Current Status and Future Perspectives of Clean Energy Technology Innovation in DICP, CAS

Zhongmin LIU

Dalian Institute of Chemical Physics (DICP), Chinese Academy of Sciences (CAS), China

1. Introduction

Energy is the material basis for the survival and development of a country. Sustainable high-quality development of the economic society with the green transformation of energy resources is a long-term and tough task. The construction of clean, lowcarbon, safe and highly efficient energy system is an important strategic goal putting forward by the government for the future energy development of China, while technological innovation is the key to such goal.

2. R&D activities related to clean energy technology

Based on the analysis of Chinese energy development status, major problems and great challenges, combining with global energy development trends, a new idea on the development strategy of energy technology of China is proposed, the main line of which is the clean and efficient use of fossil resources and coupling substitution, multi-energy complementarity and scale application of clean energy, and the low-carbon multi-energy strategic integration.

3. Specific research activities in hydrogen, CCUS, and related technologies

Hydrogen is a clean secondary energy carrier, and hydrogen fuel cells (FC) have the advantages of high fuel energy conversion rate, low noise, and zero emission. Hydrogen is also a bridge between renewable energy and traditional fossil energy, via hydrogen fuel cells, the blueprint of clean energy utilization can be realized in the future. The major developed countries in the world have paid great attention to the development of hydrogen energy. China has followed the footsteps of developed countries in the world to innovate in hydrogen production, hydrogen storage, and hydrogen perfusion. However, the imperfect hydrogen and fuel cell industrial chain leads to high cost. Therefore, it is necessary to strengthen research on key materials, realize the engineering and localization of core materials and components, establish production lines, and complete the industrial chain as soon as possible.

The CO_2 utilization technologies are developed rapidly in China. Fossil energy coupled with CO_2 conversion and utilization technology, which has experienced rapid growth in recent years due to the easy access and low cost of fossil energy, will bring huge carbon emission reduction potential and economic benefits in the near future. Meanwhile, nuclear/renewable energy assisted CO_2 to fuel and chemicals technology, boosted by the advancement of zero-carbon power generation technologies, promises to be one of the most competitive controllable CO_2 reduction technologies in the medium term. Solar-driven CO_2 conversion technology, which can realize the ecological carbon cycle, is expected to be the most promising CO_2 reduction technology in the long run.

Related programs/projects conducted by the institute

- Strategic Priority Research Program of Chinese Academy Science/ Hydrogen/liquid fuel from renewable energy (2018-2023)
- Strategic Priority Research Program of Chinese Academy Science/Non-Electric Applications of Nuclear Energy (2018-2023)

- Strategic Priority Research Program of Chinese Academy Science/ 100% Renewable Energy Application Demonstration (2018-2023)
- Strategic Priority Research Program of Chinese Academy Science/Key technologies and demonstration of renewable energy (2018-2023)

4. International collaboration

4-1 International alliance/networking development

DICP is an internationally well connected institution.Through academic communication, personnel exchange, students cultivation, joint projects, symposium and conferences, DICP is tightly cooperated with universities, institutions and companies around the world. Today DICP's faculty members are playing active roles in more than 100 international academic communities. DICP has also established strategic partnerships with internationally well-established research institutions and companies. With industry, DICP has built with BP the DICP-BP Energy Innovation Laboratory and with SABIC the DICP-SABIC Research Center for Advanced Chemical Production Technology. In addition, DICP has strong collaborations with many international institutions, such as the French National Scientific Research Center, the Queen's University Belfast, and the Netherland's Association for Applied Science, etc.

DICP is willing to work together with politicians, scientists, engineers, managers all over the world at the forefront of energy, for exploring the pathway to energy future in an international perspective.

4-2 International joint R&D activities

DICP is conducting energy related researches with partners all over the world in the field of fundamental and applied research. The topics cover a wide range of fields, including bio-Fuels, solar energy and solar fuels, energy storage, fuel cell, hydrogen generation and storage, catalytic process for fossil energy utilization, etc.

Related programs conducted in the institute

- Efficient Utilization of Heat and Electric power from Renewable Energy in Urban Areas Mediated by Hydrogen Energy Project（2016-2019）

5. Future perspectives

A global transition to a clean, efficient and diverse energy system is accelerating. China is calling energy technology revolution for industrial upgrade and sustainable development. As an institute with long history of conducting energy research, DICP puts best efforts to promote the development of energy technology to meet national strategic demands. With establishing the CAS Innovation Center for Clean Energy, DICP has integrated laboratories across CAS institutions to form a strong S&T union in the field of clean energy. Through the efforts of making breakthroughs and demonstrations of transformational and key technologies we will provide cutting-edge theories and technologies to realize the integrated development of fossil energy, renewable energy,and nuclear energy for a clean, low carbon, safe and highly efficient energy system. These approaches will also lay a foundation for the application and establishment of the National Laboratory for Clean Energy. Moving forward, DICP keeps focusing on sustainable energy research and aims to play an indispensable role in national economy and security, and to become a leading research institute in the world.

Prof. Zhongmin LIU

2019 Vice President, Executive committee, International Zeolites Association
2017 Director General, Dalian Institute of Chemical Physics (DICP) and Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT),CAS (Current)
2015 Academician, Chinese Academy of Engineering
2011 Director, National Energy Low-carbon Catalysis and Engineering R&D center (Current)
2008 Director, National Engineering Laboratory for Methanol to Olefins (Current)
2008 Deputy Director General, Dalian Institute of Chemical Physics, CAS
1996 Professor, Dalian Institute of Chemical Physics, CAS
1994 Associate professor, Dalian Institute of Chemical Physics, CAS
1991 Assistant professor, Dalian Institute of Chemical Physics, CAS

Research interests:

- Catalysis and New Catalytic Reactions
- Molecular Sieves Synthesis
- Methanol & Derivatives Conversion Technologies
- Syngas Conversion
- Hydrocarbon Conversion Research
- Multiphase Catalytic Process Development and Scale-up
- Engineering R&D

Major Honors
2018 Professional Achievement Award for Innovations in Green Process Engineering by AIChE
2017 National Innovation Competition Awards
2017 The 6th Chinese Catalytic Achievement Award in
2015 The Science and Technology Innovation Award of 2015 HLHL Foundation
2014 The state Technological Invention Awards First Prize on “The technology of methanol to olefins (DMTO)”
2013 The China Petroleum and Chemical Industry Federation (CPCIF) Science and technology Progress Award (special class) on “Sets of Industrial Technology Development and Application in Demonstration Project of Coal to Olefin in Baotou”
2012 National Engineering Laboratory for Methanol to Olefins won the state Innovative Talents Promoting Plan in Key Area
2011 The research group for methanol to olefins won Outstanding Science and Technology Research Achievement Prize of the Chinese Academy of Sciences

2011 "Approaching Commercialization of the Technology of Olefins Manufacturing from Coal Instead of Oil" was picked out as one of Top Ten “Science and Technology Progress News" of China
2011 The China Petroleum and Chemical Industry Federation (CPCIF) Technology Invention Award (special class) on " DMTO technology"
2011 The 13th China Patent Award of "Method for Producing Light Olefin from Methanol or/and Dimetyl Ether（ZL200710064232.3）"
2009 The first class Technology Invention Award on "catalyst for DMTO technology" by Dalian Municipality Government
2008 The first class Science and Technology Progress Award on “DMTO technology” by Liaoning Province Government
2008 The first class Technology Invention Award on “The Technology of Solid Acid Catalysis Pressure Propylene Hydration Isopropanol” by Dalian Municipality Government

Academic Background
1983, B.S., Chemistry,Zhengzhou University
1986, M.S., Chemical Physics, Dalian Institute of Chemical Physics, CAS
1990, Ph.D., Chemical Physics, Dalian Institute of Chemical Physics, CAS