Abstract submission for a presentation at the CO_2-based Fuels and Chemicals Conference 2026

Catalytic Approaches for Sustainable Production of Synthetic Hydrocarbon Fuels from Methanol/DME

Gia Trung Hoang, Benjamin Niethammer, Ulrich Arnold, Jörg Sauer

Karlsruhe Institute of Technology (KIT), Institute of Catalysis Research and Technology (IKFT),

Eggenstein-Leopoldshafen, Germany

Through the "Hightech Agenda Germany", the German government aims to promote the sustainable production of fuels in order to reduce CO_2 emissions. One promising approach to support these objectives is the synthesis of dimethyl ether (DME), either from dehydration of methanol, or directly from syngas with low H_2/CO ratios or increased CO_2 content. This pathway offers thermodynamic and economic advantages over the conventional methanol-based route and enables the production of high-quality synthetic fuels via the DME-to-Hydrocarbons (DTH) process.

Within this work, the DTH process over zeolite catalysts will be discussed, highlighting recent advances with *MRE-type zeolites and their ability to shift product selectivity towards C_3-C_{11} olefins. Catalyst lifetime extension and product selectivity were investigated through palladium modification of *MRE zeolites via incipient wetness impregnation. Catalysts with different Pd loadings were synthesized, characterized, and evaluated under DTH reaction conditions with co-fed hydrogen. The Pd/*MRE catalyst showed a drastic increase in lifetime. Methane and ethylene yields remained low, and both the gaseous C_3-C_4 and liquid C_5-C_{11} fractions showed high olefin contents and low aromatics content.

These findings highlight the potential of Pd/*MRE catalysts for the sustainable production of synthetic fuels and value-added chemicals. The light olefins produced could be further upgraded via oligomerization, while the C_5-C_{11} fraction can serve as a feedstock for gasoline and jet fuel components. Current work focuses on catalyst shaping via extrusion to support scale-up, and first results on this topic will be presented.