Nanostructured surfaces

Effect of zirconium silicate nanostructure on gas-phase dehydrogenation of light alkanes

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Catalytic dehydrogenation of neutral light alkanes into reactive olefins is currently considered as an alternative to the petroleum method of obtaining this valuable raw material for the chemical industry [1]. In a recent study of these processes, special attention is paid to the remarkable properties of zirconium dioxide as a catalyst and a support for active oxides of transition metals [2]. However, the use of ZrO_2 limits the fact that its surface is significantly reduced during the heat treatment. Stabilize the state of zirconia can be by synthesis its mixed system with SiO_2. This makes it possible to create a carrier with a greater strength of the active acid sites and with a developed surface and a porous structure that can have a significant effect on the course of such gas-phase reactions.

In the work using the sol-gel synthesis method, spherical granules of the mixed oxide $0.6ZrO_2$-SiO_2 were obtained. The active phase - 10% V_2O_5 was supported by impregnating it with a solution of $VOSO_4$ salt. After drying and calcining the part of the impregnated hydrogel, it was obtained an amorphous bimodal micro/mesoporous system of disordered, tortuous pores with an average diameter of 2.9 nm, with a volume of 0.25 cm^3/g and a specific surface area of 290 m^2/g. Other parts of vanadium containing hydrogel were pre-hydrothermally treated for 5 hours at 250 °C and decanted with alcohol. This resulted in the production of ordered mesoporous structures with pore diameters of 6-8 nm, with volume 0.5-0.7 cm^3/g with a greater surface area. Testing of the obtained catalysts in the model reaction of propane dehydrogenation showed that an increase in the volume, diameter, and ordering of the structure of their pores lead to a significant increase in the yield of propylene and a decrease in the reaction temperature required for this, which indicates important influence of the catalyst nanostructure on the course of gas-phase reactions of dehydrogenation light alkanes.

1. *Nawaz Z.* Light alkane dehydrogenation to light olefin technologies: A comprehensive review // Rev. Chem. Eng.-2015.-**31**, N 5.-P. 413-436.
2. *Otroshchenko T., Sokolov S., Stoyanova M. et al.* ZrO_2-Based Alternatives to Conventional Propane Dehydrogenation Catalysts: Active Sites, Design, and Performance // Angew. Chem. Int. Ed.-2015.-**54**.-P. 15880 –15883.