Nanohydroxyapatite and its hierarchical textures as carriers of medical radionuclides

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Modern development of nuclear medicine cannot be imagined without introducing new promising diagnostic and therapeutic radionuclides and radiopharmaceuticals based on them. Due to their nuclear-physical and chemical properties, short-lived alpha-emitters (Ra-223, Ac-225, Bi-213, Pb-211) are effective for treating cancer and are successfully passing clinical trials. However, the scope of their use is limited by the availability of suitable means of delivery to cancer cells. Organic and inorganic nanotransporters are increasingly used as delivery system. In this work, we proposed nanosized hydroxyapatite (HAP), which has both complete biocompatibility and, in many cases, bioactivity, for the target transport of the mentioned radionuclides. It does not accumulate, but is completely metabolized in the body and has long been widely used in medical practice, including as a carrier of medicines. The HAP is able to form various hierarchical textures, each of which can find its application in different variants of nuclear medicine. In our work, the focus was on identifying patterns of sorption interaction between the selected radionuclides and HAP of several morphological and textural forms. The kinetics and isotherms of sorption and desorption of radionuclides on HAP from aqueous solutions were studied. The diffusion of radionuclides in a granular sorbent or in its watered layer was studied and the diffusion coefficient in these media was estimated (for Ra and Ac). For the binding of the radionuclide and carrier, a cocrystallization method was also proposed, when the target radionuclide is introduced directly into the synthesis of the sorbent itself (in this case, HAP).

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