Bioethanol can be produced from fermentation, but as this competes with food, bioethanol from cellulose is a method currently being developed. ESR, however, is limited by the reverse decomposition of acetate in the intermediate stage, which produces carbon monoxide and water, and which ultimately decreases the overall hydrogen selectivity of the process. In this work, research has been conducted examining the possible promoting effect of lithium as a potential alkali promoter. The aim of the work was to accelerate the forward decomposition of the acetate intermediate into CO and increase the overall selectivity to H2. Acetate decomposition also produces CH4, which can be further steamed reformed by commercial catalysts (e.g., Ni-based) or catalysts may be designed in future to capture the methane (adsorbed CH4), subsequently reforming it for subsequent reforming. Ultimately, this study aims to improve the H2 selectivity of the overall process by promoting the forward decomposition of acetate via the decarboxylation/ demethanation route (ultimately generating CO2 and 3H2) versus the undesired reverse decomposition of acetate pathway via decarbonylation (generating 2CO + 2H2). Diffuse reflectance Fourier transform infrared spectroscopy (DRIFTS) and temperature programmed reaction of adsorbed ethanol/water was performed to determine whether Li+ addition electronically weakens the C-C bond in the acetate intermediate, thereby facilitating C-C scission of acetate and promoting forward acetate decomposition.

The current catalysts will be tested using a fixed bed catalytic reactor. In the future, our group will continue to test catalyst activation involves Pt oxide reduction, the generation of reduced defects in the zirconia, and the decomposition product.

As the global population continues to grow exponentially, non-polluting means of energy production are necessary to meet increasing energy demands while combating the depletion of fossil fuels. Hydrogen gas is of particular importance as it possesses the highest energy per unit mass of common fuels and can be generated from renewable resources. However, due to its low energy per unit volume, one potential solution is to store hydrogen in liquid chemical hydrogen carriers (e.g., light alcohols). As such, ethanol steam reforming (ESR: C2H5OH + 3H2O → 2CO2 + 6H2) is commonly applied to produce hydrogen gas from renewable bioethanol. Bioethanol can be produced from fermentation, but as this competes with food, bioethanol from cellulose is a method currently being developed. ESR, however, is limited by the reverse decomposition of acetate in the intermediate stage, which produces carbon monoxide and water, and which ultimately decreases the overall hydrogen selectivity of the process. In this work, research has been conducted examining the possible promoting effect of lithium as a potential alkali promoter. The aim of the work was to accelerate the forward decomposition of the acetate intermediate into CO and increase the overall selectivity to H2. Acetate decomposition also produces CH4, which can be further steamed reformed by commercial catalysts (e.g., Ni-based) or catalysts may be designed in future to capture the methane (adsorbed CH4) and subsequently reforming it for subsequent reforming. Ultimately, this study aims to improve the H2 selectivity of the overall process by promoting the forward decomposition of acetate via the decarboxylation/demethanation route (ultimately generating CO2 and 3H2) versus the undesired reverse decomposition of acetate pathway via decarbonylation (generating 2CO + 2H2). Diffuse reflectance Fourier transform infrared spectroscopy (DRIFTS) and temperature programmed reaction of adsorbed ethanol/water was performed to determine whether Li+ addition electronically weakens the C-C bond in the acetate intermediate, thereby facilitating C-C scission of acetate and promoting forward acetate decomposition.

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