



Research Article

# Effect of Precursor and Temperature Annealing on the Catalytic Activity of Intermetallic Ni<sub>3</sub>Sn<sub>2</sub> Alloy

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## Abstract

The effect of nickel precursors and the temperature annealing to obtain intermetallic Ni<sub>3</sub>Sn<sub>2</sub> alloy catalysts on its activity and selectivity in the selective hydrogenation of biomass-derived furfural (FFald) were investigated. Two types of nickel precursors (c.a., *i*) nickel metal (Ni<sup>0</sup>) derived from Raney®nickel and *ii*) nickel ion (Ni<sup>2+</sup>) derived from nickel chloride) were employed as the starting materials via hydrothermal at 423 K for 24 h followed by reduction with H<sub>2</sub> at the elevated temperature of 573-873 K for 1.5 h. The physico-chemical properties of the intermetallic Ni<sub>3</sub>Sn<sub>2</sub> were characterized by XRD, N<sub>2</sub>-, and H<sub>2</sub>-adsorption, ICP-AES, and NH<sub>3</sub>-TPD. The intermetallic Ni<sub>3</sub>Sn<sub>2</sub> alloy catalysts, both bulk and supported, demonstrated high activity and selectivity towards hydrogenation of FFald. The activity and selectivity of  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> and AA-supported Ni<sub>3</sub>Sn<sub>2</sub> alloy catalysts in the hydrogenation of FFald to furfuryl alcohol (FFalc) were maintained even after annealing at up to 873 K, but that of bulk Ni<sub>3</sub>Sn<sub>2</sub> drastically dropped. Ni-Sn alloy catalysts which were obtained from Raney®Ni precursor showed more stable than that of nickel salts during hydrogenation of furfural to furfuryl alcohol.

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**Keywords:** intermetallic Ni<sub>3</sub>Sn<sub>2</sub>; bulk & supported Ni<sub>3</sub>Sn<sub>2</sub>; selective hydrogenation; furfural; furfuryl alcohol

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## 1. Introduction

Most building blocks of biomass-derived compounds are in the forms of oxygenates which have a number C–O bonds and higher oxygen content, including sugar alcohols, functionalized carboxylic acids, aldehydes and ketones, phenolic compounds, and furanic derivatives [1–3]. In this sense, the transformation of the oxygenates

into high value-added chemicals and fuels using simple supported metal catalysts are quite difficult to catalyze the complexes of C–O bonds. Bimetallic or bifunctional catalyst systems, typically consisted of active metals, supports, and promoters, would be a promising catalyst for feedstocks upgrading. The interaction between metals in the bimetallic or bifunctional catalyst system can modify the properties of catalyst, enhance the activity and selectivity, significantly improve the catalyst stability in presence of biomass-derived impurities or in severe reaction

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