PHOTOCATALYTIC CONVERSION OF CARBON DIOXIDE AND WATER VAPOR TO HYDROCARBONS AND HYDROGEN

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The Carbon dioxide (CO_2), which is mainly obtained from fossil fuel combustion, plays a significant role in global warming and is currently considered a key challenge for the world. Photocatalytically converting CO_2 into valuable fuels and chemicals has become a popular and promising technology among many researchers which simply uses ultraviolet (UV) and/or visible light as the excitation source for semiconductor catalysts, and the photoexcited electrons reduce CO_2 with H_2O on the catalyst surface to form energy-bearing products such as carbon monoxide (CO), methane (CH_4), methanol (CH_3OH), formaldehyde (HCHO), and formic acid (HCOOH). In this application, wide band-gap TiO_2 photocatalysts (3.2eV) are considered the most convenient candidate in term of cost and stability. However, the design of highly efficient and selective photocatalytic systems for the reduction of CO_2 with H_2O is of vital interest. The highly dispersed titanium oxide (Ti-oxide) catalysts anchored on porous Vycor glass, zeolites and some mesoporous silica materials showed a high photocatalytic activity compared to bulk TiO_2 powders. Therefore, in the present work, an attempt has been made to prepare highly dispersed isolated Ti-materials within the novel KIT-6 and SBA-15-spherical materials and utilize these for the photocatalytic reduction of CO_2 with H_2O vapor to form CH_4 and other valuable fuels.
Figure 1 shows the most important results regarding novel synthesized Ti–mesoporous silica (KIT-6, SBA-15-S) materials with different Si/Ti ratios (200, 100 and 50). They have revealed that Ti–KIT–6 (Si/Ti=100) showed higher CH_4 formation than all other materials studied. It was due to the 3D pore structure of KIT-6 which facilitated the lower number of Ti-O-Ti or TiO_2 agglomerates and the more isolated Ti species as well as the increased OH groups. Optimizations of the reaction conditions and the factors affecting the catalytic activity of CO_2 reduction have significantly increased the fuel products. The economical way fuels production by this reaction and the easy regeneration of the photocatalyst makes it promising in future research.

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