

Ceramic catalysts based on SnO₂:Ni²⁺ for biodiesel synthesis

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Abstract – Ni doped SnO₂ catalysts were synthesized by the polymeric precursor method, with previous elimination of carbon and calcination at 600, 800 and 1000°C. The material was characterized by X-ray diffraction, infrared spectroscopy and scanning electron microscopy. The best synthesis condition was the calcination at 800 °C, that leads to a well crystallized material with less aggregates than calcination at 1000 °C. Synthesis of biodiesel was evaluated, with a reduction of 16 % in the oil viscosity, which was improved when the catalyst was activated by reaction with ethanol. Acknowledgements: The authors acknowledge the financial support of CNPq/MCT and FINEP/MCT

Biodiesel has been gaining popularity around the world as an alternative energy source, due to the emission of lower amounts of toxic gases, obeying the carbon cycle, reducing CO₂ emission. Besides not being toxic, it is biodegradable, with strategic, social, economic, environmental and technological advantages [1]. In Brazil, after the publication of the Biodiesel Law, 11.097/2005, biodiesel was incorporated in the Brazilian energetic matrix, as a strategic action for the near future. Transesterification is widely applied in the biodiesel synthesis [2]. This reaction is usually done using a homogeneous catalyst, which has a lot of disadvantages in spite of the high kinetic of reaction. In the present work, heterogeneous catalysis was evaluated, considering that SnO₂ is one of the main acid catalysts for biodiesel synthesis, being applied after sulfate impregnation [3].

In this work, SnO₂:Ni²⁺ was used as catalyst, with synthesis by the polymeric precursor method. The polymeric precursor was milled, calcined in O₂ for carbon elimination and at 600, 800 and 1000 °C for crystallization. Catalysts were characterized by infrared spectroscopy, X-ray diffraction and scanning electron microscopy. Rutile phase was the only phase present in all samples. A low crystallinity was observed after calcination at 600 °C, with a low long range order. At 800 and 1000 °C, well defined peaks were already obtained. The disadvantage of the heat treatment at higher temperatures was the formation of aggregates as observed in the SEM micrographies. Infrared spectra showed the presence of a band at 1080 cm⁻¹, assigned to the presence of hydroxyl groups on the surface of the material; a band at 1634 cm⁻¹ indicating the presence of adsorbed water; Me – O bands between 500 and 700 cm⁻¹.

Biodiesel synthesis was done using soybean oil, with a oil:ethanol ratio of 1:10 and 1.5 % of catalyst. A gentle reflux was maintained during 4 h of synthesis. A reduction of 16 % in the oil viscosity was obtained after reaction. Activation of the catalyst, by previous reaction with ethanol was also evaluated and increased the conversion degree, as well as the increase in the amount of catalyst to 5 %.

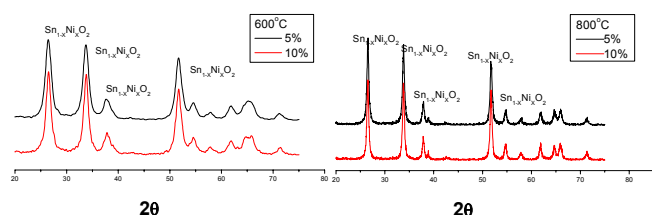


Figure 1 – XRD patterns of SnO₂ doped with 5 and 10 % of Ni²⁺ after calcination at 600 and 800 °C.

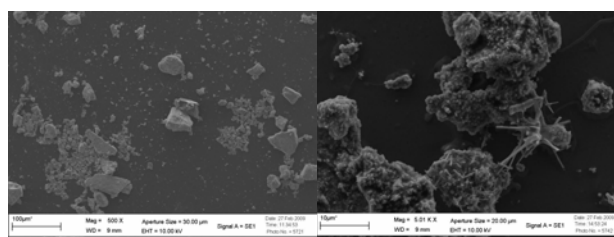


Figure 2 – SEM micrographies of SnO₂ doped with 5 % of Ni²⁺, after calcination at 800 and 1000°C.

References

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