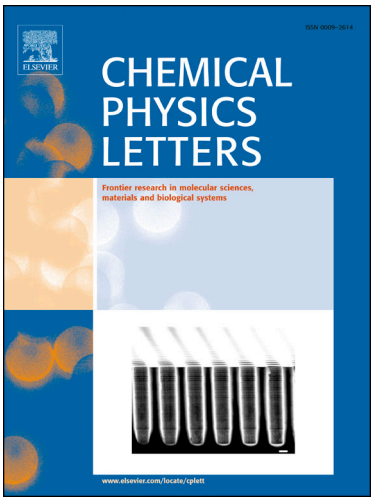

Research paper

Enhanced Photocatalytic Reduction of CO_2 to Methanol by ZnO Nanoparticles Deposited on ZnSe Nanosheet

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Enhanced Photocatalytic Reduction of CO_2 to Methanol by ZnO Nanoparticles Deposited on ZnSe Nanosheet

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Abstract

In this work ZnO/ZnSe composites were successfully synthesized via solvothermal method and characterized by a series of experiments for investigating into their compositions, morphologies, microstructures and the activities of photocatalytic reduction of CO_2. The methanol rates of bare ZnO and ZnSe respectively were 763.9 μmol/g_{cat}/h and 503.88 μmol/g_{cat}/h. However, the sample of 3%wt ZnO/ZnSe performed better photocatalytic activity up 1581.82 μmol/g_{cat}/h compared to bare ZnO and ZnSe. In the as-prepared photocatalyst the nanosheet of ZnSe benefited the light harvest; suitable deposition of ZnO on the ZnSe nanosheet constructed a type Ⅱ heterojunction for transferring the photo-generated electron to reduce CO_2.

Keywords: CO_2; photocatalytic reduction; methanol; ZnO/ZnSe composites;

1. Introduction

Nowadays we are facing with two urgent and unsolved issues, one is the energy shortage; the second is the environmental damage. With the enlargement of population and the continuous expansion of energy consumption, the fossil fuel in the earth, such as petroleum, coal and natural gas, is in short supply and CO_2 emission is significant increase[1,2]. Photocatalytic reduction of CO_2 comes into being, on the one hand to solve the energy problem, on the other hand to reduce the concentration of CO_2 in atmosphere and achieve sustainable development[3,4]. Since Fujishima[5] firstly discovered TiO_2 promoted water splitting to produce hydrogen, so many researchers have been inspired to develop photocatalysts of semiconductors[6-8], including the metal organic frameworks[9,10], however, which exhibited low photocatalytic activity during photocatalytic reduction of CO_2 and almost absorbed ultraviolet light during irradiation[11].

Over the years, TiO_2, as the most common photocatalyst of semiconductor, has attracted intensive attention due to its inexpensive price and chemical stability. But it can only be excited by ultraviolet light, which takes merely 4% in the sunlight [12-14]. Hence, it is necessary to develop the photocatalysts of semiconductors with good response to visible light. ZnSe as Ⅱ-Ⅵ semiconductor has achieved significant utilization of light because of its unique properties of narrow band gap and wide absorption spectrum[15-19], specially it has stronger absorption in visible light comparing to the TiO_2. The ZnSe has been applied in organic degradation and solar cells [17-19] due to its more negative conduction band than that of TiO_2 for reducing