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THE METHOD OF OBTAINING Fe_3O_4/Al-FUM COMPOSITE

Metal-organic frameworks (MOFs) is a relatively new class of compounds, which is actively developing. MOFs are compounds consisting of metal ions (clusters) connected by rigid organic molecules through carboxylate fragments or nitrogen atoms [1, p. 933]. They have a specific surface area which is characterized by large values of water vapor absorption [2, p. 15018]. In recent years, in order to expand the field of application of MOFs, the possibility of creating composites on their basis has been actively studied. Such materials make it possible to combine the properties of MOFs with the optical, magnetic, and catalytic properties of additional components. So, for example, magnetic composites of MOFs can be used in the field of drug delivery due to the adsorption capacity.

The purpose of the paper is to show the method of obtaining the Fe_3O_4/Al-Fum composite in which magnetite nanoparticles are surrounded by a matrix of porous material. Recently, it has also been proposed to use such composites for cooling in electronics [3, p. 435].

To obtain 2 g of magnetite, 3.35 g of $FeCl_3 \oplus 6H_2O$ was dissolved in 100 ml of distilled water, 0.96 g of $FeSO_4 \oplus 7H_2O$ was dissolved in 50 ml of distilled water, the solutions were combined and stirred for 3 min. The resulting solution of iron salts was poured into a solution of sodium hydroxide containing 2.7 g in 200 ml of distilled water. The reaction mixture was stirred on a magnetic stirrer for half an hour, constantly monitoring pH≈11 by using an indicator paper. The particles were washed by magnetic decantation to neutral pH and stabilized by adding sulfuric acid to pH≈5. Then, the particles were washed to a neutral medium and stabilized with citrate ions. The concentration of Fe_3O_4 particles obtained in a dispersion with a volume of 150 ml was 21.3 mg / ml.

To obtain the Fe_3O_4/Al-Fum composite, 13.2 ml of magnetite dispersion with a concentration of 21.5 mg / ml was poured into a mixture of solutions of sodium hydroxide and fumaric acid with a volume of 360 ml. The resulting mixture was stirred for 10 on a magnetic stirrer and then poured into solution of aluminum sulfate. The resulting light brown precipitate was separated and dried. The calculated mass ratio of Fe_3O_4 and Al-Fum in the composite is 1:10.

The substances show a clear response to the effects of a neodymium magnet. Micrographs of the Fe_3O_4/Al-Fum composite obtained by scanning electron microscopy show that the Fe_3O_4/Al-Fum particles have an irregular shape and a size of about 100 nm. Mass fraction of magnetite in Fe_3O_4/Al-Fum is 9.41% ± 0.02%. This content of the magnetic phase in the resulting powder is in good agreement with the data on the sorption of water vapor.

The MOF/magnetite composite suitable for water vapor sorption applications were obtained. A method for synthesis of composite Fe_3O_4/Al-Fum has been proposed. The results of the study of magnetic properties indicate that the magnetite particles in the composites retain their superparamagnetic properties.

References

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