Mendeleev 2024

XIII International Conference on Chemistry for Young Scientists

BOOK OF ABSTRACTS

St Petersburg University

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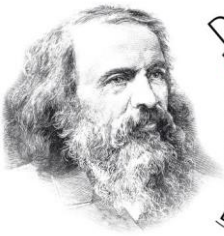

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DIRECTED MODIFICATION OF HYDROXYAPATITE-BASED BIOCOMPATIBLE MATERIAL AS A WAY TO REGULATE ITS PROPERTIES

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Nowadays synthetic analogs of natural materials are widely introduced in biotechnology, biomedicine, bone tissue engineering, and cosmetology. Recently, a great attention has been attracted to hydroxyapatite, as it is the main mineral component of the bone tissue of living organisms and can be obtained synthetically with scalable methods. Hydroxyapatite (HAp) is widely used in various fields of technology such as environmental remediation, biomedicine, gases detection, applications in catalysis and protein separation. However, in order to improve properties, the surface needs to be modified. Surfactants are typical and widespread agent used for HAp surface modification. In addition, PVA, casein sodium salt, lactic acid and other can be used as capping agents. The main problem of modification is the impact of capping agents of different nature on nanoparticles morphology as well as the position of the agent on nanoparticle surface are out of consideration.

Current work is dedicated to the synthesis of inorganic materials based on HAp NPs with different shape, size, and surface compositions and studying the impact of their morphological and structural parameters on the position of capping agent's molecules on surface. Salicylic, tartaric, succinic acids, pyrocatechol, 1,10-phenanthroline, and Nitroso-R salt were used as capping agents with a different ratio of hydrophilic / hydrophobic regions.

Two sets of HAp NPs samples were prepared. First set of HAp NPs were synthesized by hydrothermal procedure (2 h at 240 ℃). Second set of HAp NPs with a modified surface were synthesized by chemical wet precipitation method at room temperature. Morphological parameters of all obtained samples were characterized by complex of physical and chemical methods: XRD, IR spectroscopy, TEM, SSA, and DLS. All resulting NPs had a rod-like shape and structure of hydroxyapatite. The dimensions of HAp NPs from first set were in the range of 23-26 nm (thickness) and 48-81 nm (length). For the second set – dimensions were in the range of 7-12 nm (thickness) and 18-32 nm (length).

The position of modifiers on the surface of HAp NPs was determined based on quantum chemical calculations using an original approach. It was shown that synthesis technique is impact to the position of modifiers on the surface of HAp NPs.

HAp NPs synthesized by hydrothermal procedure were used for dispersive micro-solid phase extraction of tetracyclines. It was shown that the coefficient of extraction of tetracyclines from a mixture by hydroxyapatite nanoparticles under optimal conditions can reach 98%. After determining the optimal conditions for sorption and elution processes, the efficiency of isolating and concentrating tetracyclines with sorbents based on modified hydroxyapatite nanoparticles under selected optimal conditions was demonstrated on real biological objects - human urine and animal feed.

HAp NPs synthesized by precipitation method were used as stabilizer of Pickering oil-in-water emulsions. In order to study emulsions stability, the following parameters were varied: oil:water ratio, pH of the medium, and mass of modified nanoparticles. It has been shown that the best inorganic component for stabilizing emulsions is a sample of hydroxyapatite nanoparticles modified with salicylic acid. The Pickering emulsion remained stable for more than 28 days after preparation. It was also found that with increasing mass of nanoparticles, the size of droplets of the oil phase decreases, while the size of the droplets increases with increasing oil:water ratio.

So, the directed modification can assist to produce HAp NPs for various application.

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