Zeolite Catalysis for Carbon Neutrality

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Zeolites have widely been used as solid acid catalysts in the production of chemicals and fuels. The acidity of zeolite originates from the protons of the bridging OH groups between the framework Si and Al atoms. Since the control of environment of active sites in heterogeneous catalysts is one of the important factors for affecting the catalytic activity, the zeolites with framework Al distribution controlled have attracted much attention. We have developed several approaches to its control by means of different types of the organic-structure-directing-agents (OSDAs) [1, 2], the starting materials [3] and so on. Besides, metal-containing zeolites have received much attention because they have diverse catalytic functions such as hydrogenation, dehydrogenation, oxidation, and C-H activation. We have also succeeded in controlling the location of metal cations in zeolites [4-6].

Thus, zeolites have been considered as a key material for achieving a Carbon Neutrality 2050. In this presentation, our recent achievements on the zeolite catalysis for activation of C1 molecules including CH_3OH, CH_4, and CO_2 will be focused. The methanol to olefins reaction [7, 8], methane to methanol [5, 6, 9-11], and hydrogenation of carbon dioxide to methanol [12] will be introduced.

Recently, I'm involved in a start-up company, iPEACE223 Inc. [13], which has been qualified as "Tokyo Tech Venture". iPEACE223 stands for Innovative Process for Eliminating Anthropogenic CO_2 Emission (IPEACE), and Catalytic conversion ethylene to propylene (ETP, two to three: 223). Our goal is to establish a novel ETP process to produce propylene and its derivatives from bioethanol via ethylene, contributing to the achievement of carbon neutrality.

References

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Toshiyuki Yokoi received a Ph.D. in 2004 from Yokohama National University under the supervision of Prof. Takashi Tatsumi. Soon afterwards, he worked as an assistant professor of Prof. Tatsuya Okubo, The university of Tokyo, from 2004 to 2006. He returned to the Tatsumi's group in Catalytic Chemistry Division, Chemical Resources Laboratory, Tokyo Institute of Technology as an assistant professor in 2006. Since 2018, he is an associate professor, and a research unit leader of Nanospace Catalysis Unit, Institute of Innovative Research, Tokyo Institute of Technology. His research focuses on nanospace materials such as zeolite and mesoporous materials, and he aims to create nanospace catalyst that can make effective utilization of diverse carbon resources including naphtha, methane and carbon dioxide and that can contribute to the development of green production of chemical feedstocks and value-added chemicals.