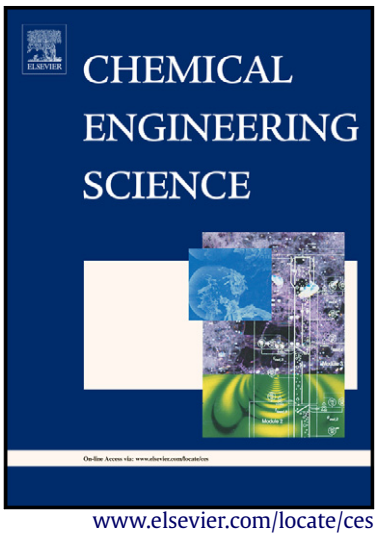

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On the engineering part of solar hydrogen production from water splitting: photoreactor design

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Abstract

Water splitting under sunlight illumination in the presence of semiconductor photocatalyst is a very promising way to produce clean hydrogen fuel. Solar hydrogen can be obtained in two routes: photoelectrochemical (PEC) water splitting based on immobilised photocatalysts in thin films and photocatalytic (photochemical) water splitting based on powder photocatalysts in slurry system. Over the past several decades, tremendous research work has been devoted to exploring new semiconductor materials suitable for PEC and photochemical systems and understanding the underlying mechanism of the water splitting process. However, much less attention has been paid to the design of photocatalytic reaction systems or reactors, which is indeed critically important for the overall solar energy conversion performance. This paper summarizes the basic working mechanisms of both PEC and photochemical systems, and gives an overview of a variety of photoreactor design and development.

Keywords: Photochemistry; Materials; Chemical Reactors; Solar Energy; Hydrogen Production; Reactor Engineering

1. Introduction

Due to the growing concern of quick exhaustion of traditional fossil fuels including coal, petroleum and natural gas, mankind have tried to explore renewable energy sources during the past several decades. In particular, this research enthusiasm was greatly promoted during the energy crisis in mid-1970s. So far, several energy sources are considered to be renewable energy sources for the future of human beings, including wind energy, tidal energy, geothermal energy, solar energy, etc. Among these so-called “green energy resources”, solar energy is considered to be the most promising source