Nanotechnology and nanomaterials

Synthesis of V-Ti-ion-modified nanoporous silica MCM-41 types catalysts and their catalytic activity for the dehydrogenation of propane

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Ordered mesoporous silicates are widely used as supports of the active phase of catalysts [1]. Partial isomorphic substitution of silicon on tetrahedrally coordinated transition metal ions, especially Ti or V, contributes to the creation of active sites and obtaining selective catalysts. The introduction of two heteroatoms can afford to make more fine-tuning the properties of the formed system [2]. In this work mono- (V, Ti) and bimetallic (V-Ti) ions modified nanostructured silicate MCM-41 were prepared by direct hydrothermal synthesis on the basis of gels pyrogenic aerosil or titanoaerosil, containing 1,4 wt.% tetrahedrally coordinated Ti^{4+} ions. Samples were identified by X-ray diffraction, X-ray fluorescence spectroscopy, DR UV-vis analysis and nitrogen adsorption. Their catalytic properties were tested in extensively studied now processes dehydrogenation of propane into propylene under the absence and presence of oxygen in the reaction mixture and were compared with reactivity of supported vanadium oxide catalysts.

It has been shown that the synthesis of V-MCM-41 from aerosil and $VOSO_4$ provides a highly ordered structure containing ~ 1,5 wt. % V, implanted in the form of tetrahedrons VO_4 highly isolated in the amorphous pore walls. Structure of V-MCM-41 hydrolytically more stable, than MCM-41 and it exhibits catalytic activity close to the sample 5% VO_x/MCM-41 containing more than twice the amount of supported vanadium.

During synthesis of V,Ti-MCM-41 from titanoaerosil and $VOSO_4$ in the sample only 0,3 wt. % V ions were included while the initial content and state of the ions Ti were remained. The introduction of V into the structure Ti-MCM-41 increases the spatial ordering and hydrolytic stability system and under additional supporting of 5% VO_x groups promotes obtaining of the catalyst which in the dehydrogenation of propane produces propylene with higher selectivity and yield than when VO_x supported on MCM-41 and Ti-MCM-41.

1. *Taguchi A., Schuth F.* Ordered mesoporous materials in catalysis // Micropor. Mesopor. Mater.-2005.-**77**.-P. 1-45.
2. *Guczi L.* Bimetallic nano-particles: featuring structure and reactivity // Catalysis Today.-2005.-**101**.-P. 53–64.