

Preface

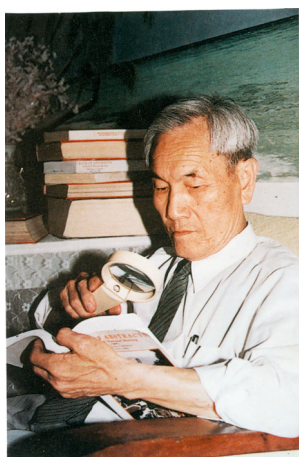


Figure 1 Prof. Khi-Rui Tsai

Prof. Khi-Rui Tsai was born in Tongan (Xiamen, Fujian), in the December of 1913. After graduated from Xiamen University in 1937, he was appointed as an assistant professor of Xiamen University. He was selected as a government-supported oversea student to continue his education in the US in 1947, and obtained his PhD degree in 1950 from the Ohio State University. After the establishment of the People's Republic of China, he overcame

difficulties and returned to Xiamen University in 1956. He established the Teaching and Research Section on Catalysis at Xiamen University, which was the first of such kind sections in all the Universities of China. Prof. Tsai has been working at Xiamen University, and has devoted all his life to catalysis research and teaching. He served as the vice president of Xiamen University, the director of the academic committee of Xiamen University, and the director of the academic committee of the State Key Laboratory of Physical Chemistry of Solid Surfaces. In 1980, he was elected as the academician of the Chinese Academy of Sciences. Prof. Tsai was the member of the Academic Committee of the State Council, the member of Chemistry Department of State Science and Technology Commission. He was also the council member of the International Association of the Catalysis Societies. Prof. Tsai has made outstanding contributions in many aspects to the chemical science, especially catalysis science, including academic research, talent cultivation, academic exchange and other social activities.

The research area of Prof. Khi-Rui Tsai in the early stage was structural chemistry. He studied the crystalline structures of cesium oxide and peroxide, the polarization phenomenon of ionic crystals, the polarization energy, lattice energy and crystal field splitting of barium titanate and



Figure 2 Group photo of National Catalysis School hosted by Xiamen University entrusted by the Ministry of Higher Education (1965). Prof. Khi-Rui Tsai (fourth from the left, first row), Prof. Jiayi Lu (fourth from the right, first row).

layered α - TiCl_3 crystals. These experiences in structural chemistry lay a solid foundation for his later research in catalysis field.

In 1958, a Chinese delegation including Prof. Tsai visited the former Soviet Union for the advanced catalysis research at that time. Inspired by their activities and rapid progress in catalysis, Prof. Tsai started the catalysis research and established the first Teaching and Research Section on Catalysis at Xiamen University. In 1963, he organized the National Catalysis School entrusted by the Ministry of Higher Education, which initiated the teaching and research of catalysis in China.

In 1960s, the state planned to develop the strategy to use acetylene for the “Three Synthetic Materials” because of the lack of crude oil. For this, the Ministry of Chemical Industry issued a mission of “construction of basic organic synthesis routes based on acetylene to solve key issues on the monomer production for synthetic rubber”. Prof. Tsai led his research team to perform excellent studies on the catalytic transformation of acetylene. His studies on the niobium oxide-catalyzed trimerization of acetylene to benzene, the zinc oxide-catalyzed hydration of acetylene to acetaldehyde were published in *SCIENTIA SINICA* and *Acta Chimica*



Figure 3 Prof. Aoqing Tang, Prof. Jiaxi Lu and Prof. Khi-Rui Tsai co-organized a research project on the chemical simulation of nitrogen fixation enzymes in Xiamen (1972).

Sinica.

Prof. Khi-Rui Tsai devoted most of his life to fundamental research on catalysis. In 1964, he developed key concepts for coordination (complexation) catalysis. He systematically elaborated the catalytic functions of transition metal compounds in the activation of the unsaturated organic compounds and carbon monoxide. Prof. Tsai proposed “four effects” in the coordination catalysis, that is, the activation effect by coordination, the selective effect on the reaction direction and the product structure, the enhanced electron transfer effect by the valence-variable active centers and ligands, and the coupling effect of the transfers of electrons and energy. He combined homogeneous catalysis, heterogeneous catalysis and enzymatic catalysis in his research. He was actually one of the founders in studying the catalytic mechanism on a molecular level.

In 1972, under the auspices of Chinese Academy of Sciences, Prof. Khi-Rui Tsai began to study the chemistry of nitrogenase in collaboration with Professors Aoqing Tang and Jiaxi Lu. Prof. Tsai proposed a cluster model for the active center of the nitrogenase as cubane-like structure with active entrance and the enzymatic mechanism for nitrogen activation over multi-core complexes. He correlated the insights gained from the enzyme systems with those from ammonia synthesis over heterogeneous iron catalysts. Combined *in situ* Raman and IR spectroscopic results, his research team detected intermediates from nitrogen in ammonia synthesis and found that the major chemisorbed species was dinitrogen species instead of atomic nitrogen or NH under reaction conditions over iron catalysts. Based on experimental and theoretical studies, Prof. Tsai proposed associated mechanism for the nitrogen activation and the two proton-relay pathways via hydrogen bonding in the nitrogenase system. He also deduced the activation mode with multi-core ligands for the nitrogenase.

Prof. Khi-Rui Tsai actively participated in formulating the State Medium- and Long-term Science and Technology Development Plan. Based on the energy and resource struc-



Figure 4 Prof. Khi-Rui Tsai was delivering concluding statements in a symposium for Fundamental Research on C1 Chemistry, a key project of the National Natural Science Foundation of China (1992).

ture in China, he suggested to utilize the coal and natural gas in Chinese energy and chemical industries. After the first oil crisis, Prof. Tsai submitted a proposal on “integrated utilization of fossil resources” to National People’s Congress in 1982. In 1986, Prof. Tsai organized a cross-institute collaborative project of “Fundamental Research on C1 Chemistry” together with Prof. Shaoyi Peng. His achievements in this area largely promoted the development of C1 chemistry in China.

Prof. Khi-Rui Tsai was also engaged in the studies on the syntheses of methanol and ethanol from syngas, the oxidative coupling of methane and the selective oxidation of lower alkanes. For example, for ethanol synthesis over the Rh-based catalyst, Prof. Tsai proposed a new mechanism involving formyl-methylene-ethenone-acetyl intermediates with sound experimental evidences through isotopic labeling, *in situ* IR and chemical trapping studies.

Prof. Khi-Rui Tsai has published or participated in more than 380 publications and 20 authorized patents. He and his team received many awards including the National Natural Science Awards in 1982, 1988 and 1995.

Prof. Khi-Rui Tsai is not only an outstanding scientist



Figure 5 Prof. Khi-Rui Tsai, Prof. Xiexian Guo, Prof. Enze Min and Prof. E.I. Solomon (Stanford University) in Xiamen (1984).

but also an inspiring educator. Since 1956, Prof. Tsai has supervised more than 70 MSc students, PhD students and post-doctors. The catalysis research team of Xiamen University led by Prof. Tsai was commissioned by the former Ministry of Higher Education, the Ministry of Education and the State Education Commission to organize the national catalysis school, seminars on advanced catalysis and modern catalytic research methods. These programs promoted catalysis research and education in China. He always encouraged young people to be creative. His scientific spirit of believing in truth, keeping innovations is valuable wealth for the younger generation.

In December of 2013, Xiamen University organized a special ceremony and a symposium to celebrate the 100th birthday of Prof. Khi-Rui Tsai and the 55th anniversary of the foundation of catalysis discipline of Xiamen University. We are very much honored to organize a Special Issue to celebrate 100th Birthday of Prof. Khi-Rui Tsai. We take this opportunity to thank all the authors, reviewers, and editors of *Science China Chemistry* for their kind contribution to this Special Issue.

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Huilin Wan Professor of Xiamen University. He graduated from Xiamen University as a graduate student in 1966. He once worked as a visiting scholar in the department of chemistry in Massachusetts Institute of Technology (MIT) from 1982 to 1983. Prof. Wan was elected as the academician of the Chinese Academy of Sciences in 1997. He is currently the director of the faculty of natural science of Xiamen University, and the director of academic committee of science and engineering division of Xiamen University.



Xinhe Bao Professor of Dalian Institute of Chemical Physics, Chinese Academy of Sciences. He graduated from Fudan University in 1982 and received his PhD degree from the same university in 1987. He was a visiting scholar in Fritz-Haber Institute of the Max-Planck Societies during 1989–1995. Prof. Bao was elected as a member of the Chinese Academy of Sciences in 2009. He was the former director of Dalian Institute of Chemical Physics and the president of Shenyang Branch of Chinese Academy of Sciences, and is currently director of the Catalysis Society of China.



Ye Wang Professor of Xiamen University. He graduated from Nanjing University in 1986 and received his PhD degree from Tokyo Institute of Technology in 1996. He worked at Tokyo Institute of Technology, Tohoku University and Hiroshima University during 1997–2000, and was promoted to Associate Professor at Hiroshima University in 2001. He became a Professor of Xiamen University in the August of 2001. Prof. Wang received the National Science Fund for Distinguished Young Scholars in 2006. He is currently the director of Institute of Catalysis Science and Engineering of Xiamen University.