SF-P001

Catalytic Reactions of Ethanol and Acetaldehyde Over TiO_2-supported Gold Catalysts

김정진, 김유권*

Department of Energy Systems Research and Department of Chemistry,
Ajou University, Suwon 443-749, South Korea

As an environment-friendly alternative energy resource, ethanol may be used to obtain hydrogen, a clean energy source. Thus, studies on catalytic reactions involving ethanol have been studied to understand the underlying principles in the reaction mechanism using various oxide-supported catalysts. Among them, Au-based catalysts have shown a superior activity in producing hydrogen gas. In the present study, Au/TiO_2 catalysts were prepared by deposition-precipitation method to understand their catalytic activities toward ethanol and acetaldehyde with increasing gold loading, especially at the very low Au loading regime. A commercially available TiO_2 (Degussa P-25) was employed and the Au loading was varied to 0, 0.1, 0.5, and 1.0 wt% respectively. The catalysts showed characteristic x-ray diffraction (XRD) features at $2\theta = 78.5^{o}$ that could be assigned to the presence of gold nanoparticles. Its reactivity measurements were performed under a constant flow of ethanol and acetaldehyde at a flow rate of ~0.6 μmol/sec and the substrate temperature was slowly raised at a rate of 0.2 K/sec. We observed that the overall reactivity of the catalysts increased with increasing Au loading along with selectivity favoring dehydrogenation to product hydrogen gas. In addition, we disclosed various reaction channels involving competitive reaction paths such as dehydrogenation, dehydration, and condensation. In addition, subsequent reactions of acetaldehyde obtained from dehydrogenation of ethanol, were found to occur and produce butene, crotonaldehyde, furan, and benzene. Based on the results, we proposed overall reaction pathways of such reaction channels.

Keywords: Au/TiO_2, Ethanol reaction, Acetaldehyde reaction, Temperature programmed reduction, XRD