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Steam reforming of isobutanol for production of synthesis gas: Effects of metals

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Abstract

The catalytic steam reforming of biomass derived oxygenated hydrocarbons like isobutanol is a promising technology to produce synthesis gas for applications in chemical industries, for example, in Fischer-Tropsch synthesis of fuels and chemicals and for applications in fuel cell to generate electricity and as transportation fuels. In the present work, the production of hydrogen rich synthesis gas from isobutanol (product of ABE fermentation) has been examined using γ-Al_2O_3 supported different metals catalysts in fixed bed reactor at atmospheric pressure. The metals (Ni, Co, Mo) supported on γ-Al_2O_3 catalysts were prepared by wet impregnation method and characterized by powder XRD, BET, H_2 pulse chemisorption, and temperature programmed reduction to determine crystallinity, surface area, metal dispersion, and reducibility of the catalysts respectively. The nickel supported on γ-Al_2O_3 showed highest catalytic activity followed by cobalt and molybdenum supported on γ-Al_2O_3. The H_2, CO, CO_2, and CH_4 were identified as the non-condensable gaseous products. The analysis of liquid samples by GC-FID and GC-MS revealed the formation of large number of chemical compounds including acetaldehyde, propionaldehyde, 2-propenal, butyraldehyde, 2-butanone, and butanols (1, 2, and iso-butanols). The hydrogen yield was found to remain unaffected for all three metals supported γ-Al_2O_3 catalysts. The selectivity to CO was found to be more for Mo compared to Ni and Co and selectivity to CO_2 was higher for Ni compared to Co and Mo. The study was further extended to observe the effects of Co loading on γ-Al_2O_3, temperature, steam-to-carbon ratio on hydrogen yield and selectivity to gaseous products.

Biography

Vimala Dhanala has completed her Bachelor of Technology from Bhoj Reddy Engineering College for Women affiliated to JNTU, Hyderabad and M.tech from University College of Technology, Osmania University, Hyderabad. At present, she is a doctoral student at IIT Hyderabad. Dr. Sunil K. Maity has completed his M.Tech and Ph.D from IIT Kharagpur before joining IIT Hyderabad as Assistant Professor. He has published more than 15 papers in reputed journals. Dr. Debaprasad Shee has completed his M.Tech and Ph.D from IIT Kanpur before joining IIT Hyderabad as Assistant Professor. He has published more than 7 papers in reputed journals.