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ABSTRACTS

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Synthesis and Properties of MIL-100(Fe)/Diatomite Composites

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Today, the materials with the hierarchical porous structure find practical applications in sorption, catalysis and environmental safety [1]. The composites based on silica and MOFs feature the enhanced properties due to the high utilization efficiency of the porous structure of materials [2]. In this work diatomite was used as a primary matrix with opened wide pores to create the composites by the assembly of MIL-100(Fe) inside these pores. The dependence of the features of the composite structure on the synthesis conditions was studied.

The reference sample MIL-100(Fe) was synthesized according to the reported procedure using the hydrothermal synthesis [3]. The MIL-100(Fe)/diatomite composites were prepared by the assembly of the microporous MIL-100(Fe) in the meso-macroporous diatomite structure by hydrothermal synthesis in the presence of diatomite under the same conditions.

The porous structures of the diatomite, MIL-100(Fe) and composites were studied by low-temperature N_2 adsorption-desorption. The MIL-100(Fe) has high surface area (1864 m^2/g) and pore volume (1.02 cm^3/g). The initial diatomite is characterized by the surface area and pore volume of 29 m^2/g and 0.08 cm^3/g, respectively. The surface area of the MIL-100(Fe)/diatomite composite is 336 m^2/g and the pore volume is 0.26 cm^3/g. The micropore size distributions of the composites are characterized by the maxima corresponding to the MIL-100(Fe) structure. A hysteresis loop for the composite is identical to the one for diatomite. This indicates the presence of wide diatomite mesopores in the composite. The presence of both micropores of MOF and macropores of diatomite is observed for the synthesized composites confirming that the hierarchical materials are formed. The crystal structures of the samples were examined by the XRD method. The XRD pattern for MIL-100(Fe) indicates the structure of bare MIL-100(Fe). The diatomite structure is composed of the amorphous silica and α-quartz phases. In the case of the MIL-100(Fe)/diatomite, the MIL-100(Fe) and diatomite phases are observed. These results indicate the formation of MIL-100(Fe) particles on the diatomite surface. The formation of the MIL-100(Fe) structure for the MIL-100(Fe)/diatomite composite is also confirmed by the thermal analysis data.

Thus, the opportunity to synthesize the diatomite-based composite with the hierarchical porous structure has been demonstrated. The MIL-100(Fe) can be easily prepared by the hydrothermal synthesis from the diatomite surface (the Fe impurities in diatomite) or from the iron salt $Fe(NO_3)_3$ previously introduced into the diatomite pores.