

Structural Engineering of MOF and Metal Oxide Catalysts for Biomass Valorization: Insights from Synchrotron X-ray Characterization

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Abstract

Addressing global energy demands and promoting sustainable chemical production are paramount challenges driving the need for novel catalytic systems. This work focuses on the rational design and development of catalysts crucial for enabling the sustainable utilization of biomass-derived feedstocks, with a key emphasis on enhancing activity, selectivity, and long-term stability. We emphasize the structural engineering of Metal-Organic Frameworks (MOFs) and metal oxides for their application as high-performance catalysts, where enhanced performance is obtained by controlling the creation of structural defects and coordination unsaturated sites. To gain fundamental insights into the intricate structure-property relationships of these catalysts, we extensively employ synchrotron X-ray Diffraction (XRD) to provide detailed crystallographic information. Additionally, X-ray Absorption Spectroscopy (XAS) offers unparalleled insight into oxidation states and local coordination environment of active sites. These powerful characterization methods enable us to elucidate reaction mechanisms and identify active species. This comprehensive approach accelerates the rational design of next generation catalysts, paving the way for greener, more efficient, and sustainable processes in the chemical industry.

Biography

Suttipong Wannapaiboon is currently a Head of Crystal Structure Section, Beamline Division, and a Beamline Scientist at Beamline 1.1W Multiple X-ray Techniques (MXT) at the Synchrotron Light Research Institute (Public Organization), Thailand. He studied Chemistry and obtained his doctoral degree (Doctor of Natural Science, Dr. rer. nat.), Summa cum laude, under the supervision of Prof. Dr. Roland A. Fischer in 2018 from the Department of Chemistry, Technical University of Munich, Germany. His research interests are structural design, modification, and characterization of metal-organic frameworks, inorganic materials, thin-films, and porous materials aiming for chemical catalysis, photocatalysis, electrochemical catalysis, selective adsorption, and sensing. In addition, his expertise includes synchrotron-based characterization techniques namely X-ray diffraction (XRD), X-ray absorption spectroscopy (XAS), and X-ray fluorescence spectroscopy (XRF).

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