MODERN CONCEPTS OF CREATING SCAFFOLDES BASED ON BIOACTIVE GLASS-CERAMIC MATERIALS

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Today, one of the promising areas for stimulating bone tissue regeneration is the use of scaffolds. Due to a unique ability of uniting with a living bone and creating a strong biochemical bond with it, these materials are seen as the most effective among numerous non-organic materials used in bone implants and endoprosthetics for traumatology, maxillofacial surgery, dentistry and other fields of bone implantology. In future, bio glass ceramics and materials on their base may become a key in solving one of the most important problem of modern medicine – creating the artificial bone. It is these materials that are promising when creating a matrix for scaffolds that will be used on the loaded areas of the bone skeleton.

Considering the existing literature data, following requirements to the structure and properties of bioactive glass ceramics has been stipulated: fine volume-orientated crystallization of the model glass at one-stage thermal treatment method with formation of strengthened bioactive structure; optimal solubility levels of glass ceramics in physiological environment for the short term (one month) formation of an apatite-like layer on the surface *in vivo*; leaching ions from the material to the solution in order to provide the apatite forming ability and biocide properties for bone formation and preventing inflammatory reactions upon the introduction of the implant into the body.

The purpose of this work is to develop bioactive scaffolds based on glass-ceramic materials and study their structure.

To ensure the simultaneous bioactivity and mechanical strength of the scaffold, was chosen composites consisting of calcium phosphate silicate glasses and lithium aluminosilicate glasses in different ratios.

Calcium phosphate silicate glass matrix has been developed based on $Na_2O–K_2O–Li_2O–ZnO–CaO–MgO–ZrO_2–TiO_2–CeO_2–MnO_2–Al_2O_3–B_2O_3–CaF_2–P_2O_5–SiO_2$ system with the ratio of CaO / P_2O_5 = 1.66–1.67 to obtain materials in used under dynamic loads. *After thermal treatment (*980–1080 °C, 30 min*), experimental glass-ceramic materials contained crystalline* hydroxyapatite *in the amount of 50–60 vol. %.* As a glass-forming was taken as a lithium aluminosilicate system $R_2O–RO–RO_2–R_2O_3–P_2O_5–SiO_2$ and the composition range of the initial samples was chosen: R_2O – Σ (K_2O, Li_2O); RO – Σ (CaO, SrO, MgO, ZnO); ZrO_2; CeO_2; R_2O_3 – Σ (Al_2O_3, B_2O_3); Sb_2O_3; P_2O_5; SiO_2. It was used to synthesize model glasses of the with the ratio SiO_2/Li_2O = 4.0 The obtained glass-ceramic materials by glass technology under conditions of low-temperature heat treatment (I stage – 600–680 °C, 30 min; II stage – 850–960 °C, 5–10 min) are characterized by a volume fine structure with the presence of the main crystalline phase of lithium disilicate with the total content of 50–60 vol. %.

The composites were obtained on the basis of calcium phosphate silicate and lithium aluminum silicate glasses at a ratio of 9/1 – 7/3 by the method of duplicating a polymer matrix and fired at temperatures of 930÷1050 °C for 30 minutes. After heat treatment, the samples were ground to open the pores. The presence in the structure of composites of a bioactive crystalline phase of hydroxyapatite and a high-strength crystalline phase of lithium disilicate will ensure its reinforcement at the nano- and micro-level, which will significantly reduce the time of fusion of the implant with the bone tissue under load. The presence of a developed porosity of composites as a matrix for scaffolds within 17÷39 % and open matching pores ranging in size from 125 to 750 μm will make it possible to create a single cellular-biomaterial structure in a living organism when they are saturated with cellular systems and bioactive substances, which will ensure high biocompatibility of the implant with bone tissue.