BIOCOMPOSITES BASED ON SELENIUM-SUBSTITUTED HYDROXYAPATITE*

A.I. KARPOVA, O.A. GOLOVANOV

Omsk State University F.M. Dostoevsky, Omsk

Natural apatite has better physical and biological properties compared to synthetic hydroxyapatite due to a significant amount of ion-substituted impurities, and therefore more and more research is being conducted to improve the physical and biological properties of HA by including various elements in its composition. In HA, both anions and cations can be replaced by ions of other metals. Metal substitution alters the physical (crystallinity, lattice parameters, and stability) as well as biological properties of HA. Bacterial infections affect a large number of implants after implantation, despite improvements in biomaterials.

Selenium (Se) is an essential trace element for human health and is the active site of selenoenzymes (e.g. glutathione peroxidase) that protect cell membranes from oxidation. Selenium also plays a positive role in the treatment of skeletal tumors, for example by inhibiting the growth of tumor cells and preventing the metastasis of bone cancer. A recent study showed that Se-substituted GA nanoparticles enter osteosarcoma cells through endocytosis and induce apoptosis.

Selenium is an essential nutrient present in biological tissues, and selenium-containing biomaterials have been shown to slow the development of bone tumors and improve tissue biological activity. Selenium also exhibits antioxidant properties and protects the human body from free radicals and carcinogens.

Using Fourier transform infrared spectroscopy, it was found that the synthesized samples of SeO_3-HA/chitosan composites contain the entire set of bands characteristic of chitosan, calcium phosphates and selenium ions. In the composition of the SeO_3-HA/chitosan composite, absorption bands of the O-P-O bond, in and, appear in the IR spectra, which are characterized by absorption maxima at 1033, 1031 cm^{-1} - stretching vibrations, and 564, 567 cm^{-1} - bending vibrations. Based on the reference spectrum of hydroxyapatite, the presence of bands specific to the group composition of HA was confirmed. Two bands were recorded at 820 and 890 cm^{-1} in the spectra of the mid-infrared region for HA doped with SeO_3^{2-}, the intensity of which increased with increasing concentration of selenite ions in the initial solution. These bands are attributed to symmetric and asymmetric vibrations of the Se–O bond of selenite ions in the HA structure.

Based on the location of these bands, it can be proven that selenite ions were included in the structure of HA crystals and isomorphically replace phosphate ions or OH ions. An additional study of the SeO_3-HA/chitosan sample with a selenite ion concentration of 5.0 g/L was carried out by scanning electron microscopy. SEM showed (scale 50 μm) that the resulting composite has a plate-like, elongated shape (Fig. 1).

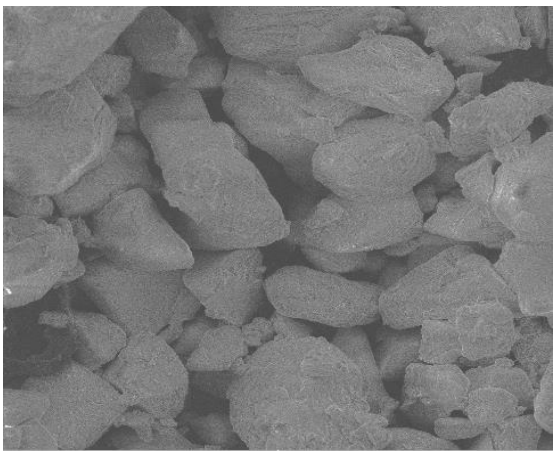

Fig. 1. SEM – micrograph of a SeO_3-HA/chitosan sample with a selenite ion concentration of 5.0 g/l.

* The work was carried out within the framework of the state assignment of the Ministry of Science and Higher Education of RF (№. 075-03-2023).