INTERNATIONAL JOURNAL OF HYDROGEN ENERGY 35 (2010) 11725–11732

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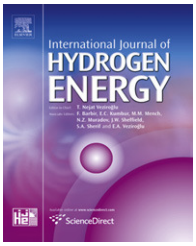

Synthesis of $NiAl_2O_4$ with high surface area as precursor of Ni nanoparticles for hydrogen production

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ARTICLE INFO

Article history:
Received 27 May 2010
Received in revised form
4 August 2010
Accepted 5 August 2010
Available online 9 September 2010

Keywords:
Nickel aluminates
Combustion method
Spinel
CO_2 reforming
Syngas

ABSTRACT

$NiAl_2O_4$ with high surface area was synthesized by the combustion method, evaluating the effect of urea/nitrate (U/N) ratio. The use of a stoichiometric U/N ratio resulted in a material with high surface area and homogeneous nanocrystallites, while the excess of fuel resulted in a non-porous material with low surface area. The formation of superficial Ni nanoparticles resulted in excellent stability on CO_2 methane reforming. This can be attributed to the rearrangement of nickel in the aluminate matrix and the migration of nickel particles through carbon filaments at the surface during the activation process.

1. Introduction

Spinel oxides have been applied in several fields, such as refractory materials, pigments, sensors and catalysts, due to their thermal stability, catalytic and magnetic properties [1–4]. Nickel aluminate ($NiAl_2O_4$) is a mixed cation oxide with normal spinel structure, where Al occupies the octahedral sites and Ni occupies the tetrahedral sites [5]. It can be used as support for catalysts due to its resistance to high temperatures and acidic or basic environments, providing chemical and physical stability for the catalyst.

Different methods have been suggested for the preparation of spinels with high surface areas. The most conventional is based on a solid–state reaction, where the metal oxides are mechanically mixed, resulting in finely divided powders. However, these materials present low surface areas and need high temperature of calcination and long reaction times [6]. On the other hand, the co-precipitation method can easily produce spinels with high surface area, around 100 $m^2\,g^{-1}$, but an enormous effort is necessary to ensure a homogeneous material with uniform particle sizes and composition [1]. Sol–gel routes have been used to synthesize nickel alumina with large surface area, but this method requires expensive metal alkoxide precursors [2,7].

The combustion method has been proposed to synthesize nanosized materials and is particularly useful in the production of ultrafine ceramic powders with small average particle size. This is an easy and fast method, with the advantage of using inexpensive precursors, producing homogeneous nanosized crystallites, and highly reactive materials [8].

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0360-3199/$ – see front matter
doi:10.1016/j.ijhydene.2010.08.024