

Catalytic Routes for Utilizing C1-based Substrates for Hydrogen Production

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ABSTRACT

Currently, hydrogen (H₂) is at the centerstage primarily because has to potential to meet the global energy demand in a sustainable and cleaner way. However, one of the major hurdles in exploring hydrogen-based economy with full potential is the safe production and storage of hydrogen gas, as carrying big and heavy hydrogen cylinders with high pressure has critical safety and economical challenges. Alternatively, using a liquid hydrogen storage material in the fuel tank of existing vehicles (using petroleum products) and generating hydrogen on-board to supply to the Fuel Cell is not only a viable concept but is also very economical. In this context, C1-based organic molecules, such as formic acid (4.4 wt% H₂), formaldehyde (8.4 wt% H₂ HCHO-H₂O), and methanol (12.5 wt% H₂), which are not only stable, safe to handle and transport but can also release hydrogen under relatively mild conditions in the presence of a suitable catalyst. For instance, Methanol, C1 alcohol, is a liquid, easy to store, water-soluble fuel, having a large content of H₂ (12.5 wt%) and is being produced on large scale from biomass resources and hydrogen and carbon monoxide, or as industrial by-products. Dehydrogenation of methanol involves three major steps: i) dehydrogenation of methanol generates formaldehyde with the release of one hydrogen molecule, ii) later simultaneous hydration of formaldehyde and dehydrogenation of diol form formic acid with the release of another molecule of hydrogen, and

finally iii) dehydrogenation of formic acid releases a molecule of hydrogen along with a molecule of carbon dioxide. Analogous pathways for catalytic hydrogen production from polyols and diols are also being explored. Therefore, the intervention of catalysts in tuning the dehydrogenation pathway becomes crucial. This presentation will provide a brief overview of various catalysts and catalytic routes we explored for hydrogen production from liquid organic hydrogen carriers.

Key Words: Catalysts, C-1 based substrates, Hydrogen Production