344f Hydrogen Production from Ethanol and Methanol over Sol-Gel Synthesized Mixed Oxides Catalysts

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The emission of carbon dioxide and nitrogen oxides from automobiles and power plants causes green house effect in the climate. Especially, the emission of nitrogen oxides, resulting in acid rain, is significant because 49% and 27% come from automobiles and power plants, respectively and only 19% comes from industrial, commercial and residential activities. Hydrogen seems to be viable fuel to eliminate air pollution. Unfortunately, it is not freely available in nature and it must be produced by some means. For instance, in industry, hydrogen is mainly produced by steam reforming of methane. Alternatively, it can be produced by the electrolysis of water, where the electricity is cheap. To eliminate net carbon dioxide emission and nitrogen oxides, low carbon containing fuels, such as primary or secondary alcohols, and low temperature operation are required. It has been known that ethanol is selectively dehydrogenated to acetaldehyde over zinc oxide in the absence of water. Besides, the steam reforming of acetaldehyde is thermodynamically favorable at low temperatures, such as 200 oC. A catalyst containing zinc oxide for ethanol and methanol is developed and their activity and selectivity will be presented. We use a single step sol-gel method to prepare mixed oxide catalysts, such as FexOy-ZnO-SiO2, BaO- ZnO-SiO2, CuOx- ZnO-SiO2 and Pd-ZnO-SiO2. All catalysts are calcined at ~550 oC and activated using H2. Premixed water and alcohol (ethanol or methanol) solution is fed into the vaporizer using a peristaltic pump and the vapor is carried through heated lines to the reactor with an argon flow controlled by a mass flow controller. The concentration of alcohol in the feed is kept constant at 8% and H2O/alcohol molar ratio is changed from 1 to 12. All the catalysts are tested in the temperature range from 250 to 500 ºC with a 30 oC increment. The reactor outlet stream is dried using a membrane drier (Perma Pure Inc.) to separate water and most of alcohols. Then, the products are analyzed with a CP-4900 Micro Gas Chromatograph equipped with a micro-TCD and Porapak Q and MS columns. The effect of space velocity and H2O/alcohol molar ratio on H2 selectivity and activity will be presented.