1 as the supplemental cover paper. He is also the Reviewer of over 20 international journals and recognized as the Outstanding Reviewer of *Chem. Eng. J.* in 2018. He also served as the Guest Editor or Editor of several international journals including *Energies* and *Green Energy and Resources*. Moreover, he has 10 granted patents, among which 1 has been valorized.