**PROBING CERIUM AND ACTINIDES PHOSPHATES STRUCTURE BY SYNCHROTRON TECHNIQUES**

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Phosphate anion is a crucial component of the life cycle as organophosphate or inorganic phosphate in bone and teeth. Phosphates are ubiquitous in various geologic formations. Besides organic phosphates are often used in different industrial schemes, and the most critical example is nuclear fuel reprocessing (PUREX process). Therefore, the study of actinide (An) phosphates is essential for most of the research fields. Cerium is often presented as a relevant non-radioactive chemical analog of plutonium, neptunium, and thorium due to the closeness of ionic radii. Despite the relatively long history of phosphate-related research, there are still many gaps in the understanding of actinides-phosphates and cerium-phosphate systems. The modern experimental techniques (especially synchrotron based) may help to obtain required information about structural type, oxidation states, chemical resistance etc., and in some cases to revise or expand the previously obtained results. Thus, the purpose of this work was to establish the relationship between the conditions for the synthesis of cerium and actinide phosphates and their structure.

As part of the work, samples of cerium and actinide phosphates were obtained in two different ways. In the first method, phosphates were synthesized by chemical precipitation from 0.1 M Ce(III), Ce(IV), Th(IV), Pu(III), Pu(IV) and Np(IV) solutions. The synthesis was carried out in a NaH2PO4 solution taken in excess at pH=1.3. In the second method, phosphates were obtained by hydrothermal treatment of preliminarily synthesized CeO2 and ThO2 nanoparticles in a 1M phosphate buffer. Electron microscopy was used to study the morphological characteristics of the obtained phosphates. To decipher the structure of the obtained cerium and thorium phosphates, a set of complementary modern synchrotron methods was used: synchrotron X-ray diffraction, high resolution XANES spectroscopy (HERFD), and EXAFS spectroscopy.

It has been found that, as a result of chemical precipitation from Ce(IV) and Ac(IV), X-ray amorphous gels are formed. Drying of such gel-like precipitates in air leads to their crystallization. The formation of nanocrystalline Ce(III)PO4 with the structure of rhabdophane occurs in the case of precipitation from a Ce(III) salt. Under the conditions of HT treatment in a 1M phosphate buffer medium, the initial CeO2 and ThO2 crystallites are reformed into nanocrystalline phosphates with different structures.

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