Ni catalysts supported over TiO_2, SiO_2 and ZrO_2 for the steam reforming of glycerol

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Ni-based catalysts supported on TiO_2, ZrO_2 and SiO_2 (in the form of mesoporous SBA-15 and of amorphous dense nanoparticles), were employed in the steam reforming of glycerol. Each sample was prepared by liquid phase synthesis of the support followed by impregnation with the active phase and calcination at 800°C or by direct synthesis through flame pyrolysis. Many techniques have been used to assess the physical chemical properties of the catalysts, such as atomic absorption, N_2 adsorption/desorption, TPR, XRD, XPS, SEM, TEM and FT-IR.

The samples showed different textural, structural and morphological properties, as well as different reducibility and thermal resistance depending on the preparation method and support. Some of these properties were tightly bound to catalyst performance, in terms of H_2 productivity and stability towards coking and sintering. A key parameter was the metal-support interaction, strongly depending on the preparation procedure. In particular, the higher the latter, the higher was metal dispersion and more stable were the metallic Ni clusters formed, leading to higher catalytic activity. Surface acidity was also taken into account, differentiating the nature of acid sites (silanols, titanols or Lewis a.s.). Lewis acidity was correlated with a possible decrease of glycerol conversion. By contrast, when a high concentration of surface OH groups was observed, a depletion of activity for the water gas shift reaction was observed.

Good results in terms of catalyst stability were especially achieved when supporting Ni over ZrO_2.