Cryochemical synthesis and properties of nanosystems of zinc, cobalt and nickel ferrites with antibacterial drug chloramphenicol

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Superparamagnetic nanoparticles of cobalt, nickel, and zinc ferrites are widely used in medicine. They are considered as promising agents for MRI and magnetic hyperthermia, they are actively used for magnetic separation of nucleic acids, proteins, and cells. Recently, magnetic nanoparticles have been increasingly used in tissue engineering in the development of functional substitutes for damaged tissues. This new technology is a promising approach to overcome the organ transplant crisis caused by the shortage of donor organs. Nanoparticles of nickel, cobalt, and zinc ferrites are promising carriers and magnetic vectors in systems for targeted delivery and controlled release of drugs, including antibacterial drugs.

In this work, hybrid nanosystems of nickel, cobalt, and zinc ferrites with chloramphenicol are obtained using low-temperature technologies. The composition and morphology of the ferrite/chloramphenicol systems were determined using XRD, IR, UV spectroscopy, TEM, and SEM. According to SEM micrographs, the resulting systems are particles 75–500 nm in size, inside and on the surface of which there are nanoparticles of nickel, zinc, and cobalt ferrites. TEM micrographs show that the particle size of $CoFe_2O_4$ and $ZnFe_2O_4$ is in the range of 1–10 nm, while the particle size of $NiFe_2O_4$ is in the range of 5–25 nm.

For nanoparticles of oxides of silver, gold, copper, with their simultaneous action with antibiotics on microorganisms, a synergistic effect was revealed - mutual enhancement of antibacterial activity by inorganic nanoparticles and antibiotics. This effect was also established for magnetic magnetite nanoparticles, which exhibit weak bactericidal activity. This paper shows the presence of this effect for cobalt and zinc-nickel ferrites. The antibacterial activity (determined by the disk diffusion method) of the obtained hybrid systems against E. coli and S. aureus exceeded the activity of individual components. The minimum growth inhibition constant of bacteria with ferrites is studied by kinetic methods with UV.

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