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PROPANE DEHYDROGENATION IN THE PRESENCE OF CO_2 OVER CHROMIUM OXIDE-BASED CATALYSTS

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The dehydrogenation of hydrocarbons in the presence of CO_2 has been recently investigated as an alternative for traditional non-oxidative dehydrogenation. In this process unsaturated hydrocarbons are obtained with simultaneous conversion of CO_2 to CO, which is more useful raw material for a number of chemical processes.

In the present work the results concerning dehydrogenation of propane in the presence of co_2 over various chromium oxide-based materials are presented. Four series of catalysts with cr loadings in the range of 0.7 – 7.0 wt. % were obtained with impregnation, characterized with different techniques (chemical analysis with bunsen-rupp method, icp, xrd, uv-vis drs, n_2-sorption and quantitative/qualitative h_2-tpr) and evaluated in dehydrogenation of propane with co_2. Two commercially available amorphous silicas (sio_2-p; s_{bet}=261 $m^2 \cdot g^{-1}$ and sio_2-a; s_{bet}=477 $m^2 \cdot g^{-1}$) as well as mesoporous siliceous sieves with cubic (sba-1; s_{bet}=1181 $m^2 \cdot g^{-1}$) and hexagonal (sba-15; s_{bet}=750 $m^2 \cdot g^{-1}$) pore structure were applied as the supports.

It was found that at a low Cr_{tot} content, the Cr^{6+} species predominate on the surface of all the supports, while at a higher Cr content, the Cr^{6+} and Cr^{3+} species coexist above the monolayer coverage. The balance of the Cr^{6+}/Cr^{3+} species, H_2 consumption (from H_2-TPR) as well as the formation of crystalline Cr_2O_3 strongly depend on the Cr_{tot} loading and the specific surface area of the silica support. In the case of catalysts with a similar Cr_{tot} content, both, the Cr^{6+} content and H_2-consumption decrease in the following order: Cr*x*/SBA-1 > Cr*x*/SBA-15 > Cr*x*/SiO_2-a > Cr*x*/SiO_2-p. The reaction rate normalized to the catalyst's weight decreases in the same sequence, what indicates that the catalytic activity in the dehydrogenation of propane with CO_2 is related to the concentration of Cr^{6+} species which are the precursors of catalytically active Cr^{3+} and Cr^{2+} sites.

Finally, based on characterization results and catalytic tests the possible pathways of propene formation in the presence of CO_2 were proposed.