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MODIFICATION OF A SURFACE OF MAGNETITE BY HYDROXYAPATITE

Modern nanotechnologies provide tools for creation unique agents for medicine and biology. The use of adsorbents with magnetic properties considerably lessens the problem of separation and gathering of substances and microbiological objects by the adsorption method. The application of chemical modification and functionalization of adsorbents' surface oallows to adapt them for exploitation in various physical, chemical and biological conditions.

The purpose of this paper is the study of properties of nanosized monodomain magnetite (Fe_3O_4) as a part of magnetic liquid, nanocomposites Fe_3O_4/hydroxyapatite (HA) and the comparative analysis of the received results.

One-domain magnetite was chosen as a starting material for synthesis of nanocomposites because of its unique physical and chemical properties, opportunities to control the movement of nanoparticles in liquid by means of an external magnetic field, application of magnetic separation method at stages of division and extraction of adsorbents.

The synthesis of magnetite was carried out by co-precipitation of iron salts according to the reaction:

$$Fe^{2+} + 2Fe^{3+} + 8NH_4OH \rightarrow Fe_3O_4 + 4H_2O + 8NH_4^{+}.$$

The received sol was precipitated in magnetic field and washed out by distilled water.

The hydroxyapatite cover on a surface of highly dispersive magnetite was prepared by sol-gel method according to the reaction:

$$10Ca(NO_3)_2 + 6(NH_4)_2HPO_4 + 8NH_3 + 2H_2O \rightarrow Ca_{10}(PO_4)_6(OH)_2 + 20NH_4NO_3.$$

Aqueous solutions containing 0.1 M Ca $(NO_3)_2 \cdot 4H_2O$ and 0.1 M $(NH_4)_2HPO_4$ were adjusted to pH=11 when 15% solution of NH_4OH was used. A certain quantity of Fe_3O_4 was placed into $(NH_4)_2HPO_4$ solution, then $Ca(NO_3)_2$ solution was gradually added to it with intensive stirring. The reaction mixture was mixed during 1 h while heating it to 100 °C and left for 24 h. The formed Fe_3O_4/HA nanocomposite was washed out with distilled water until neutral pH and separated by permanent magnet.

Fe_3O_4 phase was identified by the methods of X-ray diffraction analysis. Existence of layers of HA on magnetite surface practically did not the influence magnetic properties of initial magnetite.

The analysis of IR spectra of Fe_3O_4/HA exemplars (Fig. 1) shows that the wide absorption band (AB) in the area of 3500 cm^{-1} corresponds to valence vibrations of OH groups of a nanocomposite surface.

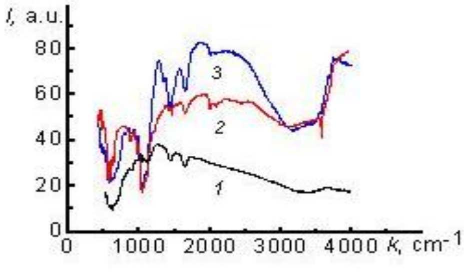

Fig. 1. IR spectra of Fe_3O_4 (1), HA (2) and nanocomposite Fe_3O_4/HA (3).

AB of 1645 cm^{-1} characterizes the deformation vibrations of water molecules adsorbed on a nanocomposite surface. AB at 1460 cm^{-1} refers to deformation vibrations of OH groups, and also shows the existence of structure of CO_3^{2}-groups in an exemplar. AB in the area of 1095-1100 cm^{-1} belongs to vibrations of HPO_4^{2-} and PO_4^{3-} groups in the structure of hydroxyapatite. AB in the area of 800-500 cm^{-1} refer to deformation vibrations of Fe - OH groups of magnetite.

The results of the work show the effectiveness of the use of the studied nanostructures for creation of adsorbents for medical, biological and technical purposes, the creation of new medicines based on magnetite.

LITERATURE

1. P. Shpak, P. P. Gorbyk (eds.). Nanomaterials and Supramolecular Structures: Physics Chemistry, and Applications. Springer, 2009, 420 p.