Operational Conditions Affecting Formaldehyde and Formic Acid Formation as By-Products of Hydrogen Production via Photo-Reforming of Methanol Using Nanoparticles of TiO2

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Abstract

It is important to understand how the operational conditions affect the photocatalytic hydrogen production and how to increase the production of valuable by products, such as formaldehyde and formic acid from the photo preforming of methanol. It is difficult to optimize operational conditions in photoreactors because several factors affect the process. To prioritize them, we focused on the quantification of the effect of four factors on CH2O and CH2O2 production: (A) presence of gold as concatalyst, (B) intensity of UV light, (C) methanol concentration, and (D) nanoparticle concentration. A main and interaction effects analysis is presented with fixed effect models for four responses: total production and catalyst productivity for both by products. Factor A showed the highest effect, followed by factors B and C, and the interactions AB and AC showed signs of influencing the catalyst selectivity with possible mechanistic variations. Factor D showed negative effect on catalyst productivities possibly related to shielding effect between particles..

Keywords

photocatalysis, formaldehyde, formic acid, photo-reforming of methanol, titanium dioxide nanoparticles, gold nanoparticles, fractional factorial experiment.