

# Recent catalysis researches in Taiwan

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A brief historical review of the catalysis researches and catalysis society in Taiwan was given, followed by the current and future development. The number of people engaged in catalysis research grew with the development of petrochemical industry in the past three decades. The catalysis research in Taiwan nowadays focuses on two extremes: those correlating to environmental protection and new energy resources and those topics related to nano-science and technology. The international and interdisciplinary cooperation is expected to grow in the future.

**KEY WORDS:** catalysis research; catalysis society; Taiwan.

## 1. Introduction

The uses of catalysts in the Taiwan chemical industry can be traced back to 1950s. However, the catalysis research in Taiwan was rare until the end of 1970s. The research was brought to the attention of the academic and industrial society by Prof. M.H. Rei, who was the director of the Science and Engineering Divisions of the National Science Council (NSC) during 1974–1978. In the early 1980s, several research groups were formed in several spots of Taiwan. A research group focused on iron-related catalysts was coordinated by Chairman W.C. Lin in the Institute of Chemistry, Academia Sinica. Topics on Fischer–Tropsch synthesis, metathesis, metal–support interaction, polymer-immobilized homogeneous catalyst and C1-related organometallic chemistry were studied. Several chemistry and chemical engineering professors in the Taipei area, including National Taiwan University (NTU), National Taiwan Normal University and Tamkang University also participated in the research of Group VIII metal catalysts and C1 chemistry. Another focus of catalysis research was in the area of synthesis and catalytic applications of zeolites at National Tsinghua University led by Professors I.K. Wang and K.J. Chao. They also consulted a research group in the Chemical Engineering Division of Union Chemical Laboratories (UCL), which was later reorganized and became one of the laboratories of Industrial Technology Research Institute (ITRI), a nonprofit R&D organization engaged in applied research and technical services to accelerate the industrial development of Taiwan. The Refining Research Center of Chinese Petroleum Corporation (CPC) in Chia-Yi, south Taiwan, was established in 1977 as a technical support laboratory for the processing of petroleum. The Center became one of the three most

active industrial groups in catalysis research in Taiwan, specialized in catalysts encountered in the refining and petrochemical industry. Another industrial institute of high catalysis research activity was the Catalyst Research Center (CRC) supported by the CTCI Foundation, which is a nonprofit corporate body of a private company specializing in petrochemical technologies. One of the most significant research results of CRC was the development of a catalytic converter for emission control of motorcycles. The CRC was, however, dissolved in 1997, and the concerning researches and studies on catalysts and chemical processes have been continually carried on under domestic and international technical cooperation projects. In the south part of Taiwan, several professors in the Department of Chemical Engineering, National Cheng-Kung University, concentrated on reaction engineering and the phase-transfer catalysis.

Prof. M.H. Rei, who became a professor at the Department of Chemical Engineering, NTU in 1978–1986, was the pioneer of the catalysis society in Taiwan. Other than pushing the catalysis research proposals through the NSC and the Ministry of Economy, he initiated the Catalysis Club, the annual meeting, and the R.O.C.-Japan bilateral workshop. The Catalysis Club has been financially supported by the NSC since 1984 so that the catalysis researchers can invite domestic and internationally renowned scientists, meet and exchange ideas 2–3 times per year. In 1982, the first annual R.O.C. Symposium on Catalysis was held. In 1983, Prof. Rei and Prof. Kozo Tanabe organized the first R.O.C.-Japan bilateral workshop on catalysis, which has become a fruitful regular joint workshop and is hosted alternatively between Taiwan and Japan since then.

The activity of catalysis research in Taiwan bloomed during the period 1980–2000 as the economy of Taiwan was built up and many scientists trained abroad came back and served in academic and industrial positions. The research area covers the processes encountered in

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the petrochemical industry, synthesis of fine chemicals, to pollution control. On the other hand, synthesis and preparation of new materials have been found important in the development of new catalytic processes. Because of the large number of researchers who got involved in the synthesis and characterization of zeolitic and porous materials, the Zeolite Club was formed in 1988. Nevertheless, many of the members of the Zeolite Club were also members of the Catalysis Club. These two clubs form the main body of the catalysis society in Taiwan. As high technology and instrumentation have been developed internationally, knowledge in catalysis has expanded to the molecular level. Surface analysis, solid-state NMR and various advanced spectroscopic techniques were applied to the characterization of the catalysts. Furthermore, the operation of the National Synchrotron Radiation Research Center (NSRRC) located in Hsinchu Science-Based Industrial Park in October of 1993 offers a cutting-edge synchrotron radiation facility for pioneering scientific research.

The catalysis society of Taiwan at its peak composes of about 180 members. It is one of the very few scientific communities in Taiwan to have members from interdisciplinary areas, specialized in chemistry, chemical engineering and physics, and from both academia and industry. In order to stimulate international cooperation, the members of the catalysis society are encouraged to participate in international conferences and organization. Moreover, the catalysis society organizes many domestic and international meetings. The third Indo-Pacific Catalysis Association Conference, originally scheduled in June 2003 and postponed to November 2003 because of severe acute respiration symptom (SARS), was the largest international meeting that the society has ever organized. The Taiwan Symposium on Catalysis and Reaction Engineering is the annual meeting of the society and is usually held in June. Several international bilateral workshops on catalysis are held every one or two years, including the R.O.C.-Japan, R.O.C.-Netherlands, R.O.C.-South Africa and R.O.C.-Korea workshops. The last two workshops, however, were terminated because of political reasons. On the other hand, the interchange of scholars and researchers between Mainland China and Taiwan has been increasing in the past several years. The Taiwan-China bilateral workshops have been held three times,

and it is proposed that they be continued every year and be hosted in alternate regions.

The activity of catalysis research in Taiwan has shrunk slightly in recent years as the CTCI Foundation closed the Catalyst Research Center in 1997 and CPC and ITRI downsized their catalysis research groups around 1998. The topics that remain active are of two extremes. On one hand, those related to daily social life, such as environmental protection and new energy resources, are emphasized in both academic and industrial laboratories. In respect of environmental protection, many pollution-control catalysts are under investigation, such as de-NO<sub>x</sub>, de-SO<sub>x</sub>, de-chloride, VOC combustion catalysts and nano-Au for ambient temperature CO oxidation. The TiO<sub>2</sub> photocatalyst is another popularly studied topic, and it has been applied to degradation of pollutants as well as the hydrogenation of CO<sub>2</sub>. In the past few months, when SARS seriously affected Taiwan, the attention on TiO<sub>2</sub> photocatalysts was markedly raised. As to new energy resources, the main focus is on the fuel cell, such as the catalysts used in the anode of direct methanol fuel cell, the catalysts for hydrogen generation from fuel reforming and the membrane reactor for hydrogen generation. On the other hand, the NSC and the Ministry of Education encourage research topics in the state of the art. In the past several years, special attention has been on those related to nanoscience and technology. In this respect, mesoporous materials have been the focus of several projects because they contain nanosized pores and have potential applications in catalysis and in photo-electronics.

The catalysis research in Taiwan in the near future will continue to emphasize its contribution to sustainable chemical technology and environmental protection. International and interdisciplinary cooperation is expected to grow in order to stimulate innovation and strengthen research capability.

### Acknowledgment

The author gratefully acknowledges Prof. Shu-Hua Chien of Academia Sinica and the former manager of the Catalyst Research Center, Mr. Guin-Man Tsau, for providing a historical review of catalysis research in Taiwan.