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SYNTHESIS AND PHYSICOCHEMICAL CHARACTERISTICS OF MESOPOROUS ALUMINOSILICATES

Abstract. In the article, the synthesis of mesoporous aluminosilicates was carried out according to the developed methods, in which tetraethylorthosilicate $Si(OC_2H_5)_4$ was used as a source of silicon, secondary aluminum butoxide $(sec\text{-}BuO)_3Al$ and aluminum triisopropoxide $Al(i\text{-}OPr)_3$ were used as aluminum's sources. The synthesis of mesostructured aluminosilicate is based on the method of copolycondensation of silicon and aluminum sources in the presence of alcohol. Hexadecylamine (HDA, $C_{16}H_{33}NH_2$) was used as a template for the formation of a porous structure. The physicochemical characteristics of the synthesized structured mesoporous aluminosilicates have been studied. It was found that the synthesized materials MAS-1 and MAS-2 possess high specific surface area from 511 to 1170.0 m^2/g. The presence of a mesoporous and ordered structure in the synthesized aluminosilicates is confirmed by the data of low-temperature nitrogen adsorption/desorption, X-ray diffraction and FT-IR. To determine the relative strength of Brønsted and Lewis acid sites on the surface of mesoporous aluminosilicates, diffuse reflectance infrared Fourier transform spectroscopy (DRIFT) of adsorbed pyridine samples was carried out. DRIFT analysis data demonstrated a majority of Lewis acid sites on the surface of the synthesized materials. We are currently studying the possibility of applying these materials as acidic components of bifunctional catalysts for petrochemical processes.

Key words: Mesoporous aluminosilicates, template, bifunctional catalysts, porosity, Lewis and Brønsted acid sites.

Introduction. More than 20 years ago, the synthesis of catalytically effective ordered mesoporous materials was reported for the first time [1-5]. Ordered mesoporous materials with adjustable pore sizes in the range of 2-50 nm have attracted much attention due to their unique structure with ordered porosity, large surface area and volume of pores, as well as potential applications, mainly in the field of catalysis, adsorption, separation, sensors and fuel cells [6]. Mesoporous aluminosilicates are one of the mesoporous materials that are of great interest for study, since they have become widely used as catalysts for the conversion process of n-alkanes into their branched isomers. Mesoporous aluminosilicates contribute to the high selectivity of the isomerization process (> 90%) at medium degrees of conversion (60-75 %), and also through the use of various methods of their synthesis, it becomes possible to regulate the size of their pores and, as a consequence, to obtain the size of molecules larger than in zeolites and other catalysts [7-10].

Mesoporous aluminosilicates can be synthesized using various "bottom-up" and "top-down" technologies such as co-precipitation, graft copolymerization, and precipitation using a silicon source and an aluminum source [11].