



Preface of Special Issue on Smart Porous Materials and Catalysis

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“New catalysis, new materials, new technologies”. The development of the discipline of catalysis is inseparable from the progress in materials science and related engineering technologies. At the same time, the continuous development of catalysis promotes the synthesis of new materials and the innovation of new process technologies. The continuous emergence of smart materials and intelligent technologies drives the development of new types of productive forces and also brings new opportunities and challenges to the development of catalytic materials science. Indeed, advanced materials and green catalysis are being increasingly important in solving the energy and environmental issues^[1].

Research on catalytic materials at Nankai University began in the 1970s. Professor Hexuan Li, a renowned physical chemist in China, obtained his doctoral degree from Lomonosov Moscow State University in 1960, and then returned to China to work at Nankai University, where he initiated the research on porous aluminosilicate materials for adsorption, separation and catalysis, and launched a specialized course on *Catalysis and Kinetics*. In 1978, the Laboratory of Catalysis and Kinetics was established under the Department of Chemistry at Nankai University, led by Professor Hexuan Li. The laboratory carried out research on the synthesis, modification and catalysis of zeolite molecular sieves, and actively supported the construction of a university-run catalyst workshop, enabling some of the laboratory's research results to be quickly transformed into productive output. In the 1980s, Professor Hexuan Li and his coworkers invented the template-free synthesis of zeolite ZSM-5 in the absence of any alcohols, amines and other nitrogen containing compounds, which was one of most important achievements and remarkably prompted the industrialization of zeolites in an environmentally friendly way^[2]. The synthesis route has been applied in the industrial production of ZSM-5 zeolites from then until now, and various zeolite catalysts have been developed.

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 studied abroad for his PhD degree in the Soviet Union from 1956 to 1960. He was promoted to Associate Professor in 1978 and then to full Professor in 1983. Professor Li served as the Dean of the Department of Chemistry during 1983–1986 and was qualified as a doctoral supervisor in 1986. He was a member of the Catalysis Committee of the Chinese Chemical Society, a committee member of the Chinese Zeolite Association, and a member of the molecular sieve group of the Petroleum Refining Society of the China Petroleum Institute. He has also served as an editorial board member of a number of journals, including *Chinese Journal of Catalysis*, *Chinese Journal of Molecular Catalysis*, and *Speciality Petrochemicals*. He has made significant achievements in the research on molecular sieve synthesis methods, modification strategies, catalytic principles, and the development of new catalysts. He has published nearly 200 research papers in well-known academic journals and owned fourteen licensed invention patents, in which six have been used in industrial production, creating remarkable economic returns and social benefits. Due to his great contributions in these fields, he received several prizes and honors. He was awarded 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 for inventing a lot of novel catalysts, such as NKC-01 catalyst for the synthesis of glycol ether (awarded the Second Prize for Scientific and Technological Progress of the State Education Commission), NKC-03A catalyst for ethanol dehydration to ethylene (awarded the Fourth Prize of National Technological Invention), NKC-8912 catalyst for the alkylation of ethylbenzene with ethanol to p-diethylbenzene (awarded the Fourth Prize of National Technological Invention), and the NKC-5 catalyst for C5 aromatization (recognized as a National New Production in 1995 by the State Scientific and Technological Commission and the State Development Planning Commission). These zeolite catalysts have been applied in industrial production and have produced significant economic benefits. They were also selected as the first batch of outstanding achievements of NSFC-supported projects. In 1990, Professor Li was recognized as a “National Advanced Scientific and Technological Worker in Universities” by the National Education Commission and



the National Science and Technology Commission. As one of the pioneers in advanced porous materials and catalysis in China, Professor Li was also actively involved in teaching and discipline development. He mentored many master's students, PhD students and postdoctoral fellows, and trained many young academic researchers.

In 1997, the Institute of New Catalytic Materials Science at Nankai University was established. Since then, catalysis research at Nankai University is experiencing rapid development in both fundamental theory and industrial applications^[3]. Nowadays, the research interests have extended from traditional adsorption and catalysis to emerging fields like photocatalysis and electrocatalysis, including: 1) Research on new catalytic materials and efficient energy conversion processes, exploration of new high-efficiency nanoporous catalytic materials and preparation strategies, and catalytic science and technology for carbon-based energy conversion and utilization; 2) New catalytic processes and technologies utilizing solar energy and hydrogen energy, such as photocatalysis, electrocatalysis, photoelectrocatalysis; 3) Environmental materials and environmental catalysis, carrying out research on the preparation and catalytic processes of new materials based on the needs of environmental protection; 4) Resource recycling and comprehensive utilization, including catalytic conversion and utilization of biomass materials, and recycling of waste tires and other wastes, etc.

In 2015, the School of Materials Science and Engineering (MSE) was established at the Jinnan Campus of Nankai University, with the Institute of New Catalytic Materials Science as one of its main units. Currently, MSE at Nankai University is committed to six cutting-edge research areas aligned with China's national strategic priorities. Each area is linked to a specialized academic unit: the Institute of New Energy Material Chemistry, the Institute of New Catalytic Materials Science, the Research Center for Rare Earth and Inorganic Functional Materials, the Research Center for Optical, Electrical, and Magnetic Materials, the Research Center for Carbon Nanotechnology and Polymer Composites, and the Research Center for Photonics and Electronic Materials. MSE has assembled a distinguished faculty team of over 100 scholars, many of whom are among the most accomplished experts in China. According to the latest Essential Science Indicators, MSE-NKU ranks 54th globally (top 0.035%), reflecting its outstanding achievements and growing international academic influence^[4].

This special issue is dedicated to Professor Hexuan Li (Figure 1) on the occasion of his 100th birthday, in recognition of his distinguished contributions to many aspects in the field of advanced materials and catalysis. This themed collection also celebrates the 10th anniversary of MSE at Nankai University, showcasing some of the recent and impactful research frontiers and progress in the field of advanced materials and catalysis, contributed by the faculty and alumni of MSE, and former students of Professor Li. The selected papers in this special collection reveal new findings and promising aspects in catalytic materials, energy materials and smart materials, such as: (1) Advanced carbon electrodes for supercapacitors, (2) UiO series of MOFs and their composites for photocatalytic CO₂ reduction, (3) Engineering of transition metal phosphide-based heterostructures for electrocatalytic water splitting, (4) Advanced catalysts and reaction mechanisms of electrocatalytic alcohol and aldehyde oxidation for sustainable chemical synthesis, (5) Synergistic regulation of lithium nucleation and anion-rich solvation structure via silver trifluoroacetate additive for stable lithium metal anodes, (6) Key requirements for photocatalysts and reactor architectures toward large-scale hydrogen generation, and (7) In-situ mechanical exfoliation of graphite to UV curable graphene/acrylate coatings and their corrosion resistance properties.



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

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 *Smart Materials and Devices*, for their great help and support in making this themed collection a success. We wish Professor Hexuan Li good health and happiness in life, and MSE continued development.

Declarations

Authors contribution

The author contributed solely to the article.

Conflicts of interest

Zhong-Yong Yuan is the Editor-in-Chief of *Smart Materials and Devices*. No other conflicts of interest to declare.

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