NEW GADOLINIUM-BASED CONTRAST AGENT: PROSPECTS AND APPLICATIONS

Matsenko R.O., Glavinskaia V.O., Zheltova V.V., Osmolowsky M.G., Bobrysheva N.P., Osmolowskaya O.M.

Saint Petersburg State University, Saint Petersburg, Russia
vladaglavinskaia@mail.ru

Magnetic resonance imaging is a modern non-invasive and radiation-free method of visualization of internal organs for the prediction and diagnosis of diseases. For better visualization, contrast agents are used. Today, the only permitted contrast agents are gadolinium-based compounds, such as Omniscan, and others. Gadolinium has a pronounced contrasting effect, but a free gadolinium ion is toxic and entails serious side effects in the organism.

Hydroxyapatite is the main inorganic component of bone tissue, biocompatible and suitable for medical use, so we suggest to use gadolinium-doped nanoparticles of hydroxyapatite as a contrast agent.

The simplest and most cost-effective methods of synthesis of this material are precipitation and hydrothermal treatment, which allow the dopant to enter the crystal lattice of the matrix without the formation of additional phases. These methods were used in the work.

The morphological parameters and surface composition of the obtained samples were studied by XRD, TEM, and IR spectroscopy, specific surface area was determined. It was shown that depending on the concentration of the initial reagents and the used synthesis method, gadolinium-doped hydroxyapatite nanoparticles are formed rod-shaped with sizes from 12 to 33 nm in thickness and from 34 to 81 nm in length.

The exposure of a preliminary prepared suspension of nanoparticles at an elevated temperature leads to the orientation attachment of the particles due to the interaction of the initial nanoparticles with each other. In this case, larger particles are formed. The parameters of the "initial" nanoparticles depend on the concentration of the initial reagents in the reaction medium, and the "final" nanoparticles depend on the holding temperature.

The imaging capabilities of gadolinium-doped hydroxyapatite nanoparticles in agarose gel were also studied. In all samples, an increase of contrast with respect to pure agarose was observed. This indicates that the obtained material increase contrast and can be used in MRI. The results of the studies showed that the relaxation times T1 and T2 increase with the increase in the size of the nanoparticles. The relaxation times, signal intensity, and image contrast are comparable to the data obtained earlier in the study of magnetite [1].

References

[1] Zheltova V., Vlasova A., Bobrysheva N., Abdullin I., Semenov V., Osmolowsky M., Voznesenskiy M., Osmolovskaya O. Applied Surface Science. 2020, 531, 147352.

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