Cyprus University of Technology

Faculty of Geotechnical Sciences and Environmental Management

Bachelor's Thesis

Computational studies on microreactors for the decomposition of formic acid for hydrogen production using heterogeneous catalysts.

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Abstract

The rapid increase of CO_2 emissions causes dramatic climate changes. Thus, finding a solution became imperative. The key is to find a back-up source that is secure, renewable, and internationally available. A hydrogen-based economy was discovered as the most effective alternative solution to replace fossil fuels due to its sustainability. In this review, many ways of hydrogen's production through various technologies are presented, such as the generation as a product of biomass refinery through thermochemical and biological processes, from fossil fuels and water splitting like electrolysis, photolysis, and thermolysis. Hydrogen is one of the greenest energy sources, providing engines with power while causing zero emissions. Unfortunately, hydrogen's storage and transportation are unsafe, costly due to its large volume, but it is easily stored in formic acid. Formic acid is produced by the hydrogenation of CO_2, and its decomposition in mild conditions is widely used as it is a safer way of transporting and producing large amounts of hydrogen with low toxicities. As a result, atmospheric CO_2 is reducing. Moreover, there are many homogenous and heterogeneous catalysts and reactors that are utilized for the decomposition of formic acid. Reactors that can be used in this procedure are batch reactors, microreactors, CSTR, and fixed-bed reactors. These types of catalysts and reactors and their advantages-disadvantages will be analyzed further in this study.

Keywords: Hydrogen, Formic acid, Decomposition, Reactors, Renewable sources, Sustainable, Environmentally Friendly.

1. Introduction

Humans are the most responsible factor for the ongoing climate change due to the combustion of large quantities of fossil fuels. Nowadays, CO_2 emissions have grown abruptly at the highest rates ever recorded. The continuous waste of energy from developing economies can surpass those of the industrialized countries that have hitherto been the main cause of emissions.[1] This fact, has motivated mankind to discover an alternative solution to replace fossil fuels with eco-friendly sources, with hydrogen being the optimal choice. Hydrogen is an abundant, clean, and secure renewable energy source which has intrigued the interest since it can be utilized as an energy carrier and a potential transportation fuel.[2] Moreover, fuel cells operate with hydrogen-rich fuels or hydrogen and are also used in transportation, distributed thermal power generation and energy