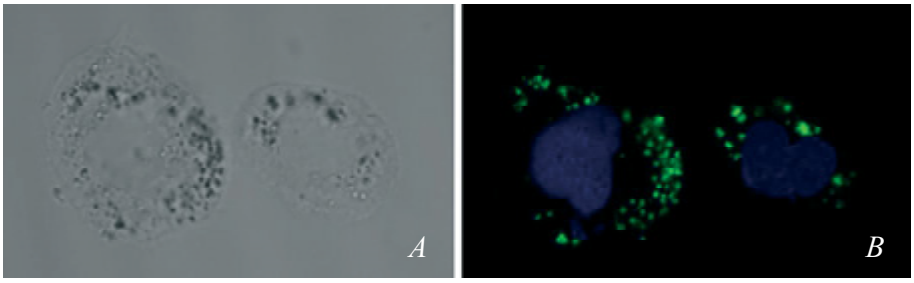
OR-2. BIMODAL MAGNETIC AND FLUORESCENT NANOPARTICLES FOR BIOMEDICAL APPLICATIONS

A. S. Minin[1,2], I. V. Byzov[1], M. A. Uimin[1], A. V. Belousova[2,3], L. T. Smoluk[3]

[1] M. N. Mikheev Institute of Metal Physics UB RAS, S. Kovalevskoy St., 18, Yekaterinburg, 620108, Russia
[2] Ural Federal University of the first President of Russia B. N. Yeltsin, Mira St., 19, Yekaterinburg, 620002, Russia
[3] Institute of Immunology and Physiology UB RAS, Pervomayskaya St., 106, Yekaterinburg, 620219, Russia
E-mail: calamatica@gmail.com

A technique was developed for the synthesis of bimodal nanoparticles with magnetic and fluorescent properties. The proposed nanocomposites consist of a magnetic core (metal-carbon nanoparticles with a magnetic core-carbon shell structure) and a fluorescent component (carbon quantum dots). The low toxicity of nanocomposites was demonstrated, their high relaxivity and quantum fluorescence yield sufficient for use as labels in confocal microscopy and flow cytometry.

When designing bimodal nanoparticles, it is important to select objects that determine the effectiveness of both modalities simultaneously [1]. Also in biomedicine various composite nanomaterials are used, for example, with a core-shell structure, such composites are stable under physiological conditions and can be relatively easily modified for subsequent conjugation with a fluorophore or biomolecules (for example, antibodies). To ensure fluorescence, a promising carbon nanomaterial was chosen – carbon quantum dots (CQD – carbon quantum dots), which have low toxicity and high quantum yield in a wide range of wavelengths, especially in the visible region.



Micrograph of HeLa culture cells (confocal microscopy).
A – in transmitted light, *B* – with the excitation of 405 nm and 488 nm.
Blue – cell nuclei, stained with Hoechst 33258, green – bimodal nanoparticles

As a result, bimodal nanoparticles based on a matrix of silicon oxide, a fluorophore and magnetic labels were synthesized, are of low toxicity for cell culture, while they have sufficient fluorescence intensity to be used as a label in flow cytometry or dye in confocal microscopy. The relaxivity of such composites is sufficient for use as a magnetic contrast device. Active absorption of nanoparticles by the HeLa culture occurs only under the condition of a positive surface charge, whereas negatively charged nanoparticles are practically not absorbed by the cells.

References

1. Bimodal Fluorescent and Magnetic Nanoparticles Based on Carbon Quantum Dots and Metal-Carbon Nanocomposites for Bio-Applications / A. Minin [et al.] // Key Eng. Mater. 2016. Vol. 683. P. 454.

The study was carried out with the financial support of the Russian Foundation for Basic Research in the framework of the research project № 18-33-00785) as well as with the help of the complex program of the Ural Branch of the Russian Academy of Sciences project № 18-10-2-5.