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Research Article

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Formation of Bioactive Nanocomposites on Surfaces of the Metal Carrier

Khakkulov J.M., Kholmuminov A.A.

National University of Uzbekistan, Tashkent, Uzbekistan
e-mail: a.kholmuminov@mail.ru

Abstract In this work, we applied the method of electrochemical reduction of macroion and ions for the formation of bioactive nanocomposites from a mixture of chitosan and tricalcium phosphate. Morphology and composition of the nanocomposite analyzed SEM method and identified characteristic sites capable of showing biological activity due to the presence of chitosan.

Keywords nanocomposite, chitosan, tricalcium phosphate, electrolysis, bioactivity

Introduction

Nanomaterials are usually characterized by pronounced surface activity, due to the nature of the structural organization and packaging of constituent elements (atoms, ions, molecules and macromolecules) [1]. Nanocomposites are especially distinguished in this on materials formed on the basis of ionogenic biopolymers (macroions) and metal ions involving anon-nanoscale base that plays the role of biocompatibility my carrier with the body. Such nanocomposites inevitably exhibit bioactivity, which is of great interest for practical use in medicine, food, textile and light industry, etc. [2]. Research development, i.e. the establishment scientific basis for the formation of nanocomposites on the surface of the base with the use of juice-efficient approaches is a very urgent task of modern nanoscience and nanotechnology. The present work was performed in this aspect by choosing the electrochemical method for the reduction of ions and macro ions on the surface of an electrode from a mixture inin the form of nanocomposites [3].

Objects and methods

Electrochemical processes were implemented on a specially assembled installation of electrolysis, cell (a) of which was equipped with a heater (c) to maintain a given temperature (T) in the mixture (c) during experiments (Fig. 1).

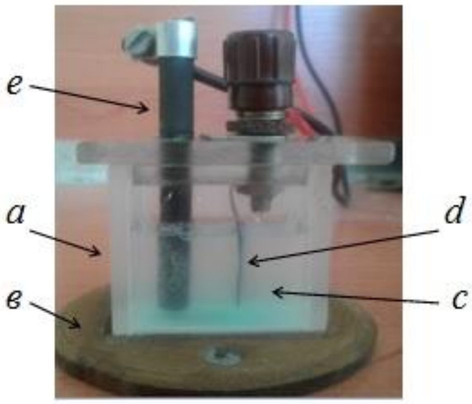

Figure 1: Electrolysis cell

As a recovery electrode (d) used a titanium plate (size 2x10x10 mm^3), widely used for manufacturing the implant, and the oxidation electrode (e) used a carbon rod (diameter 5 mm). The mixture was prepared by mixing a 0.04% solution of chitosan biopolymer in 2% CH_3 COOH and saturated aqueous solution (>60%) of tricalcium phosphate (Ca_3 (PO_4) 2).The ratio of solutions in the mixture is 1:1. Chitosan contains a functional amine (NH_2) and methyl (CH_2) groups exhibiting its own bioactivity in materials [four]. Obviously, the solvation of tricalcium phosphate ions around chitosan macroions in mixtures. Therefore, experiments were carried out at T = 50^0C in order to increase the mobility of ions and macroions during electrolysis. Trial experiments showed that intensive recovery macroions and ions occurs under the influence of direct current in the range I = 2−8mA within 4 to 16 hours. Moreover, numerous mobile tricalcium phosphate ionsform strong bonds with the ionogenic groups of chitosan and a rough surface titanium.

Results and Discussion

In the resulting nanocomposite tricalcium phosphate performs the function of binding components, i.e. matrices. This is evidenced by the results of electronic microscopic examination performed on a ZIESS instrument (SEM) at the Center for Hightechnologies (Fig.2). SEM images show characteristic regions that differ in morphological of logic.

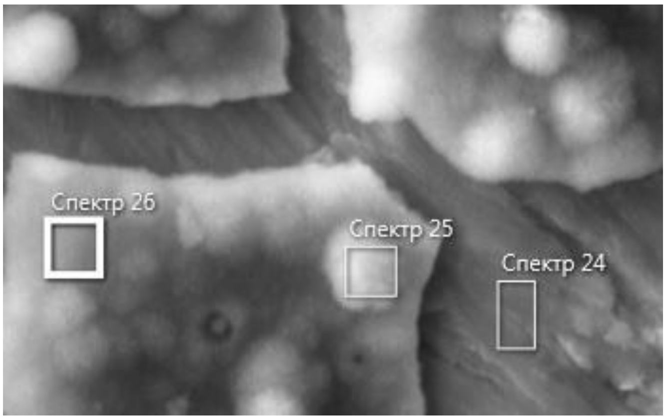

Figure 2: SEM images of a tricalcium phosphate nanocomposite with chitosan on top of titanium nostrils

For a comparative analysis of their composition, the most distinctive areas were selected and designated "Spectrum 24" Spectrum 25 "and" Spectrum 26. The analysis results are shown in Fig.3, a, b, c. It was revealed that the Spectrum 24 site (Fig. 3, a) mainly corresponds to titanium (96% Ti). A small amount of aluminum (1.9% Al) and manganese (1.3% Mn) indicates the purity of titanium isolated from natural components. Detectioncalcium (0.6% Ca) on the surface shows the reduction of this ion on titanium.

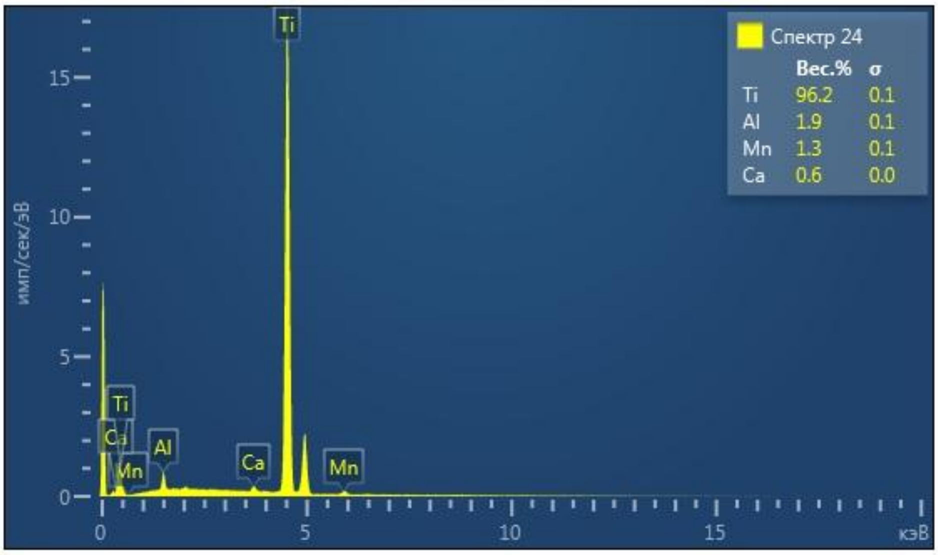

Figure 3.a: Results of spectral analysis of the "Spectrum 24" sections

The analysis of the Spectrum 25 sections (Fig. 3b) shows the presence of oxygen (53.7% O), calcium (25.5% Ca), phosphorus (12.7% P), titanium (7.1% Ti). This result is evidence, it is suggested that tricalcium phosphate ions are reduced on the titanium surface. Detected a small amount of sodium (0.7% Na) and gland (0.3% Fe). Perhaps these elements were part of the mixture, since the chitosan component was obtained by deacetylationchitin in 50% NaOH.

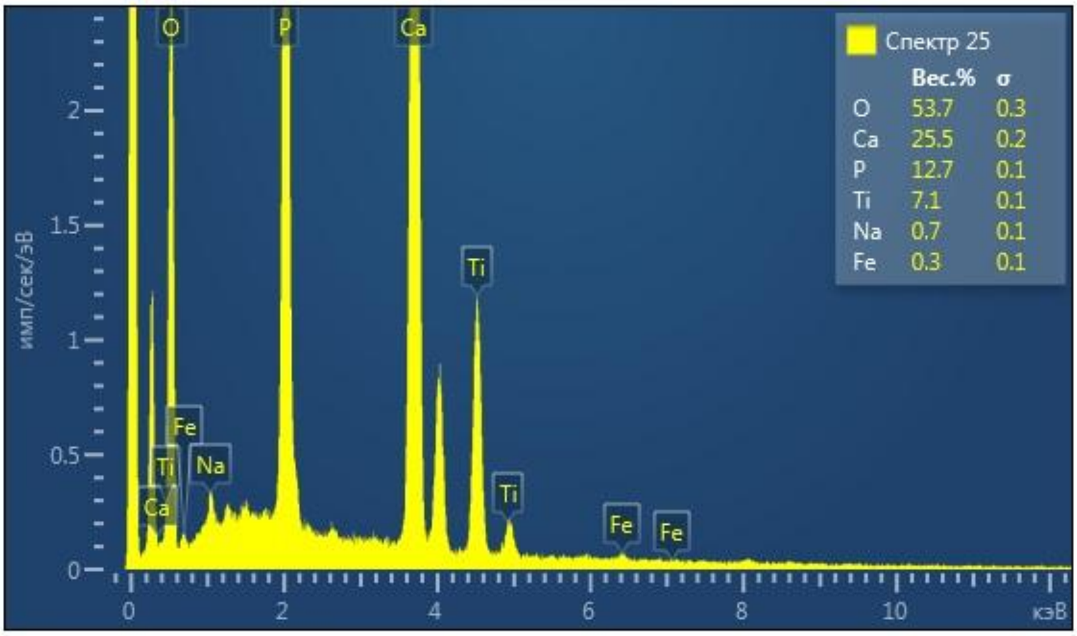

Figure 3b: Results of spectral analysis of the "Spectrum 25" sections

The “Spectrum 26” section (Fig. 3, c), unlike the others, contains carbon (9.9% C), so the same oxygen (36.5% O), titanium (28.6% Ti), calcium (15.9% Ca), phosphorus (8.0% P). It shows that chitosan macroions together with ions were reduced in this are atricalcium phosphate.

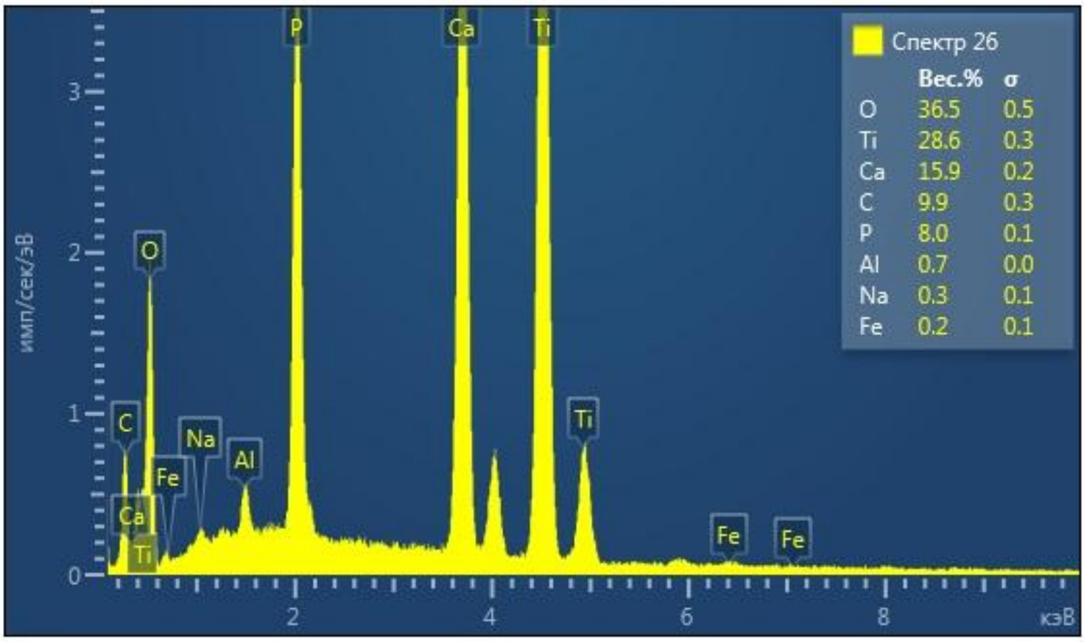

Figure 3c: Results of spectral analysis of the "Spectrum 26" sections

Based on this, we can assume that this section is formed nanocomposite exhibits pronounced surface bioactivity due to the presence of chitosan in it compared to other sections of this nanomaterial.

Conclusions

Thus, the fundamental possibility of the formation of bioactive of the nanocomposite on the surface of the titanium plate, i.e. metal carrier of mixtures of chitosan and tricalcium phosphate by electrochemical reduction of max. ions and ions. A difference in the morphology of the nanocomposite was found and quantitative analysis of its composition. A characteristic region of the nanocomposite capable of exhibit bioactivity due to the presence in it of a functionally active biopolymer of chitozan.

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