Ni/SiO_2 and Ni/ZrO_2 catalysts for the steam reforming of ethanol

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SiO_2 and ZrO_2 supported Ni catalysts were prepared for the steam reforming of ethanol. The catalytic performances, in terms of both H_2 productivity and stability towards coking and sintering, were related to the physico-chemical properties of the catalysts. The samples were prepared either by synthesis of the support by precipitation and subsequent impregnation with the active phase, or by direct synthesis through flame pyrolysis (FP). The latter has been chosen because it leads to nanostructured oxides, characterised by high thermal resistance, important for this high temperature application.

The samples showed different textural, structural and morphological properties, as well as different reducibility and thermal resistance, depending on the preparation method and support.

One of the key parameters governing the final catalyst properties was metal-support interaction. In particular, the stronger the latter parameter, the higher was metal dispersion, leading to small and stable Ni clusters. This influenced both activity and the resistance towards coking.

Surface acidity was also taken into account considering the effect of the different nature of acid sites (silanols or Lewis a.s.) of both support and metal phase on catalyst deactivation. The best results were obtained with a 10 wt% Ni/SiO_2 sample, prepared by FP, when tested at 625°C. H_2 productivity of 1.44 mol H_2/min kg_{cat} was reached, corresponding to ca. 80% of the maximum value achievable under the selected conditions. This result was accompanied by the lowest CO/CO_2 ratio, which simplifies H_2 purification steps for use in fuel cells, and 100% carbon balance without by-products in the outflowing gas.