LAYERED NI-AL-HYDROTALCITE-DERIVED CATALYSTS AS HIGHLY ACTIVE MATERIALS FOR POWER-TO-GAS PROCESS

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P2G "Power-to-gas", i.e. the conversion of CO_2 to CH_4 by using H_2 produced by electrolysis with excess renewable energy, is one of the key enabling technologies to extend the range of applications of renewable energy. Being the CO_2 reaction limited from thermodynamics (a reversible exothermic reaction), it is necessary to have a catalyst having an activity suitable to reach conversions close to equilibrium at temperatures below about 300-310°C and suitably high space-velocities for industrial use. In addition, high stability, even under frequent shut-on/off conditions, is necessary. We report here a comparison, under industrial relevant conditions, between quaternary system, i.e. composite oxide of γ-Al_2O_3, ZrO_2, TiO_2 and CeO_2, and a high-loaded nickel hydrotalcite catalysts for methanation of CO_2. Both low and high-pressure tests at high space-velocities were made. The high performances and stability of the latter are related to the use of a layered material which allows to stabilize Ni particles against sintering.

Figure 1 shows the significant improvement in the catalytic properties with respect to a Ni/Al_2O_3 catalyst as well as with respect to state-of-the-art quaternary composite oxides of hydrotalcite-type Ni/Al catalysts The amount of Ni is critical to enhance the reaction rates at low temperature. Hydrotalcites (HT, particularly prepared at pH of 12 - HT12) reaches the equilibrium at about 300°C (GHSV = 20000 h^{-1}). Stability tests confirm the improved perfomances using HT-based catalysts, which may be further promoted by introducing other elements increasing Ni reducibility.

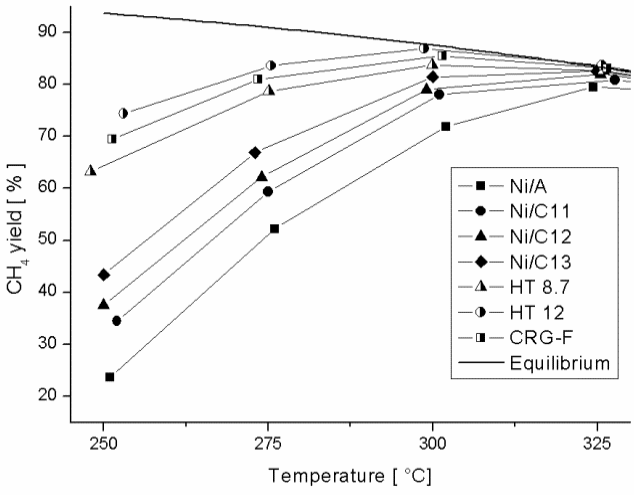

Figure 1. CH_4 yield for the prepared catalysts as function of the temperature.

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