



Contribution ID: 586

Type: Poster

## Synthesis, structure and the state of [MIII(UO<sub>2</sub>)<sub>6</sub>O<sub>4.5</sub>(OH)<sub>6</sub>]<sub>6</sub>H<sub>2</sub>O (MIII –Nd, Sm, Eu, Gd, Dy) in aqueous solutions

Tuesday, 15 May 2018 17:45 (15 minutes)

Method of synthesis of the REE hexauranates is proposed in this work. The composition and structure of these compounds were defined, processes of dehydration and thermal decomposition were studied, the state in aqueous solutions was investigated by X-ray fluorescence spectrometry, chemical analysis, IR spectroscopy, high-temperature X-ray diffraction and thermography. The choice of MIII (MIII –Nd, Sm, Eu, Gd, Dy) in present study was limited by those rare earth elements which form the compounds with same chemical composition. All synthesized compounds are formula analogues and their chemical composition corresponds to general formulae MIIIU<sub>6</sub>O<sub>19.5</sub>10H<sub>2</sub>O. The REE hexauranates have not only same chemical formulae but they are also crystallographic analogues. The presence of intense reflection in the region of small angle 2θ, that is characteristic of uranyl compounds, indicates the formation of layered structure type of the compounds under study. For evaluation of functional composition of MIIIU<sub>6</sub>O<sub>19.5</sub>10H<sub>2</sub>O, we have performed the IR spectroscopic researches. The IR-spectrums contains four groups of vibrations associated with uranyl moieties UO<sub>2</sub><sup>2+</sup>, bounds U–O<sub>eq</sub> in the equatorial plane of uranium polyhedron, H<sub>2</sub>O molecules and uranium-hydroxide groups. To assess the state and role of H<sub>2</sub>O molecules in the formation of the MIIIU<sub>6</sub>O<sub>19.5</sub>10H<sub>2</sub>O structure it was held thermographic analysis in combination with X-ray powder diffraction and IR-spectroscopy. The dehydration process of studied compounds occurs in two stages. First endoeffect on the DTA curve is observed at 195–203°C and, according to thermogravimetric study, it results to the removal of seven out of ten of the water molecules and the formation of MIIIU<sub>6</sub>O<sub>19.5</sub>3H<sub>2</sub>O phase. The ν(H<sub>2</sub>O) and δ(H<sub>2</sub>O) bands in the range 3600–3400 cm<sup>-1</sup> and 1613–1620 cm<sup>-1</sup> disappear, but ν(U–OH) and δ(UOH) at 3320 cm<sup>-1</sup> and 962 cm<sup>-1</sup> remain in the IR spectrum of the dehydration product. This transformation of IR-spectrum can take place if the dehydration product contains the equivalent number of hydroxyl groups OH instead of three H<sub>2</sub>O molecules. In this case the resulting compound would have the composition MIII[(UO<sub>2</sub>)<sub>6</sub>O<sub>4.5</sub>(OH)<sub>6</sub>]. The dehydration process ends at 302–332°C that is accompanied by a complete destruction of the crystal lattice.

The state of the REE hexauranates in aqueous solutions obeys the general laws, that is in good agreement with their similar structure. Among the variety of factors, the most significant influence over state of MIII[(UO<sub>2</sub>)<sub>6</sub>O<sub>4.5</sub>(OH)<sub>6</sub>]<sub>7</sub>H<sub>2</sub>O compounds in heterogeneous systems provides the acidity of an aqueous phase. All MIII[(UO<sub>2</sub>)<sub>6</sub>O<sub>4.5</sub>(OH)<sub>6</sub>]<sub>7</sub>H<sub>2</sub>O compounds are chemical stable and preserve their structure in heterogeneous aqueous-salts system in wide acid-base interval from pH 0 to 11.5–12.0. The structure of hexauranates is completely destroyed in strongly alkaline medium. Na<sub>2</sub>U<sub>2</sub>O<sub>7</sub> and MIII(OH)<sub>3</sub> are formed under these conditions. The REE hexauranates solubility varies by several orders of magnitude from 10<sup>-7</sup> M in neutral solutions to 10<sup>-4</sup>–10<sup>-1</sup> M in acid and strong alkaline conditions. The nature of interlayer REE atom does not influence significantly over solubility of studied compounds.

**Primary authors:** CHAPLIEVA, Kseniya (Aleksandrovna); NIPRUK, Oxana (Nizhny Novgorod State University named after N.I. Lobachevsky); CHERNORUKOV, Nikolay; KASHINA, Julia; BAKHMETYEV, Maxim

**Presenter:** CHAPLIEVA, Kseniya (Aleksandrovna)

**Session Classification:** Poster TAN

**Track Classification:** Chemistry of Actinide and Trans-actinide Elements