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Nanocatalysts for Biorefinery and Advanced Biofuel Applications

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Nanocatalysts have played an important role in biorefinery and advanced biofuel applications. The conversion of cellulosic biomass feedstocks to platform biochemicals, such as organic acids and furans, is one of the key steps in biorefining. In our research group, metal phosphate catalysts have been developed for production of 5-hydroxymethylfurfural from C6 sugar. Incorporating metal species in phosphate networks provides suitable active sites and phases for the reaction. In addition, non-crystalline mesoporous aluminosilicate catalysts with combination of strong and weak acid sites have been developed for conversion of C5 sugar to levulinic acid in one-step without any solvent and H₂ addition. The proposed processes proceed efficiently in hot water media, making it highly effective and friendly to the environment.

As for biofuel application, the conversion of vegetable oil and animal fat feedstocks to transportation fuels over heterogeneous catalysts is of interest for new biofuel industry. Such process is not only leading to lesser amount of imported petroleum and higher energy security of Thailand, but it is also valorizing byproducts from the country agricultural sector. We have developed the catalysts for the production of green diesel, a synthetic alkane, known to be one of the candidates for future energy. The process can be accomplished via deoxygenation over NiMoS₂/Al₂O₃, Ni/Al₂O₃, and Co/Al₂O₃ catalysts with high product yield at above 95%. Hydrogen, which is an important chemical for the deoxygenation, can effectively be achieved from steam reforming of oxy-hydrocarbons over Cu- and Ni-based spinel nanocatalysts. The integration of all processes mentioned above would lead to new technologies for biorefinery and biofuel industries of Thailand.

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