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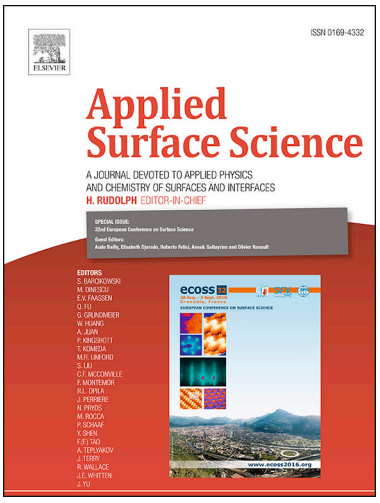

Full Length Article

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Photocatalytic hydrogenation and reduction of CO_2 over CuO/ TiO_2 photocatalysts

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Abstract:

Photocatalytic hydrogenation of carbon dioxide is one of the promising technologies which can convert carbon dioxide under ambient condition to sustainable fuels, such as methane and methanol. The pure TiO_2 and copper doped TiO_2 photocatalysts with 1, 3 and 5 wt.% CuO were prepared by sol-gel processing within reverse micelles and characterized by N_2 physisorption, UV-Vis, XRD, TPR, Raman spectroscopy, photoelectrochemical measurement and analysis of work function. Two types of experimental photocatalytic hydrogenation and reduction of CO_2 in the liquid phase and gas phase, respectively, were carried out under hydrogen. In the case of reaction in liquid phase, the highest yield of CH_4 was found in the presence 5 wt.% CuO/TiO_2 and pure TiO_2. Activity of photocatalysts was affected mainly by two factors: the availability of active sites (S_{BET}) and the work needed to move the electron from surface (work function). In gas reaction, the most CH_4 and CO were generated in order: TiO_2 > 3 wt.% CuO/TiO_2 > 5 wt.% CuO/TiO_2 > 1 wt.% CuO/TiO_2. In the gas phase, the enhanced photocatalytic performance was connected with better separation of the generated charge carriers.

Keywords: CO_2, photocatalysis, CuO/TiO_2, work function, photocurrent

1. Introduction

Economic growth causes rising energy consumption and the resulting increase in environmental pollution, which has been studied in the last years. Emissions of CO_2 have increased by 1.9 % yearly over the past three decades, which can be attributed to higher use of fossil fuels. The IPCC predicted that CO_2 emissions in 2030 will have increased by 40-110 % (compared with the year 2000). In 2011,