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Effects of the synthesis parameters on Ni/TiO_2 catalysts for ethanol steam reforming

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Hydrogen is the ideal candidate to solve environmental problems related to CO_2 emissions. Nevertheless about 96% of hydrogen derives nowadays from the conversion of fossil resources. Ethanol steam reforming (ESR) is an attractive process to produce hydrogen in a sustainable way. Nickel is highly active and selective in steam reforming reactions, but also the support plays a key role. The aim of this contribution is to evaluate the effects of the synthesis parameters on the catalytic performance of Ni/TiO_2 samples for ESR.

TiO_2 support was prepared by a precipitation method [1]. Ni (10 wt%) was added by incipient wetness impregnation, either before (label "NiC", where C stands for Calcined) or after (label "CNi") the calcination of the support. Samples were calcined either at 500 °C (NiC500 and CNiC500) or at 800 °C (NiC800 and CNiC800). The samples were characterized by XRD, TPR, HR-TEM and N_2 physisorption. Activity tests were performed, after catalysts reduction, at 500 °C and atmospheric pressure by feeding a 3:1 (mol/mol) H_2O:CH_3CH_2OH mixture.

The results revealed that the synthesis procedure strongly affects the interactions between the titania support and the Ni active phase. It was observed that, in certain conditions, Ni species can be even incorporated in the anatase lattice (NiC500) [1,2] or in the Ni-Freudenbergite phase (CNiC800), thus lowering Ni availability for the reaction and making the catalysts poorly active. The best results were obtained with NiC800 sample, in which the best compromise between Ni accessibility and its interactions with the support was achieved.

In conclusion the proper choice of the synthesis approach is a key step to increase Ni availability and stability on the TiO_2 support.

References

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