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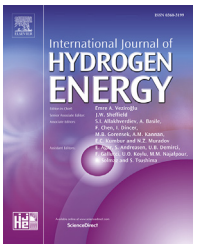

Synthesis and characterization of supportless Ni-Pd-CNT nanocatalyst for hydrogen production via steam reforming of methane

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ABSTRACT

Supportless Ni-Pd-0.1CNT foamy nanocatalyst with specific surface area of 611.3 m^2/g was produced by electroless deposition of nickel, palladium and multiwall carbon nanotube (MWCNT) on interim polyurethane substrate. Application of temperature programmed reduction (TPR) and temperature programmed oxidation (TPO) data into Kissinger (Redhead) kinetic model showed lessening of their activation energies due to Pd and CNT addition. Presence of foamy Ni/SiC caused 8% higher steam reforming of methane; while Ni-Pd-0.1CNT presence resulted in 22% higher methane conversion. The catalytic behavior of the samples was described by morphological and compositional studies which were carried out by transmission electron microscope (TEM), field emission scanning electron microscope (FESEM) equipped with energy dispersive spectroscopy (EDS) and atomic absorption spectrometer (AAS) pondered with Brunauer–Emmett–Teller (BET), TPR, TPO and X-ray diffraction (XRD).

Introduction

During the last decade, hydrogen production industry attracted significant funding sources because of the wide application range and environmental concerns like climate change and the greenhouse effect. Due to the about three times higher energy density than the oil, along with cleanness, hydrogen has been recognized as a promising source of energy [1–4]. Hydrogen-energy processing chain includes three significant steps of production, storage, and repowering. All three steps require serious attention and improvement [4,5]. The need for higher production efficiency is considered as a fundamental issue in hydrogen generation. Several green production methods like electrochemical, solar and biomass have been introduced recently [6,7]. According to the irreversible nature of hydrogen storage, production by means hydrolysis reactions of hydrides has drawn exceptional attention due to the safety and amenability to mild reaction conditions [8–12]. However, neither of these approaches still shows promising efficiency results for industrial-scale production [13]. Therefore, fossil fuels are used predominantly for hydrogen production in several sectors. Due to the inevitable need for H_2 production from hydrocarbons and low conversion values (<70%) of these techniques, a huge emission of greenhouse

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