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Study of calcium phosphates crystallization process using the method of fractal analysis

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Abstract

A promising direction in the field of physical chemistry is the development of methods for the study of synthetic samples based on hydroxyapatite, which is a component of human bone tissue.

With the purpose of promptly obtaining data concerning the structure and properties of the objects under study, methods with the use of the fractal analysis tool are rapidly developing in recent years. Its main advantage is the possibility of examining samples without destroying them, as well as high sensitivity, even to a slight change in properties. Potentially, the fractal analysis tool can be used to study the properties of materials based on calcium phosphates used in biomedical applications. However, there are no studies confirming this theory at the mom

This article discusses the possibility of using the fractal analysis method for studying the crystal structures of calcium phosphates in a drying drop obtained as a result of spontaneous precipitation from an aqueous solution. Optimal deposition conditions and concentrations of solutions for this method were determined. During the study, the relationship between the fractal characteristics of the samples and the conditions of their deposition were determined (such as the concentrations of the solutions, the deposition time and the Ca/P ratio).

The paper shows that for the fractal analysis method, hydroxylapatite structures obtained by precipitation from aqueous solutions of $CaCl_2$ and Na_2HPO_4 with salt concentrations of 0.02-0.07 mol/l are applicable. It was found out that in the initial period of crystallization (<15 min) the fractal dimension of the hydroxylapatite structure changes insignificantly, then decreases linearly. During crystallization for several (2-5) hours a stable precipitate structure is formed, while the fractal dimension also assumes a constant value (D = 1.2-1.25). Obtained, the rate of decrease in the fractal dimension during the crystallization of hydroxylapatite is directly proportional to the ratio of the concentrations of Ca/P in the solution.

The resulting correlations demonstrated the high potential for using the fractal analysis method to study materials based on calcium phosphates. It can be used for the rapid evaluation of the properties of samples or for the theoretical calculation of the synthesis conditions.

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