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Catalysts for biodiesel based on $Zn_{2-x}Co_xTiO_4$

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Abstract – Co-doped Zn_2TiO_4 powders were synthesized by the polymeric precursor method and characterized by thermal analysis, XRD, IR and UV-vis spectroscopy. Spinel phase $Zn_{2-x}Co_xTiO_4$ was obtained, with small amounts of impurities. Co^{2+} oxidation to Co^{3+} was detected by thermal analysis and UV-vis spectroscopy. The efficiency of the catalyst in the biodiesel synthesis varied according to the reaction conditions and to the previous treatment of the catalyst.

Transesterification reactions have been receiving a lot of attention due to biodiesel synthesis, stimulated by the brazilian biodiesel national program. This fuel is usually synthesized using homogeneous catalysis, which requires an anhydrous media to avoid saponification reactions [1]. Among heterogeneous catalysts, an important one is $ZnAl_2O_4$, which promotes a transesterification reaction without catalyst loss [2].

In this work, $Zn_{2-x}Co_xTiO_4$ ($0 \leq x \leq 2$) was synthesized by the polymeric precursor method and evaluated in the biodiesel synthesis by transesterification reaction. The $Zn_{2-x}Co_xTiO_4$ powder precursors were milled, calcined at 300 °C in O_2 atmosphere and then at 800 °C for 2 h. Powder precursor was characterized by thermogravimetry/differential thermal analysis and crystalline samples were characterized by infrared spectroscopy (IR), UV-vis spectroscopy and X-ray diffraction (XRD).

Thermal analysis indicated the oxidation of Co^{2+} to Co^{3+}, in agreement o UV-vis spectra, that showed absorption bands assigned Co^{2+} and Co^{3+} as displayed in Fig. 1a [2]. This redox reaction may be important in the biodiesel synthesis, as Co^{2+} can behave as an electron donor. Infrared spectra (Fig. 1b) showed Me – O bands characteristic of spinel phase. All samples showed bands at 1629 and 1080 cm^{-1}, assigned to the presence of water and to hydroxyl groups on the powder surface, respectively. XRD patterns of $Zn_{2-x}Co_xTiO_4$ (Fig. 1c) confirmed the formation of spinel phase after calcination at 800 °C, according to JCPDS index card 02-1033. Secondary phases were observed for cobalt-rich samples.

Biodiesel was synthesized from corn oil, using a molar ratio oil:alcohol of 1:6 and 1:10, besides 1.5 and 5 % of catalyst (wt/wt). Synthesis was done at 65 °C, with reflux. Reduction of 10 % in viscosity was obtained, increasing with the previous treatment of the catalyst and with the amount of spinel and alcohol present in the reaction system.

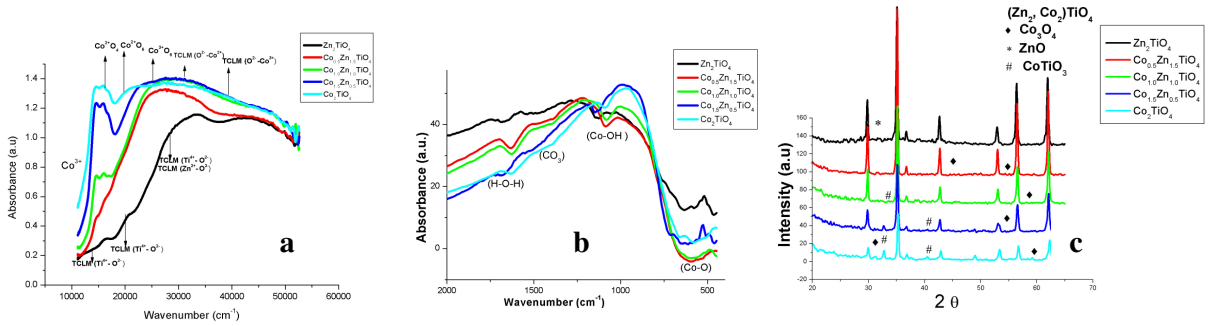

Figure 1: (a) IR spectra, **(b)** UV-vis spectra and **(c)** XRD patterns of the $Zn_{2-x}Co_xTiO_4$ ($0 \leq x \leq 2$) calcined at 800ºC.

References

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