Catalytic conversion of CO_2 into valuable products.

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Synthesis gas, a mixture of H_2 and CO, is an important feed-stock for several chemical processes operated in the production of methanol and synthetic fuels through a Fischer-Tropsch synthesis. Synthesis gas is produced via an endothermic steam reforming of methane ($CH_4 + H_2O \rightarrow CO + 3H_2$, $\Delta H = +225.4$ kJ mol^{-1}), catalytic or direct partial oxidation of methane ($CH_4 + (1/2)O_2 \rightarrow CO + 2H_2$, $\Delta H = -38$ kJ mol^{-1}) and CO_2 reforming of methane ($CH_4 + CO_2 \rightarrow 2CO + 2H_2$, $\Delta H = +247$ kJ mol^{-1}). The main disadvantage of these processes is the high coke formation, essentially in the nanofilament form, which may cause severe deactivation of the catalyst by pore or active site blocking and sometimes, physical disintegration of the catalyst body causing a high pressure drop along the catalyst bed and even, in some cases, inducing damage to the reactor itself. Previous results obtained in the catalytic partial oxidation of methane have shown that due to the hot spot and carbon nanofilaments formation, especially in the case of the CO_2 reforming, the alumina-based catalyst in an extrudate form was broken into powder which induces a significant pressure drop across the catalytic bed. In the case of endothermic reactions, steam and CO_2 reforming, the temperature drop within the catalyst bed could also modified the activity of the catalyst.

Silicon carbide (SiC) exhibits a high thermal conductivity, a high resistance towards oxidation, a high mechanical strength, and chemical inertness, all of which make it a good candidate for use as catalyst support in several endothermic and exothermic reactions such as dehydrogenation, selective partial oxidation, and Fischer-Tropsch synthesis. The gas-solid reaction allows the preparation of SiC with medium surface area, i.e. 10 to 40 m^2. g^{-1}, and controlled macroscopic shape, i.e. grains, extrudates or foam, for it subsequence use as catalyst support. In addition, due to its chemical inertness the recovery of the active phase is extremely easy, i.e. acidic or basic washing, which reduce the cost investment of the process for the final spent catalyst disposal and the fully re-use of the support. The high thermal conductivity of the SiC support could also allow the reduction of the temperature loss during the reaction taken into account the high endothermicity of the reaction.

The aim of the presentation is to report the synthesis and use of SiC-based catalyst for CO_2 reforming which allows the conversion of CO_2 into a more valuable products for further fuel processing via the Fischer-Tropsch synthesis.

Keywords: Silicon carbide – Heterogeneous catalysis – Reforming – Synthesis gas.