

Preface to special issue on “Advanced Materials and Catalysis”

Zhong-Yong Yuan (✉)

School of Materials Science and Engineering, Nankai University, Tianjin 300350, China

© Higher Education Press 2021

Advanced materials and catalysis have attracted increasing attention in recent years, particularly due to the rapid development and great progress in energy and environmental areas. It is well acknowledged that the key to mitigating energy crisis, ameliorating global environment and improving the life quality of people is to explore green and renewable energy resources, in which catalysis plays a significant role. Over the past years, besides the conventional thermocatalysis, both electrocatalysis and photocatalysis have been developing rapidly. And numerous advanced materials have been designed and applied in the catalysis fields for energy storage and conversion, such as hydrogen production, fuel batteries and secondary batteries, oil refining, pollutant degradation, ammonia synthesis, greenhouse gases conversion, and so on. The emergence of new advanced materials provides new insights and opportunities for the development of catalysis. Hence, *Frontiers of Chemical Science and Engineering*, one of the transactions of Chinese Academy of Engineering, organized this special issue aiming to showcase some of the prominent achievements and progress made in the relevant research fields. This special issue is also dedicated to Professor Hexuan Li (Fig. 1) on the occasion of his 95th birthday, recognizing his distinguished contributions to many aspects in the field of advanced materials and catalysis.



Fig. 1 Professor Hexuan Li lecturing on the occasion of his 90th birthday.

Professor Hexuan Li was born in November, 1926 in Changsha, Hunan Province. He received his B.Sc. degree in Chemistry in 1952 from Nankai University, and then joined the faculty of the same University. In 1956 he went abroad to the Soviet Union for graduate study, and obtained his doctoral degree from Lomonosov Moscow State University in 1960. Then he established the Laboratory of Catalysis and Kinetics in the Department of Chemistry, Nankai University, mainly carrying out heterogeneous catalysis research. He was promoted to Associate Professor in 1978, and then full Professor in 1983, and served as the dean of Department of Chemistry during 1983–1986. He was the

member of the Catalysis Committee of the Chinese Chemical Society, the committee member of Chinese Zeolite Association, and the molecular sieve group member of the Petroleum Refining Society of China Petroleum Institute. He has served as editorial board members of a number of journals including *Chinese Journal of Catalysis*, *Chinese Journal of Molecular Catalysis*, and *Speciality Petrochemicals*.

Professor Li's research has focused on the synthesis and modification of zeolites and their applications in catalysis. He and his co-workers made great contributions to the fabrication of several new zeolites, mesostructured materials, phosphate molecular sieves, heteroatom-incorporated zeolites, zeolite membranes and ultrafine zeolites. In order to examine the zeolite modification methods and verify the influence of surface properties on the catalytic activities, Professor Li proposed and developed a series of new characterization approaches to corroborate the change of valence state of aluminum and the existence type of acid sites by solid-state nuclear magnetic resonance (NMR) technologies, providing both theoretical and practical tools for the design of new zeolite catalysts. Impressively, in the 1980s, Professor Hexuan Li and Professor Shouhe Xiang invented the template-free synthesis of zeolite ZSM-5 in the absence of any alcohol, amine and other nitrogen containing compounds, which remarkably prompted the industrialization of zeolites in an environmentally friendly way. The synthesis route has been in use in the industrial production of ZSM-5 zeolites since then, and various zeolite catalysts have been developed and commercially applied elsewhere.

Professor Li devoted his scientific enthusiasm to the development of zeolite materials and catalysis. He led and managed numerous big projects, including two major programs and one key program of National Natural Science Foundation of China on the basic research of zeolite catalysis, as well as other key research projects from Chinese ministries and commissions, making a series of distinctive research achievements. He has published nearly 200 research papers in well-known academic journals, and 14 authorized patents. Six inventions have been used in industrial production, creating remarkable economic return and social benefits. Due to his great contributions in these fields, he received a number of prizes and honors. He was rewarded by the First Prize of Science and Technology Achievements of Tianjin in 1982, the Second Prize of National Technological Invention in 1985, and the Top-Ten Patent Award of Tianjin in 1989 for the new synthesis method of NKF molecular sieves (ZSM-5 zeolite). He also won many other awards by inventing a lot of novel catalysts, such as NKC-01 catalyst for the synthesis of glycol ether (awarded as the Second Prize for Scientific and Technological Progress of the State Education Commission), NKC-03A catalyst for ethanol dehydration to ethylene (awarded as the Fourth Prize of National Technological Invention), NKC-8912 catalyst for the alkylation of ethylbenzene with ethanol to p-diethylbenzene (awarded as the Fourth Prize of National Technological Invention) and NKC-5 catalyst for C5 aromatization (recognized as National New Production in 1995 by the State Scientific and Technological Commission and the State Development Planning Commission). Those zeolite catalysts have been applied in industrial production and acquired significant economic benefits, which were selected as the first batch of outstanding achievements of NSFC-supported projects. In 1990, Professor Hexuan Li was recognized as "National Advanced Scientific and Technological Worker in Universities" by the National Education Commission and the National Science and Technology Commission.

Professor Li is one of the pioneers in advanced nanoporous materials and catalysis in China. He has also been actively involved in teaching work and discipline development. He mentored many master students, PhD students and postdoctoral fellows, and trained many young academic researchers. In 2006, on the occasion of his 80th birthday, Professor Li and his former students, as well as some catalyst enterprises, jointly donated funds and set up the "LI Hexuan Scholarship" to reward outstanding postgraduates and doctoral candidates, who can demonstrate excellent character and learning skills, and outstanding scientific research work in the catalysis discipline in Nankai University.

This special issue includes six review articles and eight featured research papers, contributed by the former students of Professor Hexuan Li, and his students' students from China and overseas, aiming to present an overview of the wide research interests of Professor Li to some extent, and the current research frontiers and progresses in the field of advanced materials and catalysis. The selected papers in this special issue reveal some new findings and promising aspects of catalysis and advanced materials, such as 1) advanced Li-ion capacitors based on biomass-derived materials, 2) new insights in constructing heteroatom zeolites and hierarchically porous zeolites, 3) novel sulfide nanocomposite systems for photocatalytic degradation and hydrogen production, 4) multifunctional electrocatalysts based on MOFs- or COFs-derived nanocomposites, 5) electrocatalytic hydrogen production from direct seawater splitting, 6) applications of electrocatalysts in treatment of dye wastewater and electrochemical biosensor, 7) carbon materials and other state-of-the-art materials for catalysis, and 8) cluster beam deposition technology for catalysis application.

Finally, we would like to express our sincere gratitude to all the contributors, including the authors and reviewers, as well as the editorial staff of *Frontiers of Chemical Science and Engineering* for their great help and support to make the success of this special issue, and wish Professor Hexuan Li good health and happiness in life.

Guest Editor

Prof. Zhong-Yong Yuan received his PhD degree from Nankai University in 1999. After his postdoctoral research at the Institute of Physics, Chinese Academy of Sciences, he joined the Laboratory of Inorganic Materials Chemistry at the University of Namur, Belgium in 2001. In 2005, he was appointed as a professor at Nankai University. In 2006, he was awarded the “Program for New Century Excellent Talents in University” by the Ministry of Education. In 2016, he was elected as a fellow of the Royal Society of Chemistry. He is now the director of the Institute of New Catalytic Materials Science, Nankai University. He is currently an associate editor of *RSC Advances*, and the editorial board members of several journals. His research interests are mainly focused on the self-assembly of hierarchically nanoporous and nanostructured materials for energy and environmental applications. He has published over 340 peer-reviewed papers with *h*-index of 62, and 1 book.