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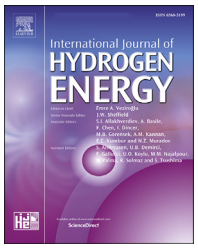

Challenges arising from the use of TiO_2/rGO/Pt photocatalysts to produce hydrogen from crude glycerol compared to synthetic glycerol

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ABSTRACT

Photoreforming has emerged as a novel technology expected to obtain chemical energy through solar energy transformation. In this way, sustainable valorization of glycerol, a biodiesel by-product, to clean fuels is a promising alternative to help meet the world's growing energy demand. In this work, TiO_2/rGO(x)/Pt(y) photocatalysts have been developed for hydrogen production from synthetic and crude glycerol solutions. The effect of several key operating parameters (including vol% of glycerol, pH, catalyst loading, wt% of GO, wt% of Pt, temperature, and light source) on hydrogen production rate has been studied. The results indicated different optimal operating parameters depending on glycerol origin, achieving up to 70.8 and 12.7 mmol h^{-1} g^{-1} of hydrogen using synthetic glycerol and crude glycerol, respectively. Additionally, GO nanosheets and Pt nanoparticles strongly influenced the hydrogen production rate but not the overall reaction mechanism. Impurities contented in crude glycerol are key factors in developing realistic hydrogen production processes.

Introduction

The environmental pollution and the energy demand have become two of the main societal challenges associated to the increase of the world population [1]. Currently, 90% of the world's energy supply comes from fossil fuels, which are a limited energy source [2]. Moreover, CO_2 release is a well-known disadvantage of carbon burning contributing to greenhouse effect. Therefore, sustainable energy production is currently a global issue.

Hydrogen is a potential alternative to fossil fuels and is widely considered to be the most promising clean energy carrier since it is storable, presents high energy content and absence of greenhouse gas emissions, toxic pollutants or particle matter during its combustion [3–6]. Moreover, hydrogen fuel presents a high heating value of 141.8 MJ kg^{-1} (about 3 times of gasoline) therefore, it has potential to participate in satisfying the world's growing demand for energy [7].

Industrial hydrogen production processes are based on transformation of substances which contain hydrogen since it

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