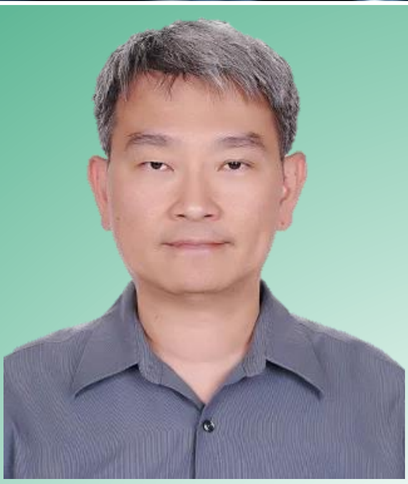
Metal Oxides as Catalysts for Oxidative Steam Reforming of Ethanol



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Hydrogen production from renewable energy resources has been attracted to the research on energy applications to mitigate the energy crisis and is regarded as a promising clean fuel. Among these hydrogen production routes, the conversion of ethanol is one of the potential technology to produce hydrogen for renewable energy applications because ethanol is a sustainable and carbon–neutral fuel. To achieve a high conversion of ethanol and a high yield of hydrogen, a stable and active catalyst for ethanol conversion is desired. Oxidative steam reforming of ethanol (OSRE) to produce hydrogen or syngas (H_2/CO) is a potential process for energy applications. In this presentation, our efforts in the development of metal oxide-based catalysts for the OSRE process are summarized. Metal-substituted oxides are synthesized and used as catalysts for oxidative steam reforming of ethanol. Our work on the development of new catalysts for OSRE were focusing on the studies of (1) morphology control of nanoparticles, (2) metal-substituted metal oxides, and (3) new supporting materials. For example, pyrochlore phases $M_xLn_{2-x}Ce_{2-x}Ru_xO_{7-\delta}$ (M = Li, Mg, Ca; Ln = Y, Sc, La) supported by $La_2Zr_2O_7$ (LZO) were studied as OSRE catalyst that exhibited high ethanol conversion and hydrogen selectivity with low carbon deposition. The substitution of metal cations not only modified the oxidation states of active sites with $Ce^{4+}/^{3+}$ and Ru^{n+} ions but also create oxygen vacancies. Catalysts supported on LZO showed stable OSRE performance and low carbon deposition compared to catalysts supported on Al_2O_3. We ascribe the enhanced activity to well-dispersed metal ions in the host structure of solid solution phases, synergistic effects of (Ak^+, Ae^{2+}, Ln^{3+})/$Ce^{3+,4+}$/Ru^{n+} ions, and strong catalyst-support interaction that lead to full ethanol conversion, stable hydrogen production activity, and low carbon deposition.

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