Nanocomposites and nanomaterials

Low-temperature synthesis, structure, sorption properties and acidity of micro-mesoporous aluminosilicates obtained from sol-precursor of zeolite ZSM-5

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In recent years search and development of methods of obtaining of micro-mesoporous aluminosilicates (MMAS) which possess ordered mesostructure, developed surface (up to 1200 m^2/g), significant mesopore volume, acid sites with strength and concentration comparable to zeolites, thermal and hydrolytic stability and consequently catalytic activity in acid-base reactions with bulky molecules (kinetic diameter greater than 1 nm) is one of the most actual problems in the field of creation of porous materials. The assembly of primary products of zeolite formation in structure of mesoporous molecular sieve (MMS) in the presence of a micellar template is one of the most promising approaches to obtaining of MMAS [1]. This approach allows to investigate in detail and control the process of sequential formation of structure at various stages of synthesis.

Synthesis was performed by introducing of micellar template cetyltrimethylammonium chloride (CTACl) in sol-precursor of ZSM-5, which contains molecular template – tetrapropylammonium hydroxide (TPAOH), and subsequent hydrothermal treatment of bitemplate reaction mixture at 100 °C for 2 – 6 days. Adding of micellar template – CTACl to reaction mixture of zeolite containing X-ray amorphous particles with size of 1.5 – 1.7 nm (method of dynamic light scattering) and subsequent hydrothermal treatment of bitemplate reaction mixture (Si/Al = 50, TPAOH/CTACl = 3.5, pH = 12.8) at 100 °C for 2 days leads to the formation of X-ray amorphous MMAS possessing mesostructure. According to IR spectroscopy these samples contain secondary building units of ZSM-5, S_{meso} of samples is about 1250 m^2/g, mesopore volume (V_{meso}) – 0.6 cm^3/g, mesopore diameter (D_{meso}) – 2.3 nm. According to temperature-programmed desorption of ammonia the samples contain acid sites of medium strength (shoulder with a maximum of NH_3 desorption at ~320 °C), the concentration is 150 μmol/g.

Thus, low-temperature template synthesis in alkali-free medium allows to obtain the samples of MMAS that possess developed surface and mesoporosity, as well as acidity higher than in MMS AlSi-MCM-41 and comparable to ZSM-5.

1. *Serrano D. P., Escola J. M., Pizarro P.* Synthesis strategies in the search for hierarchical zeolites // Chem. Soc. Rev.-2013.-**42**.-P. 4004-4035.