Nanocomposites and nanomaterials

Dendritic structure of $H_3PMo_{12}O_{40}$/Lysine nanocatalyst

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Recently, bifunctional acid-base heterogeneous nanocatalysts on the base of heteropolyacids combined with amino acids for one-pot synthesis of important chemicals, biomass products including, have begun to use [1,2]. Using of bifunctional acid-base catalysts permits to carry out the reactions of hydrolysis, isomerization, dehydratation, and even esterification, simultaneously because of presence acid and base active centers in catalysts..

We had synthesized acid-base nanocatalysts by interaction of heteropolyacids ($H_3PW_{12}O_{40}$ and $H_3PMo_{12}O_{40}$) with lysine in forms of pure heterogeneous nanocatalysts and inside of hybrid mesoporous silica nanocomposites. Transmission electron microscopy showed that $H_3PW_{12}O_{40}$/Lysine are in form of separate particles with sizes about of 3-8 nm, as described in [1]. While, $H_3PMo_{12}O_{40}$/Lysine unexpectedly formed dendritic structure with primary particles about the same sizes. FTIR spectroscopy confirmed the Keggin structure of the ions with some deformation both in the structure of pure acid-base nanocatalysts and in nanocatalysts inside of hybrid nanocomposites. FTIR spectrum of lysine was next to absent in samples of nanocatalysts because of its strong interaction with heteropolyacids.

Catalytic activity of our synthesized catalysts was tested in hydrolysis of fructose to 5-hydroxymethylfurfural in an aqueous solutions. Hydrolysis of fructose to 5-hydroxymethylfurfural with all our synthesized acid-base nanocatalysts, as in an initial forms and included inside of hybrid nanocomposites, carried out at the so low temperatures 105-120 °C that is very promising for practical applications.

1. *Zhao Q, Wang H, Zheng H, Sun Z, Shi W, Wang S, et al.* Acid–base bifunctional HPA nanocatalysts promoting heterogeneous transesterification and esterification reactions// Catal. Sci. Technol. – 2013. - **3**. –P.2204–2209.

2. *21. H. Li, K.S. Govind, R. Kotni, S. Shunmugavel, A. Riisager, S. Yang.* Direct catalytic transformation of carbohydrates into 5-ethoxymethylfurfural with acid–base bifunctional hybrid nanospheres// Energy Conversion and Management. – 2014. – V. 88. – P. 1245-1251.