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Review

Catalysts for hydrogen production through glycerol reforming

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ABSTRACT

Hydrogen is considered as an important energy vector for the 21st century and its production from renewable resources, like biomass-derived products, is one of the main challenges. On the other hand, glycerol, a byproduct of the biodiesel production, may turn out to be an environmental problem due to the large amount of glycerol generated worldwide. The production of hydrogen from glycerol is a promising route to alleviate this problem. This paper focuses on the conversion of glycerol to hydrogen through aqueous-phase reforming and steam reforming, by providing a comprehensive review of the catalysts used in these processes and examining the involved reaction mechanisms.

KEYWORDS: hydrogen, glycerol, aqueous-phase reforming, steam reforming

1. Introduction

The search for alternative energy sources is increasing in the world motivated by a progressive decrease in the production of fossil fuels and the continuing increase in emissions of pollutants, especially those related to global warming. Therefore, there is growing interest in developing new sustainable and renewable fuels. In this context, hydrogen is considered one of the most promising future clean energy vectors.

Hydrogen is an attractive alternative fuel because it can be produced from a variety of feedstocks and utilized in different applications. Nowadays, nearly 95% of the world hydrogen is produced from fossil fuels [1-2]. Hydrogen generation from biomass-derived products is considered one of the best alternatives for the fossil fuel routes, with great environmental benefits, as the produced CO_2 is consumed during biomass growth, providing a neutral carbon balance [3].

Glycerol is a commodity chemical widely used by the pharmaceutical, personal care, food and cleaning industries. Currently glycerol is mostly obtained from saponification in soap manufacturing and transesterification in biodiesel synthesis. Because of the recent boom in biodiesel production, a substantial amount of crude glycerol is flooding the market. One ton of biodiesel yields about 110 kg of crude glycerol [4]. Crude glycerol contains impurities such as inorganic salts, fatty acids, water, and methanol in varying concentrations. Direct applications of crude glycerol are scarce and its accumulation not only hampers the development of the biodiesel industry, but it also creates economic and environmental problems [5].

In Brazil, according to National Agency of Petroleum, Natural Gas and Biofuels (ANP), the production of biodiesel (B100) in 2013 was approximately 2.9 million m^3, generating 290,000 m^3 of crude glycerol. Biodiesel production is increasing in Brazil largely because of the compulsory addition of biodiesel to diesel: the addition of 2% biodiesel (B2) in diesel is mandatory since 2008; this amount increased to 5% (B5) in 2010 and the Brazilian government announced that from November of 2014 the percentage of biodiesel added to diesel will be 7% (B7). With the fast increase of glycerol supply in the world market the price of glycerol dropped

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